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PREFACE.

Under command of His Highness the Maha Rajah, the preparation of the State Manual of Travancore was decided upon some time ago, and I was appointed to it with the simple instruction that the book was to be after the model of the District Manuals of Madras. This instruction I have faithfully carried out and I am happy to report now that the book is completed and issued in three large volumes. Although I have allowed myself some latitude in forming my own conception of the design and scope of the work and devoted my best attention and energies to their exposition and elucidation, I still feel I might have done better if I had been left to myself, to work at it leisurely, spending "a laborious day upon each page," undisturbed by limitations of time and space.

The difficulty of compiling a work of this nature will readily enlist the sympathies of those who have laboured in similar fields, for as Sir Frederick A. Nicholson points out in his Report on Agricultural Banks, at which he worked for about 3 years:—

"The delay in submitting the report is due to many causes, principally to the immensity and complexity of the subject, to the difficulty of ascertaining and then of obtaining sources of information, to the discontinuity thereby imposed when a half finished study had to be broken off till the receipt of further information, to the extreme difficulty arising from the incessant demands of a Collector's work notwithstanding two periods of special duty. ... For the Madras Presidency statistics and information did not exist, and it is only through much enquiry and by the courtesy of numerous correspondents that information has been obtained."

Mr. H. H. Risley's portion of the Indian Census Report of 1901 covers, according to Mr. Gait,* 136 pages of that volume —

* In the Introduction to the Report on the Census of India (1903) Vol. I. pp. xvi and xvii, Mr. E. A. Gait, I. C. S., writes:—"The Office of Census Commissioner for India was held by Mr. H. H. Risley, C. I. E., from its creation in October 1899 until September 1902 when, unfortunately for the Census, his services were required for a higher appointment and his immediate connection with the operations came to an end. At that time the reports for a number of Provinces and States still remained to be received, and it had thus been impossible to make much progress with the General Report for the whole of India. Mr. W. F. Meyer, C. I. E., took charge of the office temporarily, in addition to his duties as Editor of the Imperial Gazetteer, and I succeeded him as Census Commissioner on the 23rd January 1903. In spite of the pressure of other work, Mr. Risley has himself completed the Chapter on Caste, and the portions of four other Chapters, as noted in the margin, are also from his pen."

a circumstance which can hardly represent the magnitude of his labours or research during the 3 years he was in charge of the last Imperial Census. The Report of Sir James Thomson's Excise Committee, which was ordered by the Government of India to be submitted in 8 months *i. e.* by the end of April 1906, evidently took more time than was anticipated. It is not yet available to the public. More instances could be cited to prove that neither the quantity of matter written nor the time taken can serve as a correct gauge of the labour or research involved in an undertaking of this sort. This is the invariable experience of all past workers.

Now that the work is finished, no word of explanation or justification is needed save to remove misapprehension in certain quarters. The idea of writing a State Manual was first broached to me by Dewan T. Rama Row, C. I. E., one fine morning 14 years ago, *i. e.* even before I had begun to compile the Census Report of 1891. He said I must do the Census Report first and then take up the Manual. All this was, of course, to be done along with my heavy legitimate duties as Dewan Peishcar and District Magistrate of Quilon, which I then was. I agreed without a moment's hesitation though fully alive to the responsibility I thus took upon myself, for it was impossible for me to decline an offer so kindly made and with such flattering compliments by so estimable a chief as Dewan Rama Row. He immediately obtained His Highness' sanction and sent me official orders in the last quarter of 1891. He retired a few months later and with his retirement the matter was dropped, for nothing came of it during the six years of Mr. Shungrasoo's Dewan'ship, as he did not seem to care for it at all. Dewan Bahadur Srinivasa Raghavaiyengar, C. I. E., complains of a parallel circumstance in the writing of his book,* for he says in his Preface:—

"The departure of Lord Connemara to England and pressure of other official work led to the preparation of this Memorandum being laid aside for some time, and I was able to resume the work only in the latter half of 1891. Since then

* 'Forty years' Progress of Madras' (1893).

I have been more or less engaged on it, but as the work has had to be carried on in addition to my other official duties, it has not been possible to finish it earlier."

The matter was however revived by Dewan Mr. K. Krishnaswamy Row, C. I. E., in 1901, and during his time I devoted to it, off and on, such leisure as the pressing duties of the Settlement Department permitted. It was only in December 1904 that I took it up as a full-time officer and it may be safely said that the best part of these three closely printed volumes is the result of assiduous and sustained labours carried on since.

In reporting completion of the manuscript of the book, I wrote to the Dewan in my letter, No. 387 dated 1st October 1905, thus:—

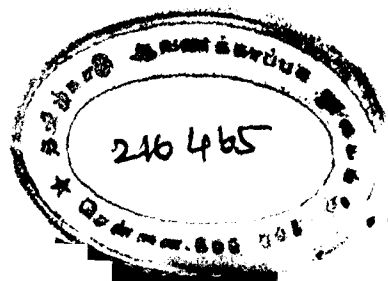
"In continuation of my letter No. 371 dated 26th August 1905, I have the honour to inform you that I have finished the State Manual of Travancore in which I have been engaged continuously for the past nine months and my services are available for any other work which His Highness' Government may be pleased to entrust me with."

I added:—

"I take this opportunity of expressing my grateful acknowledgments to His Highness' Government for entrusting this important work to me without any solicitation on my part—a work in which I have spent much thought and study during several years past though owing to more pressing duties I could not devote to it that attention which it deserved, except at distant intervals of business. It is due to us also to add that my extremely limited staff and myself have worked at it with energy and diligence."

To this letter the Dewan made no reply. The additional time thereby gained has however proved of much advantage to the work; not only were the proofs read carefully and well, but the old data, already collected, were verified, new data added where possible, some chapters were either revised or wholly re-written, additional matter put in, the manuscript throughout was touched up and the whole book itself satisfactorily finished and passed through the Press, with a full table of contents, a glossary of vernacular terms and an exhaustive index. In the letter referred to above, *viz.*, No. 371 dated 26th August 1905, I had observed:—

"I estimated the work to be completed in 6 months at the most, but that was as I explained to you in my letter noted in the margin (No. 313 dated 23rd May 1905) under the belief that I was to be allowed a staff of 10 clerks applied for."



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by me, the choice of clerks from the permanent Departments who would not run away as 7 or 8 temporary clerks did during the last 7 months, and that I was to be allowed also to expend the money saved every month by shortage of hands. You disagreed to every one of these 3 proposals. So it became impossible for me to finish the work in 6 months as originally estimated in my letter of the 11th November 1904. ... I believe I have been very moderate in applying only for 3 months' time from the 30th June last. Under the circumstances explained above, there was ample justification for my asking for 6 months' more time. But as I have already reported, I am most anxious to be done with this work as early as possible."

Mr. Srinivasa Raghavaiyangar, the talented compiler of the *Forty Years' Progress of Madras*, took 27 months to write his book—a volume of 340 pages, speaking of quantity alone, the subject-matter of which is admittedly one of a more homogeneous and less complex nature than that of a State Manual. And yet in his forwarding letter to Government, Srinivasa Raghavaiyangar wrote of the delay in the issue of his book thus:—

"The collection and reduction of the necessary statistics and the preparation of the second part of the memorandum took up more time than I had anticipated and I was able to complete the work only last May notwithstanding that I took privilege leave for three months in the beginning of this year for the purpose."

His achievement is a safe criterion to judge of the work of other labourers in similar fields, for to my mind the late Srinivasa Raghavaiyangar was a perfect embodiment of indefatigable industry, deep thought, wide reading, unostentatious independence and high literary skill. In these circumstances, no special justification seems needed for the unavoidable delay in the issue of the Travancore Manual, a work of an encyclopædic nature spread over a space of more than 1820 pages of letter-press—to say nothing of the continued strain, the anxious and unremitting attention or the huge preliminary studies it cost.

As for the plan of the book, it is enough to say that the mass of information collected has been thrown into 21 chapters and placed in 3 volumes for convenience of handling. Under these 21 chapter-headings almost every subject of importance and interest concerning the State has been brought in. For these chapter-headings several District Manuals of Madras have been consulted, particularly the revised ones of Bellary and Anantapur by

Mr. W. Francis, I. C. S., and it is enough to observe that the Travancore State Manual is fuller and more comprehensive than the Manuals of Madras. In order to do justice to the amplitude of information collected and the labour spent upon it, the size of the book has been enlarged into *three* volumes from what was originally intended to be one moderate-sized volume. It would be false economy, I thought, to throw away the results of great labour and research in order to save some printing space. Tediousness were, in my view, a much lighter fault under such circumstances, especially in a book of this nature; but terseness has been my ambition, though after the most conscientious endeavours to clip and prune I could not do more, on the present occasion, without keeping out matter which I really wished to retain. Even as it is, I feel the chapters on 'History' and 'Castes' are capable of further amplification, particularly the latter chapter, of which only the outer fringe, so to speak, has been touched in these pages. It is a never ending theme of value and interest, and the stores of information still available on it remain unutilised. A whole volume ought to be devoted to 'Castes' alone. The chapter on the 'Gazetteer' may well be amplified in a future edition.

In the writing of this book, my aim has been to present to an utter stranger to Travancore such a picture of the land and its people, its natural peculiarities, its origin, history and administration, its forests and animals, its conveniences for residence or travel, its agricultural, commercial, industrial, educational and economic activities, its ethnological, social and religious features as he may not himself be able to form by a 30 years' study or residence in it. If this is a correct view of the object of a Manual, I trust I may be permitted to entertain the hope that a fairly successful debut has been made, notwithstanding defects or shortcomings that may exist, especially as this is only a pioneer attempt in a novel direction. It is not necessary to prejudge here what a revision might give opportunities for, in the way of condensing in some directions or amplifying in others. If I get the chance myself at a not distant

date, I should probably do both and thus try to reach the ideally perfect Manual, perhaps a vain Utopian desire, which standard of excellence however, I know, is far from having been attained in the present performance.

In the 'History' chapter in which I have spent much thought and study, I have endeavoured to give faithful pictures of Parasurama's early colonists and their autonomous governments, their landed aristocracy, their peculiar tenures and permanent tenantry, of the later kings and ministers, of wars and conquests, of the dissensions of the Ettuvittil Pillamars, the Tampis and the Yogakkars, their mutual jealousies and intrigues, of the fortunes of the minor principalities which make up the Travancore of to-day and the events which led to their final absorption, of the chief forces that were at work during successive epochs which enabled a petty village near Eraniel to reach its present dimensions of a compact block of territory 7,000 sq. miles in area, of the European powers that successively bid for supremacy of trade on this coast and the ultimate success of the English East India Company, our early friendships with them and the staunch support which they in return uniformly gave us through all vicissitudes of fortune, ultimately resulting in a strong bond of political alliance and reciprocal trust and confidence, which assured to us internal security and immunity from external aggression, thus enabling us to achieve the triumphs of peace and good government, until step by step we reached the enviable height of being known as the 'Model Native State' of India—a title which we have maintained by wise rule and sound financial policy during successive reigns up to this day. And this has been no easy task as the narrative had to be woven out of a tangled web of falsehoods and mis-statements, of exaggerated versions and contradictory chronicles, inseparable from oral tradition, fragmentary record and a disorganised debris of scattered and confused materials. The difficulty of writing a history of events which took place long ago is great indeed, for as pointed out by John Morley, in his 'Life of Gladstone', "Interest grows less vivid; truth becomes harder to

find out; memories pale and colour fades". It is much more so in the case of a nation—the events of whose life and progress cover a space of many centuries and comprise multitudinous interests and concerns. The History chapter is dealt with in three sections, *viz.*, Ancient history, Early history, and Modern history—the last comprising a period of 10 reigns or 175 years, bringing the narrative down to the end of the year 1079 M. E. (15th August 1904), that being the last year for which full information was available on this and other headings when the book was written.

The labour involved in the task was truly gigantic, for it often entailed a wading through a mass of records of all sorts in order to get at a grain of information. The nature of the research may be judged from the following extract of my letter to the Dewan, dated 25th June 1903 :—

"As suggested in your D. O. of 1st Inst., I beg to submit herewith a revised list of records to be obtained from Fort St. George. I have cut down 79 numbers from the list of 336 papers originally selected, which itself was a selection from a total of about 600 papers relating to Travancore. In a matter like this where the granting of the application for records is entirely a question of pleasure with Government, there can be no argument; all that I can say is that an indulgent view should be taken of the application and that I should be given some latitude in the choice of records. It is possible that a good many of the papers that one has to read through in the preparation of a book or report may not be ultimately utilized. In the opinion of Milman, one of the biographers of Lord Macaulay, 'The historian, the true historian must not confine himself to the chronicles and annals, the public records, the state papers, the political correspondence of statesmen and ambassadors; he must search into; he must make himself familiar with the lowest, the most ephemeral, the most contemptible of the writings of the day. There is no trash which he must not digest; nothing so dull and wearisome that he must not wade through'. In the instance which the Resident refers to, *viz.*, 'note of the firing of the usual salute on the departure of the king of Travancore to the north', I should just like to know what the actual 'salute' fired was, if such information is available from that record. It is not of course absolutely essential for my book. It may even be put down as a mere antiquarian curiosity; but if so, it is a curiosity which is justifiable, * * * * I shall content myself with the papers that are placed at my disposal."

'Archæology', 'Fauna', 'Census and Population', 'Language and Literature', 'Economic Condition', and 'Legislation and Statute-book' are new chapters in this Manual, not found in the revised Madras Gazetteers. 'Local Self-Government' is a heading

which I have not utilised as we have nothing corresponding to it here just yet. The information under my other chapters *viz.*, 'Religion', 'Castes', 'Trade and Commerce', 'Arts and Industries', 'Land Tenures and Land Taxes', and 'Administration' deals with the matter comprised in Mr. Francis' chapters on the People, Occupation and Trade, Land Revenue Administration, Salt, Abkari and miscellaneous revenue and Administration of Justice. The other chapters are the *same* in both the books.

I have been much exercised in the matter of arranging the order of the chapters in the Manual. What I have ultimately decided upon, though slightly different from that adopted in the Madras Gazetteers, appears to me to be the most natural order. It is thus. The first 4 chapters deal with the lie of the land, its climatic conditions and its exuberant vegetable and animal life. The next 2 chapters deal with History and its chief basis for facts, *viz.*, Archæology. The whole of the second volume (chapters VII to XII) deals with the people as a whole in all their many-sidedness, *i. e.* their growth of numbers, their faiths, ethnography, language, education and health. The first 5 chapters of the third volume deal with the economic condition of the people such as agriculture and irrigation, trade and industries and the conveniences that exist for the same. Then come 3 chapters dealing with 'administration' more or less; and the book concludes with an alphabetical description of places of interest, so necessary for a stranger to understand a country aright. This arrangement I believe is the most natural one to adopt and has been finally resolved upon.

One encouraging circumstance in the course of writing the book has been the fact that some of the chapters were perused in manuscript by Messrs. G. T. Mackenzie, I. C. S., and J. Andrew, I. C. S., our former British Residents. Both of them expressed approbation of the work done. Mr. Mackenzie who took a warm interest in the progress of the Manual from the very beginning wrote to me on the 9th October 1903:—

"I have perused the Mss. of the first portion of the Manual and it seems to me to be excellent."

Again, he wrote on the 8th February 1904:—

"I return these draft chapters with many thanks; they are really very good"

Again on the 19th November 1904 (the day he resigned the Civil Service and left Travancore), he was good enough to write of the 'History' chapter thus:—

"I have now perused it and find it deeply interesting. I have corrected one or two clerical errors but otherwise there is nothing to alter."

Since then, one whole chapter and a portion of another have been submitted for His Highness the Maharajah's perusal. Mr. R. C. C. Carr, I. C. S., Bar-at-Law, the present British Resident, has now perused several chapters of the Manual. He wrote on the 8th April 1906:—

"I am much obliged to you for your kindness in sending me the advance copy of the second portion of the State Manual. It contains a great deal of interesting matter and I hope to study it shortly. I have already received the bound copy of Vol. I and am very glad to have it."

To my numerous helpers in this work I offer my grateful acknowledgments. No work of this magnitude can be satisfactorily performed except with the aid of a host of coadjutors; and I have had that aid from all sides—officers of Government, retired public servants, vakils, journalists, private individuals, land-lords, planters, bankers, merchants, agriculturists, *Vydyans*, *Man-travadis*, Christian *metrans*, bishops and missionaries and numerous other correspondents of divers sorts. As was justly remarked by Sir J. A. Baines, K. C. S. I., I. C. S., in his preface to the Imperial Census Report of 1891,

"The Census deals with so many subjects each of which, in the present day falls within the province of a specialist that no single individual can safely trust to his own unaided capacity in reviewing them, but is forced like Moliere, *a prendre son bien on ill be trouve*, and I have done my best to acknowledge such depredations at the time I have found it convenient to make them."

The same may be said of my State Manual, for which if I have been compelled to make depredations, it will be noted that I have ungrudgingly acknowledged them in the body of the book itself, for such acknowledgment not only lessens the burden of my responsibility but also confirms my own opinions, thereby enhancing the value of the work achieved.

I must next express my obligations to Mr. C. V. Raman Pillai, B. A., the energetic Superintendent of the Government Press, for the help and co-operation he has willingly rendered in passing this huge work through the press, in spite of repeated calls on him for urgent work from other departments of the State. He has also prepared the index to the Manual which I entrusted him with, under orders of Government, on account of his special experience in it as the late Indexer to the Travancore High Court. I have to commend his work to the notice of Government.

A map of Travancore specially designed for this book by Mr. G. N. Krishna Rao, Superintendent of Survey is placed in the pocket at the end of the third volume. A few photographs are also inserted to illustrate the book; more should have been put in but for the cost. If time had permitted, I should have added a volume of appendix of papers made in this connection, containing monographs on several special subjects, *Sthalapurāṇams* of temples and places of pilgrimage, accounts of noble families and the chiefs of petty principalities, extracts made from books, newspapers and magazines and documents examined in the course of these studies and other evidence relied on in the writing of the Manual, all of which will form a mass of valuable data, upon which to base more extended researches in the same direction in the future.

In conclusion, I beg to tender my respectful thanks to His Highness the Maharajah's Government for having vouchsafed to me the opportunity of performing so herculean a task—notwithstanding the many difficulties and obstacles I had at the outset. At one time it appeared to me, judging from the correspondence that took place, that I was engaged in a thankless work amidst inhospitable surroundings, and that though I had undertaken it years ago under favourable auspices, a change had come and I was evidently exhausting myself in an uphill work, which would give no satisfaction. The following extract of my letter to the Dewan, dated the 20th June 1905, will explain the circumstance. I wrote :—

"I do not wish to refer to the observation which you have more than once made in your letters about 'entrusting the work to other agency'. This is a matter entirely left to the pleasure of Government. I was appointed to the writing of the State Manual by His Highness' Government without any solicitation on my part; and three of your immediate predecessors who knew me and the public service thoroughly well for long years, concurred in thinking that the work should be done by me, as if they could not think of any other officer equally competent to do it, though for my part I did not show the least unwillingness to give it up, especially as I was so fully occupied otherwise. They evidently meant it to be done by me during intervals of business, as they all knew the quality of similar work I had done before, which repeatedly received the approbation of His Highness' Government."

This however was only a passing cloud and the situation soon improved. Now that the difficulties have all been surmounted and the work itself done and done to my own satisfaction more or less, there is but one feeling uppermost in my mind, and that is one of deep thankfulness and gratitude to Government for the opportunity afforded me to associate my name with a book of this nature, in which I trust Government will see ample evidence of earnest, assiduous and sustained labours on my part, for more than a year past.

It is hardly necessary to add that the views expressed and the suggestions made in these volumes, the result of years of patient study and observation, are wholly conceived in the interests of the State and the people; and as such I have no doubt they will receive careful consideration at the hands of Government in due time, for when carried out they will, I am satisfied, not only add to the credit of His Highness' enlightened rule but, in the wise words of Bacon, "make the estate of his people still more and more happy, after the manner of the legislators in ancient and heroic times."

Trivandrum,
16th August 1906.

V. NAGAM AIYA.

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THE TRAVANCORE STATE MANUAL.

CHAPTER I. Physical Description. SECTION A. PHYSICAL FEATURES.

"Were there, below, a spot of holy ground
Where from distress a refuge might be found,
And solitude prepare the soul for heaven;
Sure, nature's God that spot to man had given,
Where falls the purple morning far and wide
In flakes of light upon the mountain side;
Where with loud voice the power of water shakes
The leafy wood, or sleeps in quiet lakes."

Wordsworth.

Name of the Country.—This ancient kingdom of Travancore forms the southern-most portion of the west coast of India. The country from Gokarnam to Cape Comorin has been known by different names at different times, such as, Malayalam, Parasurama-kshetram, Karma-bhumi, Cheram, Keralam, Malanad, Malavaram and Malabar. This tract of land, according to the Bhoogola Purana—a Sanskrit work on the ancient geography of the Hindus—was 100 yojanas* long and 10 yojanas broad.

The word 'Malayalam' is its Tamil name and signifies 'mala' (hill) and 'azham' (depth) i. e., the hill and dale country, or the land at the foot of the mountains.

The word 'Parasurama-kshetram' is derived from the tradition that Parasurama, the great Brahmin sage† of the race of Bhrigu, reclaimed this land from the sea.

The name 'Karma-bhumi' signifies that the spiritual salvation of the inhabitants of this land depends entirely on good actions, as contrasted with the East Coast, or 'Gnana-bhumi' otherwise 'Punya-bhumi',

* 1 yojana is equal to ten miles.
† See Ancient History, *infra*.

where a man obtains salvation by mere birth irrespective of his actions, as the land itself is said to be consecrated ground. So far is this believed in, that an orthodox Brahmin of the East Coast would not wish to die in Keralam, lest he be born an ass in the next birth.

'Keralam' is the name by which the country was known from the earliest times and one by which the native of the soil always loves to designate it. The word is supposed to have been derived from 'Keram' a contraction of 'Nalikeram', the Sanskrit name for cocoanut, as this part of India abounds with cocoanut palms. Another theory is that the country takes its name from 'Cheraman Keralan', a sovereign among the Perumals, who, raised to sway by the people's will, distinguished his government by a course of wisdom, moderation and benevolence. Both the derivations are however improbable as the country had its name long before the advent of this legendary Perumal, or the introduction of the cocoanut palm on this coast.

Alberuni seems to have been the first to call the country 'Malabar,' which is an Arabic corruption from Mala (Vernacular) — mountain and Vara (Sanskrit) — slope. Dr. Robertson, in his 'Historical disquisition concerning Ancient India', derives it from the word 'Mall', the name of a port (mentioned by Kosmos Indikopleustes), and says that the word means 'country of pepper'.

Fra Bartolomeo, who resided for a long time in Travancore, says that the country was called 'Malai-nadu' — the land of hills, which was subsequently corrupted into 'Mala-varom' or 'Malabar'. Other forms of the word are: Melibar, Manibar, Molibar, Malibar, Minibar, Minabar, Melibaria.

'Travancore' is the abbreviated English form of 'Tiru-Vithan-Kodu', once the capital of the kingdom and the residence of the court, but now a petty village 30 miles to the south-east of Trivandrum. Tiru-Vithan-Kodu is said to be a corruption of 'Sri-Vazhum-Kodu', i. e., a place where the Goddess of Prosperity dwells.

Travancore is also known by the names of 'Venad', 'Vanchi-Desam' and 'Tiru-Adi-Desam'. Venad is a corruption of 'Vanavanad' (the land of the celestials). Vanchi-Desam means either the land of treasure or the land of bamboos. Tiru-Adi-Desam is probably derived from 'Tiru Adikal', one of the titles of Chera kings. 'Tiru Adi' means 'holy feet' or 'the Royal feet' and represents the usual form in which the kings of the land were addressed. Even now the verna-

cular form of addressing the king is 'Adiyen Trippadom sevikkunnu' meaning 'I, a humble slave, serve thy royal feet'.

'Malankarai' is another name used exclusively by the Syrian Christians; the Syrian Metropolitan still calls himself 'The Malankarai Metran.'

Geographical position.—The Travancore State is situated at the south-western extremity of India, between 8° 4' and 10° 22' North Latitude and 76° 14' and 77° 38' East Longitude. It is a long narrow strip of territory, measuring 174 miles in length and from 30 to 75 miles in breadth, lying between the Malabar Coast and the Western Ghauts which run almost parallel with the Western Coast of India and which divide Travancore from the British Districts of Tinnevely and Madura.

Boundaries.—Travancore is bounded on the north by the Cochin State and the Coimbatore District, on the east by the range of Ghauts which forms a natural barrier between it and the districts of Tinnevely, Madura and Coimbatore, on the south by the Indian Ocean, and on the west by the Arabian Sea and by portions of Cochin running down in a narrow strip between Travancore and the sea.

Shape and area.—Its shape is triangular with the apex towards the south, its two sides running in a north-westerly direction. It is of an unequal breadth gradually diminishing from the north and converging to a point at its southern extremity. The irregularity of its breadth offers an average width of about 40 miles inland. A narrow strip of land belonging to the State of Cochin makes a deep indentation on the north-west angle and destroys the contiguity and compactness of its shape.

The total area of Travancore is 7091 square miles. Compared with the adjoining British Districts, it is about four-fifths of Madura, nine-tenths of Coimbatore, one and one-fourth of Malabar and one and one-third of Tinnevely. Compared with other Native States, Travancore is about one-twelfth the size of Hyderabad, one-fourth of Mysore, seven-eighths of Baroda, two-sevenths of Gwalior, more than 5 times the size of Cochin, and 6 times that of Pudukotta. It is smaller than the Principality of Wales by 279 square miles and bears to England and Wales together, the proportion of 1 to 8.

Lieuts. Ward and Conner estimated the area to be 6731 square miles. But they did not include the Anehanad valley together with a large portion of the High Ranges aggregating about 230 square miles, the Idiyara valley and a portion of the forest near the Alvarkurichi gap.

The following table conveying an approximate distribution of surface was drawn up between 1816 and 1820 by Lieuts. Ward and Conner:—

Rice lands.	741 square miles.
Slopes available for temporary cultivation of rice &c.	1,000 "
Areca-nut and Cocoanut topes chiefly along the coast.	356½ "
Sandy extent covered with Palmyra.	115 "
Lakes, rivers, tanks &c.	157½ "
Site occupied by buildings.	20 "
Pasturage and superficies occupied by low chains of hills.	1,961 "
Hills and forests.	2,379½ "
Total area.	6,730½ "

From the above table, it will be seen that about two-thirds only remain applicable to the purpose of profitable cultivation or pasturage, the whole cultivation of Travancore being generally confined to a contracted strip along the coast, narrower in the southern parts, but expanding as it approaches northwards.

General features.—The general aspect of the country is thus described by Ward and Conner * :—

"The face of the country presents considerable diversity, although its general character, except the southern parts, is extremely abrupt and mountainous. The coast, and for a short distance along the borders of the lake, is generally flat; retreating from it the surface immediately becomes unequal, roughening into slopes which gradually combine and swell into the mountainous amphitheatre that bounds it on the east, where it falls precipitately, but terminates less abruptly on the south. The collected villages, waving plains, palmyra topes and extensive cultivation of Nunjanaad, resemble in every particular the neighbouring province of Tinnevely, except that it in no measure partakes of its comparatively arid sterility. Approaching northward, this fertile plain is succeeded by the woody and rugged surface of the genuine Malayalim; some few champaign tracts enclosed within this ocean of forest relieve the uniformity of this sylvan scene. The extent lining the coast for its whole length presents a fertility so near the sea that imparts a peculiar character to the landscape. This rich and variegated tract is flanked by a mountainous barrier and is finally contrasted with the sombre magnificence and desolate solitude of those wilds of which the elephant seems the natural master; and though the landscape may be too much made up of this wild scenery, it boasts many striking localities and peculiar beauties, if not of the sublime, at least romantic and picturesque kinds. The eye is arrested by the wild rocky precipitous acclivities and fantastic forms assumed

* Memoir of the Survey of Travancore and Cochin.

by the mountain in the more southern parts, but proceeding north the bold and elevated contour of this Alpine tract is less sharply defined; a few rugged cliffs and spiry points or conical summits alone breaking through the sameness of its rounded and sombre outline. This appenine dissolves into clustering hills and romantic inequalities, at whose feet wind innumerable valleys, presenting (particularly in the middle parts) the most delightful landscapes, whose natural beauties are embellished and diversified by the prospect of Churches and Pagodas. Indeed the endless succession of houses and gardens scattered in picturesque disorder over the face of the country, gives it entirely a different appearance from the other coast, the nudity of whose plains is unfavourably contrasted with the robe of florid and exuberant vegetation that for a great part of the year clothes Malayalim. The Areca and Cocoanut everywhere fringe those picturesque and sequestered glens which gradually expand into the extensive plantations and cultivated lands that skirt the sea and lake. This space is enlivened and fertilised by innumerable rivers and pastoral streams, whose borders are crowned with groves and cultivation that everywhere following their winding course, present a unique, interesting and charming scenery, infinitely more diversified than most other parts of the Peninsula and one that would indicate abundance. This is especially the case in Kootanaad; the watery flatness of this fertile fen is relieved by the gardens and habitations so thickly strewn over its surface which exhibits a network of rivers meandering through the verdure they create."

Travancore is certainly one of the most picturesque portions of India. It has been the dream of poets, the delight and admiration of every traveller. Lord Curzon, the Viceroy, said:—

"Since I have been in India I have had a great desire to visit the State of Travancore. I have for many years heard so much of its exuberant natural beauties, its old-world simplicity, and its Arcadian charm. Who would not be fascinated by such a spectacle? Here nature has spent upon the land her richest bounties; the sun fails not by day, the rain falls in due season, drought is practically unknown, and an eternal summer gilds the scene. Where the land is capable of culture, there is no denser population; where it is occupied by jungles or backwater or lagoon, there is no more fairy landscape."

Here is another description founded upon closer personal acquaintance from the pen of that versatile writer, Mr. J. D. Rees I. C. S., C. I. E., a former British Resident in Travancore and Cochin:—

"It would be a hopeless task to attempt to describe the scenery of the Madras Presidency, which to the east of the ghauts has one, and to the west another character, but which nowhere is without a beauty of its own. But the districts more completely within the sphere of the influence of the south-west monsoon have a wholly different character. The rolling downs of the Nilgiris possess one of the finest climates in the world for the Anglo-Saxon, and nowhere is the scenery more magnificent than upon its western borders, where the happy sportsman can sit in a blushing rhododendron as big as an English oak, the moss and lichens of whose branches are pranked with orchids, and look down a sheer cliff of giddy height, the first shelf of primeval forest and on to another and another by gradual descents from a height of 8,000 feet, till the cocoanut gardens of the storied Malabar Coast are seen between the last step and the yellow sands and white foaming breakers, beyond which the blue Arabian Sea sparkles and shimmers in the sunlight, till the orb of day descends,

a blood red ball, into its distant waters. What mountain drive equals the Coonoor ghaut, now gashed and scarred somewhat by a none the less useful railway, upon whose forest-clad slopes white fleecy clouds gently lie, while the gigantic green feathers of the bamboos lightly wave, and the most beautiful of all butterflies flit around the traveller as he passes through tree ferns and plantains, looking up at the towering masses of rugged rocks, and the purple outline of the mountains.

"Below in Malabar, Travancore and Cochin, the beauties of the country defy description, and the forests are, of all places in this world, surely the most fascinating in which to dwell. You pass through shady aisles, which admit the sunshine by infrequent shafts, but breathe everywhere its warmth and joy, and are ever reminded of the late Laureate's happy alcaic experiment,

Me rather all that bowery loneliness,
The brooks of Eden mazily murmuring,
And bloom profuse and cedar arches,
Charm.

"Tall pillar trees, with green Corinthian capitals, support the roof, festooned with vines and creeping plants, and often blooming with red, white, and purple flowers, the floor is covered with an undergrowth of tree ferns and flowering shrubs, above monkeys and squirrels leap from tree to tree, wood-pigeons coo, wood-peckers tap the tree trunks, and cicadae whirr and whistle, while now and again a startled spotted deer jumps up and disappears, or the loud crack of branches betokens the proximity of an elephant taking his meal, the picture of lazy and lordly ease.

"This spirit pervades the atmosphere. Nature, in her most bounteous and reproductive aspects, scatters her treasures around with such a lavish hand, that it speaks well for an industrious and estimable population, that, in its case, the worship of the beautiful has never ended, as some say it always does, in orgies. None the less in the forests the life of those least sensitive to the influence of the beautiful can be nothing less than one long botanical debauch in 'valleys low, where the mild whispers use of shades, and wanton winds, and gushing brooks', tempered by occasional encounters, wherein all the sterner attributes of humanity are suddenly brought into play, and the man may have to fight with the beast, for the life, which, a few minutes before, ran 'in soft luxurious flow'. The contingency, ever present for the sportsman, of this sharp and sudden contrast, adds a thousandfold to the fascination of what surely is the happiest possible life".

I may be permitted to quote here, from one of my earlier Census Reports*, the following description of one of the highest Peaks on the Ghauts:—

"What strikes a stranger most in Travancore is the eminently picturesque character of its natural features. The view of the country from one of our hill-tops on the Western Ghauts is worth getting at even at the cost of a hundred miles journey. Nature is then seen at its best. Going up an elevation of four or five thousand feet above the sea to one of those bold and isolated heights open on all sides, the traveller is treated to an intellectual repast exceeding in grandeur all that poets or novelists have discovered in the revelry of nature itself. It is one continuous feast to the eye. On one side lie a series of mountains, rising in successive tiers till the highest peaks disappear in happy confusion with the white clouds of the East. On the other side is a vast rich

* Report on the Census of Travancore, taken in 1881 A. D.

undulating plain spread out in velvet green and covered with dense jungle not penetrated even by a Kawni's hut, the picturesque view extending over many square miles of territory and presenting scenes of indescribable beauty as far as the eye can reach; there is something like a glut produced on the human eyesight by the quantity and variety of beauty simultaneously presented to it. For a while, the traveller's eye rests on regions of magnificent primeval forest as old as Parasurama himself. Here the view is relieved by neat plots of coffee land upon which is seen the industrious hand of the mighty British adventurer, a scene full of life and calling to mind associations of lacs of plants and lacs of rupees, at one time the land of dreams, but now often the grave of fortunes. Then anon is seen towering pre-eminently over all, the Agastiar Peak or the Mount Everest of our Ghauts, supposed to be the abode of pious Rishis or at any rate now of guileless birds and beasts and of untainted perennial waters. In one word, 'every corner and every turning point opens out a panorama of inexpressible grandeur'."

To which may be added another description of a sixty miles' journey across country from Quilon to Shencottah, from my Census Report of 1891:—

"A rich picturesqueness of scenery diversified by hills and dales is the chief characteristic of Travancore. To the admiring student of nature it presents peculiar fascinations, on account of the variety and wealth of its natural beauty. If the untravelled reader will go along with me, across country, say from the western ocean to the ghauts on the eastern frontier and thence descend into one of those trans-alpine villages which abound in the flat country of Pandi, he will have seen Travancore at its best. Say we start from one of the coast towns, a place of historic importance known at once as a port, a cantonment, a centre of trade and the head-quarters of a chief revenue officer. The stranger will be taken up with its broad-backed gardens into which the town is laid out, the soil of which is half sand, half laterite, the former thickly planted with the valuable cocoanut palm for which every available space is used up, thus showing an ancient agricultural occupancy; while the remaining space is filled with wooded trees of all kinds, such as the mango, the jack, the anjili and the tamarind with the highly priced pepper vine parasitically clinging to them. This pretty town I am speaking of has a reef of rocks for its beach, which prevents its corrosion by the sea, thus helping the ryot to plant his cocoanut trees so near the water's edge that the shadows fall on the beating surf, a phenomenon not met with in any other point of this coast. On the south is the beautiful bay known to the earliest mariners of Europe as affording a perfect natural protection to ships in the worst weather; and which, it is believed, might, under favourable conditions, be turned into one of the finest harbours in India. A little to the interior you have the beautiful lake scenery, so much admired by travellers from all parts of the world, affording unrivalled conveniences for travelling and traffic and adding beauty to its general appearance. There are many turns and bends to this lake, which specially attract the eye of the traveller. On one of those turns you have a magnificent mansion standing out boldly into the lake, the waters of which reflect so well its lofty column, its halls and rooms, its high balconies and well designed circular roof that the shadows on the water seem more charming than the reality. This mansion known as the Thavally Palace is very happily situated. The ground is an elevated table-land jutting out into the lake, which bounds it on three sides. The soil is of laterite formation and the water is excellent both for drinking and bathing purposes. There are two tanks in the garden and several wells, one of them a

particularly large one within the 'nalukettoo' itself. The place was an abandoned jungle years ago, and the credit of discovering and reclaiming it belongs to the present Dewan (Mr. T. Rama Row). The late Maharajah and his Royal brother visited Thavally often. So also did the present Maharajah as a Prince and several other members of the Royal family. So Thavally became a favourite resort with the Royal family, and during His late Highness' reign, the ground and property of Mr. Rama Row were purchased by the Sircar, and a magnificent mansion erected on it. The view from the palace tower or column is most magnificent. The peculiar combination of wood and water, of groves of tall palms and forests, of well-shaded jack and mango trees, with the blue line of distant mountains on the eastern horizon, give a charm to Thavally which can only be felt, not described. Another point of vantage in this lake scenery is the Residency, the oldest and the finest of the Residencies in the country. I have heard no end of praises being heaped on this lovely spot. On occasions of State dinners the house is decorated and the gardens are tastefully illuminated, when it may well claim the encomium passed on it by one of our late Governors that it was 'Fairy Land'. The enterprising European has not been slow to avail himself of such natural facilities; so he has with his usually keen commercial instinct established mills and manufactories which, with their noisy machinery and smoky chimneys, remind you of the veneering of a superior civilization over this otherwise quiet spot. A mile to the east is the European quarter of the town and the British cantonment with their indispensable parade ground, church, mess-house and a club, and an open sea beach for their evenings to be enjoyed. Between, is the native part of the town with its thatched huts and busy bazaars containing a mixed population of Pandi Sudras, Nairs, Mahomedans, Jews, East Indians and fishermen. The town is dotted with numerous tanks and wells, an indispensable auxiliary to the comfort of the true Travancorean. It is also well supplied with flat metalled roads, the very best, I think, of all the roads we have in the country. Travelling eastwards we pass the pretty grove of Elampalloorkavoo, the only cluster of huge trees in a large expanse of open country. This 'kavoo' or grove is an interesting oasis in the open maidan, and I counted in it 129 trees of 17 different kinds such as the belleri myrabolam, the momordicus charantia, the cinnamon, the cassia, the callicarpa lanata, the anjili, (the artocarpus hirsuta), the echites scholaris, the strychnos nux vomica, the jack tree, the mango tree, the alangium decapitatum, the Kilimaram, the Vattathamara, the Vetti, the Edana and the Mottalu. They were the growth of ages and were an object of worship to the neighbouring population, who consider it sacrilegious to touch such trees with any knife or other piece of iron. Leaving this, we come upon a fine jungly station with a number of new clearings all round, and a wild mountain torrent running by its side the force of which, however, has been arrested by the recent bund-works of an enterprising company. The whole road is lined on both sides with fine avenue trees planted by an enthusiastic former administrator of the district and bearing testimony to his goodness and forethought. Proceeding further east, we reach Ottakkal, another distance of 10 miles. The whole region is one continuous forest, and is an abundant source of inexhaustible wealth, the potentiality of which exceeds our most sanguine calculations. On both sides the road is barricaded by a tall tree fence. This is a phenomenon quite unknown in most parts of India, and but for our personal knowledge we should have found it hard to believe it. The noonday sun scarcely penetrates the thick crust of green leaves, so rich is the vegetation. From Punalur to Camp Gorge the river runs nearly parallel to the road for most part of it, and I believe the natural stream served as a guide to the original engineer in laying it out. It is impossible to describe the beauties of the road or the river in this region; they should be seen to be appreciated. The best description must beggar the reality,

or as Mr. J. D. Rees writes:— 'Words fail me to describe the lovely scenery. Tall, upright standards of huge timber trees, palms of every kind, including the exquisitely graceful areca, tree ferns, creepers, ferns and flowers, all spring from a tangled undergrowth of iral reed. The pepper vine clings to the large timber trees, and ropes of rattan and giant branches hidden in creepers, combine to construct an ever varying but unending bower. ... As you travel in the chequered shade, you would say that every reach of the road had been designed by nature, to show what wealth of vegetation can be presented at once to the astonished and delighted eye.' After a night's halt in the wooden house at this lonely place (Ottakkal), you rise and see nothing but a dim daylight and a white haze all round. The tall trees and the mountains are all buried under this haze, so that one would suspect it was raining hard when it was only the morning dew. As the sun rises in the horizon, the mist disappears, and the outlines of the glorious hills and the surrounding jungle become more and more visible. Altogether this Ottakkal is a lovely station, in the heart of the forest. It composes one to fine thoughts. There is not a single human habitation within a radius of five miles. There is nothing to disturb one here except the loneliness of the spot. At night you may be awakened by a wild elephant, who pays his customary visit to the neighbouring jack tree (five yards from the wooden building) when the jack fructifying season sets in. Eleven miles further to the east is the Arienkavu pagoda. This is a small temple, with its usual accompaniments of a copper-plate-roofed quadrangle, and a cupola-shaped shrine in the centre, dedicated to the god of the woods, a place of great sanctity and renown, approached with dread reverence by the superstitious traveller. The road still lies by the side of deep and fearful ravines, thickly overgrown with moss and shrub, and through a continuous belt of tall and stately forest of the kind already described, and tenanted by the majestic elephant and the royal tiger and all the minor denizens that

'Roam the jungle free,
Graze the turf untilled,
And drink the stream unbrewed.'

Midway between Ottakkal and this pagoda is a two-roomed terrestrial paradise, used as a rest-house by the much-travelled Briton, and which is situated on the side of a precipitous and magnificent gorge, from which it takes its name. It is the most favoured of all the fair spots on which the eye of Heaven rests, and when fitted up with the equipments of modern civilization, it might well raise the envy of even an English prince. A mile to the east of this venerable pagoda, is the famous pass through the ghauts, known as the 'Arienkavoo Pass'. This beautiful glade on the ghauts is fifty miles away from where we started, and forms a sort of natural gateway through the chain of mountains which would otherwise be an impassable barrier to Travancore. The road, already described, outs the mountain saddle at its lowest point, and connects it to British India. This road, upon which the business-bound traveller of to-day does not pause to spend a moment's thought, bears at once willing testimony to the financial genius and engineering skill of former times. It would be ingratitude in us to forget our old benefactors, though the world is so much occupied with its present self that it has no time to look back or cherish memories of the past. The road struggles up inch by inch, for several hundred feet above the sea-level, before it reaches the top of this gap, and any but the stoutest heart must have been baffled in the attempt to make it, so great are the natural obstacles of wood, rock and ravine. The topmost part is presently reached, and you stand still and take breath for a while. Then, as you slowly wind down the tortuous path, looking at all the points of the compass, new beauties rise on every side before you. At every turn, you get exhilarating views of the enchanting landscape, which for

the nonce relieves the prosaic mind of the dull monotony of daily life and fills it with sweet thoughts of fancy. On the west is seen nothing but a dense jungle of the tall teak and the stout anjili, the valuable kongu and the oily vengai, and an impervious underwood, full of animal and vegetable life, resonant with the hum of the shrill Seevudu bee*, and the gentle murmur of the forest leaves, with the perpetual rain dripping from them, and the deafening roar of the wild torrent below dashing its headlong course—altogether a scene which, by its richness and hugeness, produces something like a glut on the vision and obscures it. The eye then fondly turns to the open east, the varied beauties of which furnish still ampler food to an imaginative mind. The view on that side, as laid out by nature, is simply grand. The ground gently falls eastward, step by step, for many miles, till at a great distance you see the ruins of a magnificent 'gopuram' (tower), which reminds you that the level country of the Tamils has been reached. The zigzag line of rich avenues, with banyan trees 30 feet in circumference and perhaps as old as Queen Mangamma herself, indicate which way the ~~carriage~~ road lies. On yonder right, flow the magnificent waters of a mighty cataract, used by millions of pilgrims from a remote past, and which, though perhaps of not equal sanctity to those of the Vedic Ganges, are yet as pure. The smoothness of the rocks, over which the water flows, reminds one of the immensity of the time that has elapsed, and the hundred little streams and channels into which the waterfall has been diverted, show how the hand of man in later ages has utilized it for religious and secular purposes. The green valley between, with their rice fields and groves of cocoanut palms in their midst, add their share of beauty to the surrounding scene. To the left, your eye falls on clusters of Hindu villages with houses closely packed to one another—an economy peculiar to this region, but unknown on the Western Coast. The houses, though small and humble, are neat and well-built ones, made of brick and chunam, and afford the inmates effective shelter from the biting winds of the monsoon, which blow here with unstinted fierceness. Further left, you catch a glimpse of an isolated rock, with a Hindu temple on its top founded according to popular tradition about the beginning of this 'yuga', but, at any rate, showing that the Hindu worshipper of old had a touch of the romantic in him. On both sides of the road the tilled red soil bespeaks the quiet and patient industry of the ryot who, though the butt of fickle fortune, has through several generations and amidst all change of circumstances yet remained a contented and loyal subject. Overhead fly troops of water-laden clouds, precipitated through a hundred gaps by the winds on which they ride as if in a hurry to convey to the anxiously awaiting villagers of Pandi the glad tidings of rain and plenty in the land of Parasurama with which their own prosperity is so indissolubly bound. In short, on every side, you are greeted with a rich and interminable prospect of Nature's beauties, sown broadcast in riotous profusion before you, such as is only possible in a Travancore landscape."

In spite of repeated tours over this pretty tract of country, my fascination remains undiminished for wood and water, for hill and gorge, for high peaks and deep chasms, for the cry of the jungle bird and the roar of the wild torrent. I am not sure if this charm will not disappear with the introduction of the Railway. This scene of never ending beauties of the Aryankavu Pass might become an old-world dream. Speedy locomotion is inconsistent with the full enjoyment of natural beauties or diversified

* A kind of bee that makes a shrill sound often met with in our jungles.

† Dr. Caldwell says, "It may be asserted without risk of exaggeration that Courtallam is the finest freshwater bathing place in the world."

landscape. One relishes them better for the dull country-cart journeys. The steam engine dashing across this 60 miles of rich scenery in a couple of hours, the natural beauty of the country will thus quickly pass the eye and escape enjoyment, like a flash of lightning. It would be as if one swallowed a whole meal in a single gulp. So sudden a change in the life of the quiet and simple Travancorean may be a matter for regret, but a vain regret after all. It is impossible to stand still in this age. Such is the current of modern civilisation. We must move on whether we will or no*.

Mountains.—The hilly region of Travancore is very extensive and is a marked feature of the State. What the Himalaya mountains are to the Indian Continent, that the Western Ghats are to Travancore. Without these Ghats Travancore would be a poor tract of land, treeless and arid and inhospitable, without rivers and rains, exposed to droughts and famine even more than the worst part of the East Coast, which itself would be the much poorer but for these Ghats. They affect all the conditions of life now peculiar to Travancore, and it is no wonder therefore that the Travancorean worships the Ghats, particularly one of the highest peaks in them where sage Agastya is said to dwell, and has deified their maker Parasurama who created Malayalam from the sea, the upheaved surface of which became the Ghats. Reference is made in another part of this book to the 5 presiding deities (Sasthas) who guard the Western Ghats.

The eastern boundary of Travancore with three small exceptions (the Anchanad valley, the Shencottah Taluk and the eastern slopes of the Mahendragiri hills) is the lofty mountain range, the chain of Ghats that forms the backbone of Southern India. The hills are of every variety of elevation, climate and vegetation. Some of the loftier mountains are entirely detached, except near their bases, from the neighbouring heights; they often have a precipitous descent towards the west and are connected with a succession of low hills diminishing in altitude near the coast. To the north, the mountains rise to an elevation of 8,000 feet with plateaus over 7,000 feet; the more important of these is part of the group known as the Anamalais (between lat. 10° 13' 45" to 10° 31' 30" N; and long. 76° 52' 30" to 77° 23' E.)

At the head of these hills stands Anamudy 8,840 feet high, round which are clustered several others, among the more important of which may be

* Since this portion of the Manual was written the Railway has been completed and the line opened for traffic between Quilon and Tinnevely.

mentioned, Eravimala or Hamilton's plateau 7,880 feet (6 miles long by 3 wide containing about 10,000 acres of tea and coffee land), Kattumala 7,800 feet, Chenthavara 7,664 feet, Kumarikal 7,540 feet, Karinkulam 7,500 feet, and Devimala 7,200 feet. All these run in a horse-shoe shape with the opening facing towards the north-east. These hills, together with the lower ground connecting them, form the elevated plateau known to Europeans as the High Range. The broken nature of the hills here causes the scenery to be far more varied and beautiful than that generally met with either in the Pulneys or Nilgiris. The general trend of the highlands is north-north-east and south-south-west, the highest elevation being to the north-east and to the south, gradually decreasing in sloping undulating hills towards the west excepting the Anamudy mountain and its plateau, which is situated at the extreme south-south-west end of the range. Strictly speaking, the tract known as High Ranges can hardly be said to be a plateau; it is rather a succession of high hills with deep valleys between, running down to a depth of 2,000 to 3,000 feet below them. Mr. Munro, the first Superintendent and Magistrate of the Cardamom Hills, has described it thus:—

"The High Ranges of Travancore rise suddenly from the lower plateau of the Cardamom Hills and form a complete range of their own. On the south-east corner, the High Ranges begin with Sholeamalla or Currincollum (8,480 ft.) and run in a south-west direction to Gennewurra, thence still south-west to Corechy and thence to Puddikut (6,000 ft.) near Davycollum. From Puddikut, the line of walls runs in the same direction to Coorkacomboo (7,000 ft.); then running slightly more west, the Hills rise to Chokenamuddy (7,300 ft.) from which the course is north-west to the gap where the Moonaur disappears. From the gap the Hills run slightly south-west and then north-west to Worrapparahundoo; thence north to Perumputti Kullo (6,500 ft.) from which again the direction is north-east as far as Aunymuddy. From Aunymuddy the course is much broken and runs irregularly to Erevimalla where there is a deep dip into the valley of the Erevimalla Aur which separates the Erevimalla plateau (also known as Hamilton's plateau) from Perumalmalla plateau. From this valley there is a steep rise to the north-west to Katoomalla (8,100 ft.). To the west of Katoomalla, the High Ranges comprise the plateaux within Chemmun Peak (7,100 ft.), Payratmalla (7,400 ft.) and thence eastward to Coomarikul (8,050 ft.). To the east of Coomarikul and Katoomalla lies the low Unjenaad Valley which separates this part of the High Ranges from the Highlands on the slopes of Tertamalla, on which are situated the hill villages of Kelandoor, Kandel, Pootoor, and Perumalla at an average elevation of 5,000 feet. In its upper part the Unjenaad Valley is also called the Thallayar Valley where the elevation is above 4,000 feet; sloping gradually to the northeast, it opens out into the Unjenaad Valley proper of 3,000 feet. Below and to the east of Unjenaad the land slopes down rapidly to the British frontier probably at about 1,500 or 2,000 feet, a very feverish tract containing no resident population.

"To the south-east of Tertamalla runs a ridge separating the water-shed between Unjenaad and Moonaur and joining the high peaks bordering the Pulneys

at a peak called Alleat Kunnoo (6,900 ft.). From Alleat Kunnoo the course is bounded by a curve north north-east to Pambadyshola (8,000 ft.) and then runs north to Kuduvurratukul (6,600 ft.), where there is a deep dip into the Wuttawudda river, and here the high land may be said to cease. From Alleat Kunnoo southward, the line to Sholeamalla is marked by clear-cut cliffs averaging about 8,000 feet. Exclusive of the low Unjenaad Valley which is not above 3,100 feet, the area within these boundaries may be roughly estimated at 400 square miles with an elevation of one of the peaks reaching as high as 8,837 feet".

The following are the chief plateaux in the High Ranges:—

GUDARAMALA. Between Karinkulam in the south-east corner and Devimala. Average elevation 6,000 feet, area 4 sq. miles; well wooded and watered.

DEVICOLAM. Lies to the west of the above and has an area of 3 sq. miles. Average elevation 6,000 feet; beautifully wooded and well watered.

ANAYCUDOO. Lies west of the Devicolam plateau and is separated from it by the Kazhuthaparathundoo. This beautiful valley is sheltered by the Chokkanmudy peaks. Elevation 5,120 feet. Between Vagavara and Anamudy there is a very pretty glen with an elevation of 7,000 feet.

ERAVIMALA. Lies north of Anamudy and is separated from it by a deep valley. Elevation 7,300 feet. Bare of wood on its summit but well wooded in the slopes. Has a cold bracing climate. Length 6 miles and breadth 3 miles.

PERUMALMALA. Length 2 miles, breadth $1\frac{1}{2}$ miles. Elevation 7,000 feet.

To the north of this lies a plateau sheltered between Kattumala, Kumarikal and Payratmala. Length 4 miles, breadth 3 miles and elevation 7,000 feet. There is another plateau to the north of Kattumala terminating at Pudikutmala. Area 3 sq. miles. Elevation 6,600 feet.

ANCHANAD. Area 30 to 40 sq. miles. Elevation 3,100 feet. This is a level terrace, two or three miles wide and five miles long.

VATTAVADA. Length 6 miles, elevation 6,000 feet. Greater portion bare of wood but the upper portion towards the top of the pass into Bodinaikkanur heavily wooded and well watered.

KUNDALA. South-west of Vattavada plateau at an elevation of 5,500 feet; length 6 miles and breadth 2 miles. A great deal of swamp land.

From the High Ranges the land slopes steeply down in three directions; north-east to the Anchanad valley, to the west into the valleys of the Kandanpara, Parishakkuthu and Idiyara rivers, and southwards to the Cardamom Hills and Peermade. These last form an extensive hill plateau,

60 miles long and 20 miles broad, lying at an elevation of from 3,000 to 3,500 feet with peaks and hills running up to 4,000 or even 5,000 feet. This is the centre of planting industry and is largely resorted to by Europeans, who have also taken up for the purpose Camp Gorge, Ponnudi, Ashambo &c. From the main range and from the western water-shed of the Peermade plateau and the High Range, rocky spurs run out to the west and north-west extending at times to within a short distance of the sea and forming a series of parallel valleys drained by numerous rivers.

South of Peermade, the lofty mountain range is of no breadth until we come to the beautiful sanitarium of Muthukuzhi Vayal or "The field of precious stones", 4,400 feet above sea level. For the remaining part of its length the great range becomes a mere ridge sloping down on either side and running north-north-west and south-south-east at an elevation of about 4,000 feet with isolated peaks rising here and there, the most important of which are the Agastyar peak (6,200 ft.) and the Mahendragiri peak (5,500 ft.). The Agastyar peak was once the seat of an Observatory. It is also famous as having been the abode of sage Agastya, "a savant, physician, philologist and theologian". The Mahendragiri peak stands on the area drained by the Hanuman River in the Tovala Taluk. This is the southernmost peak of the Travancore Ghauts and is supposed to be the hill from which Hanuman or the monkey God is supposed to have jumped to Lanka or modern Ceylon in quest of Sita.

Besides the peaks referred to above, may also be mentioned, Kallanad, Nedumpara, Papanasam, Amritamala, Kodyattur, Chengamanad, Periamala, Therathandu, and Marutwamala.

Passes. **BODINAICKANUR.** This is the most northern of the passes of Travancore. It is ascended with great difficulty from the valley below. It connects Kothamangalam with Bodinaickanur.

TEVARAM. This connects Todupuzha on the Travancore side of the Ghauts with Kambam on the Madura side. This pass reaches the top of the Ghaut after a very steep ascent; for 2 miles from there it proceeds to Perrinjincoty 12 miles, continuing its course to the eastern Periyar 14 miles further and reaching Idumpanur, the first village in Travancore 13 miles beyond that river. This is now little frequented as it traverses a very wild and mountainous region.

KAMBAM. This pass though rugged for $1\frac{1}{2}$ miles, is one of the best across the hilly tract separating the countries of Travancore and Madura. Merchants frequently pass this route.

GUDALUR. This connects Kanjirapalli with Kambam and Uttamapoliem, a distance of 44 miles. A more northern road strikes off from this at Copachetty Tavalam, 3 miles west of the Munjamulla Periyar, and proceeds by the Codamurutty Ghaut, a steep and difficult acclivity, to Erattupetta. This route runs over a rugged surface and is tolerable except near the pass which is now closed for traffic on account of the facilities it offered to smuggling.

South of Gudalur another path ascends the hills and leads to Sabarimala, but it is of no consequence being only frequented by cattle.

SHIVAGIRI GHAUT. This route is also prohibited. A road leads up to it from Rajapoliem, while another from Srivilliputtur ascends from the Satur Ghaut; but both these are difficult.

ACHANKOVIL (1,500 ft.). This lies north of the Puliara pass and joins Achankovil to Pumblypatam and Shencottah. This has a difficult ascent for a mile from the plains stretching along its eastern foot. The road, after leaving the summit, descends partly through the bed of a stream to the pagoda, a distance of $6\frac{1}{2}$ miles; thence passing over swelling ground and following the right bank of the Kulakkada river, it reaches Konni, a distance of 29 miles having crossed 9 powerful streams, the passage of which during the rains constitutes the chief difficulties of the route. This route passes from Shencottah over Konni, Pantalarn and Mavelikara to Kartikapalli measuring on the whole a distance of more than 60 miles.

ARYANKAVU (1,200 ft.). This connects Quilon with Shencottah and is one of the principal passes of Travancore. It has an easy ascent from the open country on the east and passes through Mampazhatora and Pattanapuram, pursuing its course over waving ground through thick woods.

SHANAR GHAUT (1,700 ft.). This lies south of the above pass and is very difficult and little frequented. It ascends 4 miles and descends 11 miles to Kulattupuzha, from which it passes through a thick forest.

ARYANAD. The route to British territory by this pass is now closed up. The road rising from the plains on the east to the top of this pass and thence descending through a thick forest to the village of Aryanad near Nedumangad is spoken of as having been at one time a very good one.

MOTTACCHIMALA (4,500 ft.). In the Eridge estate. This is the chief pass by which cardamoms are smuggled from Balamore to Agastyar. The

road was once rideable to Papanasam; the Kanikkars even now go down this path for tobacco which they buy about Papanasam.

From Calacaud to Muthukuzhivayal there is a path used by canemen and cardamom smugglers.

Pass from Kadukkara to Shoravalli Madam. Much used by villagers from Alagiapandyapuram and other parts going to Panagudy. Daily the Panagudy cattle come down to the Kadukkara edge of the jungle to graze. It is also used largely by estate coolies.

TIRUKKURANGUDY. c About 2,000 feet; bridle-path cut on both sides. Much used by estate coolies.

Pass through Miranjimea Estate. Formerly a good path ascending the mountains from Panagudy leading to a large coffee estate; now a very bad track overgrown and not much used.

ARAMBOLY. The trunk road from Tinnevely to Trivandrum passes through this pass. This forms the best entrance into Travancore.

YEDAMALA. A small and easy pass across the group of hills forming a ridge about 2 miles to the north-east of Marutwamala near Cape Comorin.

Rivers.—Travancore is especially fortunate in its river system. Few countries of similar extent are supplied with so many fine streams. Owing to this circumstance and to the heavy rainfall, every part of Travancore is abundantly supplied with water and that of an excellent quality. Of the numerous rivers taking their rise in the Travancore hills very few escape to the other coast. The rivers have generally a capricious course and are of varying lengths and depths. The bed over which they flow is frequently rocky in the interior, but as they leave the elevated parts, it is in most cases sandy, succeeded by a muddy sediment as they empty themselves into the lake or the sea. During the wet weather, which commences about the beginning of June and lasts till November, these rivers are filled from bank to bank with a large volume of water rolling in a strong current to the sea. The large rivers flow with turbulent and impetuous force frequently rising 12 to 14 feet above their ordinary level. The flood diminishes as the monsoon draws to a close, the rivers slowly subsiding into shallow and languid streams. In the larger rivers—the Periyar, the Ranni and the Kallada—there is always a considerable amount of water, due no doubt to the fact that the heavy forest at their sources does not allow the rains falling in the wet weather to run off too rapidly.

THE PERIYAR. The Periyar is the finest, the largest and the most important of the rivers of Travancore. It takes its rise in the Shivagiri forests. As it first emerges from the dense forest the volume of water it contains is 30 yards wide and 2 feet deep even in the driest weather. After a course of 10 miles northward it is joined by the Mullayar at an elevation of 2,800 feet. The Periyar then turns due west and continues so for about 10 miles over sandy bed. About seven miles below Mullayar Tavalam there is formed a sort of gorge by the hills rising to a considerable height on either side of the river and approaching each other very closely. It is here that a dam is thrown by the Madras Government to a height of 160 feet and a width of 1,200 feet to form a lake which greatly helps the irrigation of the land in the Vaigai valley. By the construction of the dam the river is caused to back up for a considerable distance as far as the Vazhukkappara Tavalam, and all the low lying land on the north bank of the river is submerged, the water extending up all the side valleys and reaching to within a mile of Kumili. From here a channel is tunnelled through the hill side over a mile long, by which the water is conveyed to one of the streams that go to feed the Vaigai river.

After a winding course of 8 miles from the dam, the river reaches Peer-made and then passes through a narrow gorge, below which it is joined by the Perinthura river. Lower down, passing the Todupuzha-Periyar crossing, the Kattapanayar joins it and still lower the Cheruthoni or Chittar. Lower down it is joined by the Pirinyankuta Ar and a mile later by the Muthirappuzha Ar, where the elevation is about 800 feet and there is a great fall of 800 feet in $4\frac{1}{2}$ miles. There is also another fall called Kokkaranippara, where the river is said to tumble over a cliff 100 feet high, close to the above. The Periyar after receiving the Muthirappuzha river flows west-north-west for about 8 miles when it pours under a large rock which probably has fallen from the hill side on account of landslip. In dry weather when the volume of water is small, the whole of it flows under the rock. This has been exaggerated into a sudden disappearance of the river underground. The water is considered to pass into a chasm and emerge again only after a very long distance.

Ten miles below the junction of the Muthirappuzha river with the Periyar, at Karimanal, the river becomes navigable or suitable for the floating of timber. It is then joined by the Deviär and passes the once populous village of Neryamangalam. From this place it flows for about 8 miles when it unites with the Idiyara or Idamala river. From here as far as Malayattur, the river, now a grand one upwards of 400 yards

broad, is fed by numerous streams. Passing Malayattur and after a winding course of 14 miles it reaches Alwaye, where it divides itself into two branches, which again subdivide themselves into several small ones before reaching the sea. The principal branch flows north-west and expands itself into a broad sheet of water. Another branch takes a southerly direction and is broken up into a number of small channels leading into the lake near Verapoly, while a third one flows to the south and discharges itself in the lake south of Tripunator.

THE PERIYAR flows through the Taluqs of Changanachery, Todupuzha, Muvattupuzha, Kunnatnad, Alangad and Parur. The chief places on its banks are:—Peermade, Neryamangalam, Malayattur, Cheranallur, Vazhakulam, Alwaye, Ullinad and Verapoly.

The total length of the river is 142 miles of which for the last 35 miles only it passes through inhabited tracts. It is navigable for boats for 60 miles above its mouth.

THE MINACHIL RIVER. This rises on the Peermade plateau a little above Nallatannippara at an elevation of 3,500 feet. It runs first north-west and then west and after 7 or 8 miles joins the Kavana Ar which rises on the slopes of Melakavu. The combined stream after a course of 2 miles due south is joined by the Codamurutty river and passes by Punjar. After leaving the forest boundary at Erattupetta, its course is south-east and leaving Kondur and Lalam, it passes through Kitangur and Kottayam after which its waters, dispersed in minor channels, unite with the Vembanad lake by several embouchures. The length of the river is 35 miles and it is navigable for boats 26 miles.

THE MUVATTUPUZHA RIVER. This is formed by the union of three smaller rivers, the Todupuzha, the Vadakkan and the Kothamangalam, which take their rise on the western slopes of the Peermade plateau and running in a westerly and north-westerly direction through a wild country unite at Muvattupuzha, thus getting the name. The combined river flows for about 8 miles in a westerly direction and then turns south and passes Ramamangalam, Piravam and Vettikkattumukku, at which point it forks, one branch running in the direction of Cochin and the other flowing into the Vembanad lake at Tannirmukkam. Total length 62 miles; navigable for boats 42 miles inland.

THE RANNI OR PAMBA RIVER. This is one of the finest rivers of Travancore and is formed by the junction of three rivers, the Kallar, the Kakkada Ar and the Valiya Ar, which last is made up of two other small ones—the Pamba

and the Arutha. The original stream Pamba from which the river takes its name rises on the hills to the north of Pulicchimala and after running for a long distance is joined by the Arutha which rises on the Peermade plateau, and the two together form the Valiya Ar which after a course of 6 miles westward falls over Perunthè aruvi (height 90 ft.) and is then joined by the Kakkada river. The Kallar which rises in the valley north of Chempazhakkara joins the main river a little above Ranni and the combined river now called the Ranni leaves the forest area as a powerful stream 200 yards broad. It then runs west for about 30 miles when it is joined by the Manimala river and 6 or 8 miles lower down the Kulakkada river joins it and after a course of about 20 miles the whole flows into the Vembanad lake.

The total length of the river is 90 miles. The chief places on its banks are:—Konni, Aiyurur, Aranmula, Chengannur, Mannar and Pulikunnu. The river is navigable for boats for 45 miles, and is specially useful for irrigation.

THE KALLADA RIVER. This is the third largest river in Travancore. The union of five large streams issuing from the mountainous valleys of the Ghauts forms the Kallada river which flows through the Taluqs of Pattanapuram, Kunnattur, Kottarakara and Quilon. The main branch rises in the most southerly of these valleys and is formed by numerous streams that rise on the elevated plateau stretching from the Alvarkurichi peak to Chemmunji. Flowing west it is joined by several small streams and after leaving the Kulattupuzha valley proper and running 5 miles passes the Kulattupuzha village situated on its left bank. Here the river is about 80 yards wide and never gets dry even in hot weather. Three miles lower down it is precipitated over the Minmutti cataract, the water rushing with immense velocity. It is then joined by the Chenthroni and Kalduritty rivers. Passing Ottakkal where it pours over another cataract, the river then runs for about 10 miles in a west-north-westerly direction and leaves the forest area 3 miles above the town of Punalur. Turning north and bending a little north-west, it passes Pattanapuram and 2 miles below Punalur it is joined by the Chalakkara Ar. It then flows in a westerly direction and then south-west until it falls into the Ashtamudi lake, a little north of Quilon, by several mouths. Its length is 70 miles of which 25 miles are navigable for boats. The chief places on its banks are:—Punalur, Pattanapuram, Pattazhidesam, Kulakkada, Kunnattur and Kallada (East and West).

THE MANIMALA RIVER. The main branch of this river rises under the Mothavara hill and drains the valley to the west of Amritamala. After

flowing for about 6 miles it is joined at Kuttukal by the Nyarampullar and then by several small streams before it joins the Ranni about 25 miles above its mouth. The length of the river is 62 miles. The villages of Peruvantanam, Mundakayam, Yerumakuzhi, Manimala, Kaviyur, Kalluppara, Tiruvalla, Talavadi, Kozhimukku and Chambakkulam lie on its course.

THE ACHANKOVIL OR KULAKKADA RIVER. This rises on the western slope of the Thuval mala (Coonumkal square rock) and Ramakkal peaks. It passes Achankovil village and, after receiving numerous accessions from small rivers and streams, leaves the forest area 4 miles above Konniyur. This river runs a course of 70 miles first north-west and then west and joins the Pamba river near Viyapuram. Konniyur, Oinallur, Pantalamb, Mavelikara and Kandiyur are situated on its banks. It flows through the Taluqs of Chengannur, Kunnattur, Mavelikara, Tiruvalla and Kartikapalli. Navigable for boats 40 miles and specially useful for cultivation purposes.

THE ATTUNGAL OR VAMANAPURAM RIVER. This rises on the peak of Chenmunji north-east of Trivandrum and on the spur running out from the main range as far as the cliffs of Ponnudi. It then descends rapidly and runs at first in a northwesterly direction, then west for 23 miles between high banks and over a sandy bed when it passes the village of Vamanapuram. From here it runs south-west and empties itself into the Anjengo estuary after a course of 35 miles. Nelnad, Vamanapuram, Attungal, Kuntallur and Chirayinkil are the chief places on its banks.

THE ITTHIKKARA RIVER takes its rise in the low hills situated near Madatturakani and those to the south-west of Kulattupuzha. After small accessions it leaves the forest area near Manarkoda and proceeding in a north-westerly direction is joined by a large stream. From here it flows south-west and west and falls into the Paravur backwater. Length 30 miles. Chadayamangalam, Pallikal, Kummallur and Nedungolum lie on its banks.

THE KILLIYAR. This petty river rises in the Nedumangad hills. Its course is generally towards the south and after flowing for 15 miles it joins the Karamana river near Tiruvallam. This river irrigates a small tract of rice land by means of anicuts and channels taken off from it and supplies water to all the principal tanks of the Capital.

THE KARAMANA RIVER. This rises on the ridge to the north of the Agastyar Peak and an outlying spur terminating in the Sasthankotta rock. It flows over a partially narrow rocky bed confined by high banks through a comparatively wild, woody and uneven country. Its direction

is first west, then south and finally south-west and it flows into the sea 3 miles near Puntora, at the foot of the head-land termed Covalam, after a course of 41 miles.

THE NEYYAR. This rises on the slopes of the Agastyar peak at an elevation of 600 feet and descends with great rapidity until it reaches the foot of the hills. It then runs in a southerly direction and passes downward over a cataract 300 feet high, visible from Trivandrum. From here it flows over a partially rocky bed confined by bold banks and discharges itself into the sea near Puvar where a small lagoon is formed. Its length is 35 miles.

THE PARALAYAR OR KUZHITTURA. This rises on the mountains north of Mahendragiri hills. Passing through a wild tract, it enters the plains at Tiruvattar and flows in a south-westerly direction. After a course of 23 miles from its source it is joined by the Kothayar. It flows through the two Taluqs of Kalkulam and Vilavankod and reaches the sea at Tenganpatnam. The total length of the river is 37 miles. Tiruvattar, Munchira, Kuzhittura, and Arudesapattu lie on its banks. It is intercepted by dams at Ponmana.

THE KOTHAYAR. This rises on the southern extremity of the Muthukuzhi Vayal plateau and to the east of Valiyamala peak at an elevation of 4,500 feet. It descends slowly at first and then more rapidly. After flowing for 14 miles it reaches the Mottacchi valley (1,800 ft). It continues to descend with rapidity tumbling over falls 30 feet high and eddying among huge boulders, until at last it reaches the elevation of 250 feet. From here it flows leisurely and is joined by two streams rising on the Motavan Potha and the Thacchamala hills. Proceeding south we find the remains of the Aryanad dam now in ruins. This dam was built with the intention of diverting the water into the Paralayar above the Pandyan dam and eventually into the Pazhayar whose stream is so largely used for irrigating the paddy lands of Nanjanad. After passing the Aryanad dam and about 4 miles lower down it is precipitated over the Triparappu fall (50 ft. high), a very sacred place where there is a large pagoda. From here it proceeds south and is joined above Kuzhittura by the Paralayar. Length 20 miles.

Project works on a large scale are now going on to divert the waters of the Kothayar to supplement the existing irrigation system of Nanjanad. A detailed description of the Project is given under 'Irrigation' in the Chapter on 'Agriculture and Irrigation.'

THE VATASSERI RIVER. Also called the Pazhayar. This is the most southerly river in Travancore. Many small streams combine to form

this river, one of which rises south of the Mahendragiri peak and passing down a steep gorge reaches the low country a little to the west of Anantapuram, another in the Kunimuthu Chola Estate and another drains Black Rock (Mr. Cox's Estate). All these pass out of the forest before they unite to form the main river. This flows through the Taluqs of Tovala and Agastisvaram in a south-easterly direction and flows into the Manakudi estuary after a course of 23 miles passing the towns of Bhutapandi, Kottar, Nagercoil, Tazhakudi and Suchindram. This is a very useful river for irrigation.

These are the chief rivers of Travancore. The number of smaller streams is very large but as they are otherwise insignificant any detailed description of them is unnecessary here.

Canals and Backwaters. Among the many natural advantages possessed by Travancore, one of the most important and one which adds materially to its wealth and prosperity, on account of its affording great facilities for water communication from one end of the country to the other, is its extensive backwater system. The backwaters or *kayals*, as they are locally called, are inlets from the sea which run in a direction parallel to the coast. From Trivandrum as far as Ponnani in the District of Malabar, a distance of over 200 miles, there is a succession of these backwaters or estuaries, connected together by navigable channels constructed from time to time. The total area occupied by the surface of the lakes amounts to 227½ sq. miles of which 157½ are within Travancore. Their breadth is very unequal, in some places spreading into a wide expanse, at others diminishing to a small stream, presenting on the whole a very irregular and broken figure.

Formerly there was uninterrupted navigation only as far as Quilon. It was in 999 M. E. that Her Highness Parvathi Bayi sanctioned the construction of 2 canals, one from Trivandrum to the backwater of Kadinangulam and the other to connect Quilon and the Paravur backwater, both of which projects were contemplated by Col. Munro; but the work was commenced only in 1000 M. E. (1825 A. D.) and completed in 3 years under the supervision of Dewan Vencata Row. The 2 canals measure in length upwards of 17 miles, which including 4 bridges cost about 4 lacs of Rupees. These canals bear the name of Her Highness Parvathi Bayi whose beneficent reign is still gratefully remembered by the people.

There were still the Varkala cliffs, standing as a barrier against direct and free communication from Trivandrum to Quilon. This was removed by the construction of two tunnels at an enormous cost in the reign

of His Highness Rama Varma (Ayilliam Tirunal-1860 to 1880 A. D.). The length of one tunnel is 924 feet and of the other 2,364 feet. The first tunnel was opened to traffic on the 15th January 1877; the second tunnel and the whole of the Barrier works were completed and opened to traffic in 1880. They cost upwards of 17 lacs of rupees.

Many of these backwaters are not very deep, yet they are all navigable for boats of any size. Their bed consists generally of a thin layer of soft black mud, incumbent on a fine dark sand, often with some mixture of soil. On account of the large volume of water these backwaters receive during the monsoon time, their water, except in the immediate vicinity of their mouths, is quite fresh; in some places they are always so in the interval of the tides, while in others, they continue to be so from July to October. The places where these backwaters meet the sea are called *Azhis* or *Pozhis*, according as the opening is permanent or temporary. The chief *Azhis* are those at Quilon, Kayangulam and the mouth of the Periyar; and the *Pozhis* are those of the Veli, the Paravur and the Edawa. The flood during the monsoons leaves behind a slimy deposit which effuses an abundance of fertility over the lands exposed to it. The backwaters also foster the growth of many weeds and aquatic plants. The shores of the lakes are filled with houses and plantations of cocoanut trees and present the appearance of a perpetual garden.

Starting from Trivandrum there is first, at a distance of 3 miles, the Veli Kayal which looks like an expanded canal. On one side the shore is overhung by a high cliff and the other side is skirted on by an extensive range of cocoanut plantations. Passing the Veli backwater, by the Parvathi Puthenar canal above referred to, we come to the Kadinangulam Kayal. Here again both the banks are lined with the cocoanut palm and a low brushwood. This backwater is a little larger than the Veli. The water is not deep. Going by the canal, we next pass Anjengo, formerly a place of note on account of the English factory and the early commercial relations between the British Government and Travancore, but now a small port and fishing village. Here is the Anjengo Kayal. The length of this Kayal is 12 miles, breadth ¾ of a mile, and area 8 sq. miles. This receives the Attungal or Vamanapuram river and is formed chiefly by its waters. It is connected with the sea by a narrow bar.

A few miles beyond Anjengo, the Varkala cliffs are reached. Before the construction of the tunnels, travellers used to land at a place called Kozhi-

thottam (the main line of communication ran by Kozhithottam to Edawa, a distance of 12 miles), from where they walked to Edawa until the backwater is reached, the road used being by the sea-beach, at times climbing over the summit of the cliffs that stretched into the sea. The view from these cliffs is extremely beautiful and the whole landscape charming. Here stands the village of Varkala famous for its ancient temple dedicated to Janardanaswamy, to which Hindus from all parts of India resort.

Passing the tunnels, about 6 miles northwards there is the Nadayara Kayal. This again is of minor importance. Passing the Nadayara backwater a canal runs in a northwesterly direction for some 3 miles whence the Paravur canal and backwater lead to Quilon. The Paravur Kayal, though only a small one, is very deep and dangerous on account of its being very close to the sea and in the wet weather the bar opens of itself, sometimes suddenly. The Paravur and Quilon canals aggregating about 11 miles in length, were cut between 1826 and 1829, at a total cost of Rs. 90,929. Passing the Paravur backwater we reach Quilon by the Eravipuram and Quilon canals, a distance of about 5 miles.

On leaving Quilon the traveller enters the romantic and enchanting Ashtamudi Kayal. The name 'Ashtamudi' is derived from the fact that the lake branches off into 8 creeks, called by different names. One portion near the Quilon Residency is called the Asramom lake and the other close to the Cutchery is called Kureepuzha or Loch Lomond. On either side we see a laterite bank 50 or 60 feet high enclosing little bays with deep blue waters. The broken side and the fragments of rocks are filled with various kinds of small shrubs while on the summits there are thickly planted gardens. About 2 miles north of Quilon the water opens out into a very spacious bay into which the Kallada river empties itself. There is an outlet to the sea at the western end which is locally known as the Neendakara bar. It is of sufficient depth for small vessels and the barges built at Tuet in Quilon are safely launched into the sea at this point. It covers an area of 20 sq. miles, its extreme length and breadth being 10 and 9 miles respectively. The banks are covered with many kinds of plants. Five miles beyond Quilon the backwater ends and the Chavara canal begins and the scenery becomes monotonous.

We next come to a very small inlet called the Panmana Kayal. This is followed by the Ayiramtengu Kayal which again leads us to the extensive Kayangulam Kayal. The Kayangulam lake has an outlet bar of the same name which admits of small coasters from the Arabian sea. This made Kayangulam a place of considerable commercial

importance in former days. This lake borders the two Taluqs of Karunagapalli and Kartikapalli. Its extreme length is 19 miles and extreme breadth 4 miles; area 23 sq. miles.

Passing the Kayangulam Kayal we reach Karumadi near Ampalapuzha by a natural stream through Trikkunnapuzha and Thottapalli chera. Proceeding along on our way, we see extensive rice fields on either side, the country here being flat and almost submerged in water. From Ampalapuzha, Alleppey is 12 miles distant. There are no backwaters to be passed but only canals, which at these places are very broad and join the Pallathurithy river flowing into the Vembanad lake near Alleppey. Alleppey town is reached by a canal, before entering which there is a deep basin 40 to 50 feet in depth infested by alligators of enormous size.

Alleppey is now the first commercial port of Travancore, its greatest advantage as an emporium arising from its singularly natural breakwater formed in the open roadstead and the long and wide mud bank which helps large vessels to anchor safely even in the stormiest weather.

Beyond Alleppey we come to the very large and spacious bay, the Vembanad Kayal. This stretches across to the east for a distance of over 10 miles. The waters of the Pamba, Muvattupuzha and Minachil rivers are emptied into it. It borders the Taluqs of Ampalapuzha Shertallay, Vaikam, Yettumanur, Kottayam and Changanachery. Its extreme length is 52 miles and breadth 9 miles and the area covered by it is 79 sq. miles. It has a small beautiful island in the centre known as Patiramanal, or 'the mysterious sand of mid-night', filled with cocoanut plantations and luxuriant vegetation. According to tradition, it was brought into existence by the piety of a Nambudiri Brahmin, who, while travelling in a canoe, jumped into the lake to perform his evening ablutions. The waters, it is said, gave way and land arose from below forming a small island. Pallippuram and Perumpallam are two other islands in the lake.

There are many pretty places along the borders of this lake, perpetually clothed with beautiful groves of cocoanut and other trees and with an endless succession of houses, churches and pagodas. Midway between Alleppey and Cochin stands on its eastern bank the sacred village of Vaikam where there is a large Siva temple to which thousands of pilgrims resort in the months of Vrichigam and Kumbham for the Ashtami festival. From here to Cochin the backwater is of varying breadths and depths containing small patches of land here and there always adorned with cocoanut trees.

From Cochin the water communication is by backwater to the north of Cranganore whence it is continued by creek, channel and backwater *via* Chowghat to Ponnani, and across the Ponnani river to Tirur Railway station. Thus the system is complete for a distance of 213 miles from Trivandrum to Tirur.

Among other backwaters may be mentioned:—

The Kodungalur Kayal in the Taluk of Parur. Extreme length 9 miles and extreme breadth 5 miles; area 10 sq. miles. Has an outlet in the Cranganore bar which is always open.

The Sasthankotta Kayal in the Kunnattur Taluq.

The Vellani Kayal in the Neyyattinkara Taluq.

And lastly the Manakudi Kayal in the Taluq of Agastisvaram. This is a small lagoon formed by the course of the Pazhayar before it discharges itself by a narrow mouth.

As early as 1860 the great Victoria Ananta Martandan canal was projected for connecting Trivandrum with Cape Comorin; but it had to be abandoned owing to several obstacles, though considerable sums of money had been spent on it.

Coast Line. The Travancore coast has been surveyed by the Marine Department in connection with the Coast Survey of the Madras Presidency and the following is extracted from their report:—

"The Travancore coast, from Alleppey to Comorin, is generally low and sandy, fringed with cocoanut trees. Patches of red cliffs of slight elevation here and there break the otherwise continuous line of sand. The Travancore mountains, though generally spoken of by navigators as a part of the Western Ghats, are indeed separated from the latter by a low neck of land, the Palghat valley, which has proved a most useful feature in the railway communication between east and west coasts. The length of this southern mountain chain, extending from a few miles north of Cape Comorin to the valley of Palghat, is nearly 200 miles. The western brow, overlooking the coast of Travancore, is, with little exception, abrupt. On the eastern side of the culminating range the declivity is in general gradual, the surface in many places forming extensive table-land, sloping gently and nearly imperceptibly to the eastward. In the last half of the year many cascades of great height are visible from seaward, pouring down the steep declivity of these western ghats, which present so vast and lofty a front to the violence of the south-west monsoon. The principal peaks of the Travancore Ghats are: Mahendragherry between 3,000 and 4,000 feet, about 20 miles north of Comorin, and Cootchimulla, nearly 5,000 feet, the same distance north-east of Trivandrum. Between these peaks the culminating range has a north-westerly direction, but afterwards trends a little east of north, more away from the coast. Its highest mountains, though loftier, are not so often visible at sea. They form the boundary between the State of Travancore on the west, and the British province of Tinnevely on the east. To the east of Quilon there are broad, high

peaks, estimated at 5,000 feet above, and more than 30 miles from the sea. The southern portion of the Western Ghats, from Comorin to Palghat, run like a spine from south to north, thus forming the water-parting between the east and west coasts rivers. They are exposed to all winds from east, round by the south-west, and there is scarcely a day when rain-clouds may not be seen hiding for a time the summits of the high land. Towards the vernal equinox (after which the air gets saturated with moisture and is hazy) the ghats north of Quilon up to Calicut can seldom be seen. Midway between the ghats and the low sea-coast, the country has several hills of moderate elevation, useful as landmarks. Beginning from the south, mention may be made of the isolated conical mount, in lat. $8^{\circ} 8' N.$, and long. $73^{\circ} 30' E.$, near Cape Comorin, which is taken for the cape by seamen when approaching the coast from the west. The next conspicuous peak is Maravattoor, nearly midway between Mahendragherry and the Crocodile Rock, and 10 miles north-west of the conical mount. On the south-east of Trivandrum, and again to the north of that capital, hills, averaging about 400 feet, lie parallel to the shore, some 4 or 5 miles off. Near Anjengo there are a few low hills. Above this place extensive backwaters become the peculiar feature, overspreading great portions of the low tract of country. Vessels bound for any port on the west coast of Hindostan, and to the Persian Gulf during the north-east monsoon, from China, Australia, and the Bay of Bengal, or from Europe, should sight Ceylon, and make the coast of India somewhere near Cape Comorin, and thence hug the coast to profit by the land and sea breezes. The coast from Cape Comorin takes a general north-westerly direction for nearly 300 miles to Mount Dolly."*

Ports and shipping facilities.†—ALLEPPEY (lat. $29^{\circ} 48' N.$, and long. $76^{\circ} 18' 46'' E.$) is the principal seaport town of Travancore and the seat of the Commercial Agent. It is the chief depot of the Travancore Government for the sale of forest produce, chiefly cardamoms, and is a place of considerable foreign trade in teak, cocoanut, betel-nut, ginger, coffee, pepper and fish. Many European and American Firms have their representatives here and extensive industries are carried on. It is a safe roadstead all the year round being protected by a soft mud bank on which a vessel might ride at less risk than at any other part of the coast. A shoal bank of from 6 to 9 feet extends about $1\frac{1}{2}$ miles off shore. During the south-west monsoon, although the surf breaks on the shore to the north and the sea is white with foam outside, there is at Alleppey a large extent of smooth water, on the outer part of which a vessel might conveniently anchor in $4\frac{1}{2}$ fathoms and keep up a communication with the shore. In the fine season, a vessel not drawing more than 18 feet water may anchor in 4 fathoms or a trifle less, the bottom being soft mud. The anchorage in the roads during the south-west monsoon is with the lighthouse from N. E. to E. N., in 5 or 6 fathoms water. In the fair season from October to May, vessels may anchor in 3 or 4 fathoms with the lighthouse bearing

* The Madras Manual of Administration Vol. ii.

† The information under this head is chiefly based on the results of the Marine Survey above referred to.

E. by N., the soundings being very regular. During the south-west monsoon trade cannot sometimes be carried on with Cochin, but the port of Alleppey is always available. Alleppey has a flag-staff and near it is a lighthouse with a revolving white light attaining its greatest brilliancy every minute. The light is of the second order of the holophotal description elevated 100 feet above mean sea-level and is visible in ordinary weather 20 miles. It was first exhibited on the night of the 28th March 1862. Between Cochin and Alleppey the coast is very low, covered with trees, and may be approached to 6 fathoms in a large ship, the bank being very even to 5 fathoms, about 1 or 1½ miles from the shore.

PORACAD. (lat. 9° 91' 25" N., long. 76° 23' E.). This is a village of considerable extent, coir, plank and timber for ship-building and pepper being exported from here and the adjacent places. The port has declined since the opening of Alleppey port. There is an extensive mud bank here. Steamers call in the worst part of the monsoon weather, when Alleppey is closed. A portion of the village was formerly submerged in the sea and the eastern gate of the pagoda which escaped destruction at the time is still seen standing. The coast here continues low and uneven and is safe to approach to 5 or 6 fathoms. The anchorage is opposite the village in 5½ or 6 fathoms, 1½ or 2 miles distant.

QUILON. (lat. 8° 53½' N., long. 76° 34' E.). The coast between Alleppey and Quilon except near Tangasseri, is sandy and nearly straight, but 10 miles north of Quilon there is a slight indent which does not however amount to 1 mile from a straight line drawn between the two places. The shore is safe to approach into the depth of 5 fathoms mud.

During the early centuries of the Christian era Quilon was a very important port trading with China and Arabia. Throughout the middle ages it was one of the chief seats of the Saint Thomas Christians. In 1503, the Portuguese established a factory and fort which was captured by the Dutch 150 years later. A considerable British garrison was stationed here until 1832, when it was reduced to one regiment. Till 1829 it was the principal town and head-quarters of the Travancore Government. It has still considerable inland and foreign trade. As a port it is next in importance to Alleppey. Steamers and ships call here. It is the chief entrepot of ginger and pepper on the Malabar Coast.

The beach near Quilon is steep and sandy as far north as Tangasseri cove, where rocky coast begins and continues to the northward for 2 to 3 miles. Two buoys had been laid at Quilon to mark the safe passage

to the anchorage. Vessels for Quilon should keep well out until the large factory chimney (of the Scottish Indian Company) bears N. E., and steer direct for the chimney keeping between the buoys. The coast between them is low, covered with trees, and may be approached to 6 fathoms till near the entrance of Ivica river (Azhimukam). Quilon bank of hard ground extends from the bay round Quilon point, a projecting part of the coast, where it becomes uneven and dangerous to approach under 12 or 13 fathoms.

TANGASSERI. (lat. 8° 54' N., long. 76° 38' 15" E.). Originally there was a fort built on a head-land of laterite jutting into the sea, portions of the old wall of which are still visible, as also the ruins of an old Portuguese town. The Tangasseri reef, a bank of hard ground, extends 1½ miles to the south-west and 3 miles to the west of the Quilon point, and 6 miles along the coast to the northward. The bank should not be approached under 13 fathoms water by day, or 17 fathoms at night.

To the south-east of the reef the coast forms a bight, where ships may anchor off the town and military station of Quilon in 5 or 6 fathoms sand with Tangasseri flag-staff bearing N. W., 1 mile distant. From November to April shipping vessels can lie close inshore with safety. When approaching Quilon from the northward, vessels should not shoal to less than 13 fathoms, as, off Tangasseri point, the foul ground extends westward to within less a mile of this depth. The most convenient anchorage and where a vessel will be close to the Port Office, is with the chimney of the Coffee Company's factory bearing about N. E. at the extreme of Tangasseri point west-north-west in from 4½ to 5 fathoms sandy bottom. Off Quilon point, there are 20 fathoms at 5 miles offshore; but further to the north, that depth will be found farther from the coast. A lighthouse has recently been constructed here for the guidance of mariners.

ANJENGO. (lat. 8° 40' N., long. 76° 45' E.). Three miles to the southward of Quilon, the coast may be approached to 10 fathoms, which will be 1½ miles from the shore. Anjengo flag-staff is between 4 or 5 leagues to the west-north-west of Trivandrum Observatory. Anjengo was once a place of considerable importance and the earliest settlement of the late East India Company on the Malabar Coast, but now it has a forsaken appearance.

Four miles to the north of Anjengo there is a red table-land, which denotes the approach to it, in coming from the north. The anchorage off Anjengo, under 10 fathoms, is foul rocky ground; but outside of that

depth, the bottom is sand and shells. A convenient berth is with the flag-staff about N. E. by E. and Brinjaul hill (Mukkunnimala) about S. E. by E., in 11 or 12 fathoms mud, off shore 1 mile. A considerable surf, generally prevailing on the coast, particularly to the southward, renders it frequently unsafe for boats to land.

PUNTORA. Vessels communicating with Trivandrum should anchor off the coast here. There is a flag-staff on the sandy beach. It is 2 miles south-west of Trivandrum Fort. No boats should attempt communication with the shore when there is a heavy surf in the north-east monsoon. The coast is sandy with cocoanut and other palms. Vessels should anchor in 12 fathoms sand, $\frac{1}{2}$ a mile from the flag-staff bearing N. E. and nearly in line with the Trivandrum Observatory which is distinctly made out in passing by its three domes.

Passing Puntora we come to Covalam (Ruttera point), a piece of low level land, terminating in a bluff cape higher than the contiguous coast. The coast here is low abounding with trees. It is bold to approach, having 12 or 13 fathoms at a mile's distance, 25 or 26 fathoms about 2 or $2\frac{1}{2}$ leagues' distance.

VIZHINJAM. This is a small fishing village $7\frac{1}{2}$ miles to the east of Covalam, and is "formed of steep bold land, or reddish cliffs, considerably elevated, having on the northern side a small river and village (Puvar) at the northern extremity of the high land, that form the point." The coast hereabouts is all sandy and fronted with cocoanut trees. From this point the coast takes a direction about S. E. by E. to Cadiapatnam point distant 6 leagues.

COLACHEL. (lat. $8^{\circ} 10' N.$, and long. $77^{\circ} 14' E.$). This is a very ancient seaport. The Danes once had a factory here with a Commercial Resident. Its safe harbour was well known to ancients. It has trade with the coast and Ceylon. The coffee produced in South Travancore is exported from here. The outlying rocks form a partial breakwater, within which landing is comparatively easy. Ships of good size can sail between some of the outlying rocks and ride at anchor to leeward of them in smooth water. It has a flag-staff, and a buoy which is used during the shipping season to mark the vicinity of a dangerous rock.

CADIAPATNAM POINT. (lat. $8^{\circ} 7\frac{1}{2}' N.$, and long. $77^{\circ} 18' E.$). This is 14 miles from Cape Comorin. A first order dioptric fixed whitelight, intended to mark the vicinity of the Crocodile rock, is exhibited here. It is visible 20 miles in clear weather. The column is 80 feet

high and is built of granite and its focal plane is 135 feet above sea level. A heavy surf prevails all along the part of the coast, between Comorin and Cadiapatnam. Only catamarans are used by the natives and no ships' boats attempt landing. To the south-west of this point there are two rocky islets, about $1\frac{1}{2}$ miles from each other and distant 1 and $2\frac{1}{2}$ miles from the point, surrounded by rocks under water and foul ground.

The Crocodile Rock lies south-west at a distance of about 3 miles. A part of this appears above water sometimes; but it does not break at all times nor is it visible at high water when the sea is smooth. At night it should not be approached under 25 fathoms water. In passing between these rocks and Covalam from 22 to 26 fathoms, is a good track with the land wind. The coast may be approached to 18 or 20 fathoms occasionally. The coast from here as far as Cape Comorin is low and sandy close to the sea, rising in a gentle acclivity to the base of the mountains situated a few miles inland.

MANAKUDI. (lat. $8^{\circ} 5' N.$, and long. $77^{\circ} 32' E.$). This is a village port about 4 miles to the west of the Cape and stands on the edge of the lake of the same name.

CAPE COMORIN. (lat. $8^{\circ} 5' N.$, long. $77^{\circ} 36' E.$). This, the southern extremity of Hindustan, is a low Cape with two bare rocks beyond the point. On the mainland at the water's edge is a Hindu Pagoda, a low square white-washed building, and beside the temple is the village of Kanyakumari. West of the temple stands the Residency. The shore to the west of it is bare of vegetation but to the east it is wooded. About a mile from the Cape and beyond the fishing village, a sandy spit ending in a line of rocks runs out into the sea, and beyond this point is an anchorage with sandy bottom to which native crafts run for shelter when the weather hinders them from rounding the Cape. As the south-west monsoon at this locality blows from the north-west, this anchorage is sheltered. Ships anchor bearing N. E. of the rocks that are off Cape Comorin and S. W. of the Vattakotta Fort, a conspicuous stone fort on the beach. The Government of India have been moved to make a Hydrographic Survey of this anchorage and the Travancore Government have located a customhouse on the shore and have constructed a road to the spot. A port has recently been opened under the name of the Sri Mulapuram Port.

Among other ports may be mentioned, Rajakamangalam, Muttam

(where there is a lighthouse built on a head-land at an elevation of 105 feet above sea-level), Tēngapatnam, Puvar, Paravur, Munampam and Kottur.

SECTION B.—GEOLOGY.

Geology proper.—Travancore owes its shape to the erosion of the old crystalline rocks which has taken place on a most gigantic scale. Dr. King points out the quasi-terraced arrangement the country shows, descending by steps, as it were, from the mountains to the coast. This terrace arrangement is much less well-marked in South Travancore than further to the north-west. The several terrace steps are marked by the existence of some ridges near the coast higher than the general surface of the country further inland. The most conspicuous of these is a considerable mountain pass lying north and north-east of the old Fort of Udayagiri.

In the northern part of the country, the mountain mass is very broad, but just south of Peermade, the hilly backbone narrows considerably and becomes a lengthened series of more or less parallel ridges with lower and lower intermediate valleys. The real southern termination of the Ghauts occurs in latitude $8^{\circ} 15' N.$, where the high mountains sink down into the Aramboly Pass. Southward of the pass rises the perfectly detached Kattadimala, a fine rocky mass 2,000 to 3,000 feet high, which sends off a rocky spur extending southwards with two breaks, for a distance of 7 or 8 miles and terminating in the bold Marutwa hill, 4 miles north-west of Cape Comorin. The cape itself consists of low gneiss rocks, backed up by a palm-grown sand hill, about 100 feet high. A pair of very small rocky islands rise out of the sea a few hundred yards east of the Cape, and various other rocks occur off the coast opposite Muttam, Colachel and Melmadalatora which are the culminating points of reefs formed by ridges of gneiss running parallel with the coast. These rocks, especially one called the Crocodile Rock, were sources of great danger to the coasting ships but the danger has now been removed by the erection of a lighthouse on the Muttam headland. At Colachel, the seaport of South

NOTE:—A regular and systematic Geological Survey of Travancore has yet to be undertaken. But in connection with the operations of the Geological Survey of India, Dr. W. King and Mr. R. Bruce Foote have closely examined the country and their observations have been largely utilised in the writing of this Section.

Travancore, the lie of the rocks is such that it would be easy to connect them by short rubble breakwaters and thus to form a very useful little harbour in which coasting craft could easily lie up during the south-west monsoon.

A broken band of younger rocks occupies a very great part of the tract lying between the coast and the Trivandrum-Tinnevely high road. There can be no doubt that these rocks, not very long since geologically speaking, formed an unbroken belt which extended considerably further inland than at present. The denudation they have undergone has been very great, both vertically and laterally, and the remnants left of them are in various places of such trifling thickness that all traces of their former existence will soon be effaced. They show most in the western part of South Travancore where they form small plateaus, which are well marked except to the north, on which side they lap on to the rising surface of the gneiss and thin out or are lost sight of in the Kabuk or pseudo-laterite formation—a rock resulting from the decomposition of ferruginous beds of gneiss. The surface of the plateaus, where not greatly eroded, is gently undulating and often supports a very dense and varied vegetation. The less compact portions of plateau surfaces are often cut into small, but very deep, rain gullies which render many places impassable for any but foot passengers.

The various geological formations to be found in Travancore may, for convenience of reference, be arranged in a tabular scheme as below:—

Recent.	Blown sands: the red (teris) and the white (coast dunes).
	Soils: Kankar deposits: ferruginous breccias (lateritic).
	Marine and estuarine beds.
Tertiary.	Sands and clays: the Quilon beds which are supposed to be of eocene age; overlapping these lie the Varkala beds which perhaps belong to the upper tertiary age (Cuddalore sandstone).
Azoic.	Gneissic Series.

The Gneissic Series. “The gneisses are generally of the massive grey section of the series, that is, they are nearest to the rocks of the Nilgiris, though they differ from them in being coarse-grained or more largely crystallized, and in being generally quartzose rocks. So quartzose are they, that there are, locally, frequent thin beds of nearly pure quartz rock which are at times very like reefs of vein-quartz. Often these beds are strongly felspathic, the felspar occurring among the quartz in distinguishable grains or larger crystalline masses, giving the rock rather a granitic appearance. The only other region where I know of somewhat similar beds of quartz rock occurring with other gneisses is in the schistose region of the Nellore District. There, however, the quartz rock becomes often a fine compact quartzite; here in Travancore, there are no approaches to such compact forms.

"The common gneisses are felspathic quartzose varieties of white or grey colours, very largely charged with garnets. A particular form of them is an exceedingly tough, but largely crystallized, dark-grey or greenish felspathic rock. Massive horn-blendic gneisses are not common. Indeed horn-blende may be said to be a comparatively rare constituent of the Travancore gneisses.

"All the gneisses are more or less charged with titaniferous iron in minute grains; they are likewise—only more visibly—as a rule, highly garnetiferous. In fact, one might say that Travancore is essentially a country of garnetiferous gneisses. The garnets themselves are only locally obtainable, it being impossible to break them from the living rock while they are generally decomposed or weathered. They are generally of small size, but are very rich in colour, the precious garnet being very common. Other minerals such as red, blue and yellow sapphire and jacinth; are found among the garnet sands so common on the seashore at certain places. The sea-sands are also full of titaniferous iron grain. I may instance the beautiful and long known constitution of the shore sands at Cape Comorin where, on the beach, may be seen the strongest coloured streaks or ribbons, of good width, of bright, scarlet, black, purple, yellow and white sands of all these minerals and the ordinary silica.

"The general lie of the gneisses is in two or three parallel folds striking west-north-west to east-south-east. There is, perhaps, rather a tendency of the strike more to the northward in the broad part of the hills about Peermad, and on towards the Cochin territory. Thus between Trivandrum and Tinnevely on the west coast or for some twelve to twenty miles inland, the dip is high to the south-south-west inland of the terraced or plateau country, or among the first parallel ridges there is a north-north-east dip; then, on the mountain zone, there is again a high dip generally to the south-south-west. Thus the inclination of the beds is generally high, right across the strike with a crushed-up condition of the folds; but they are often at a low angle, and the anticlinal on the western, the synclinal on the eastern, side are plainly distinguishable. About Kurtallam (Courtallum), on the Tinnevely side, the rise up from the synclinal is very well displayed, and in their strike west-north-westward into a broad mountain land, the beds of this place clearly take part in a further great anticlinal which is displayed in a great flat arch of the Peermad strata. With this widening out of the mountain mass there is rather an easier lie of the strata. Southwards from the Ariankow traverse there is much crushing up of the beds; but they roll out flatter again towards the southern extremity, and there are good indications of a further synclinal to the south-south-west in the northerly low-dipping beds of Cape Comorin.

"Foliation is very strongly developed: indeed it is here, practically, bedding and lamination, of which there are some wonderful exhibitions. At Cape Comorin, indeed, some of the gneiss in its weathered condition (not lateritized) is scarcely to be distinguished, at first, from good thick-bedded and laminated sandstones and flaggy sandstones.

"There is no special development of igneous rocks either in the way of granites or greenstones, though small veins and dykes are common, generally running nearly with the strike of the gneiss. In South Travancore, or north of the parallel of Trivandrum, there are stronger occurrences of granite in which mica is abundant and in largish masses.

"The great feature about the gneisses in Travancore and indeed also in Cochin and Malabar, is their extraordinary tendency to weather or decompose, generally

into white, yellow, or reddish felspathic clayey rocks, which, in many places and often very extensively, ultimately become what is here always called *laterite*.Very soon after one begins to leave the higher ribs of the mountains and to enter on the first long slopes leading down to the low country, the gneiss begins to be weathered for some depth into a clayey rock, generally of pale colours, streaked and veined with ferruginous matter, and having always an appreciable upper surface of scabrous or pisolitic brown iron clay, which is, of course, probably largely the result of ferruginous wash, and less so, of ferruginous infiltration. Also the ferruginous and lateritoid character is devolved to a certain extent according to the composition of the gneisses; but, on the whole, there is no doubt that the upper surface generally over large areas is lateritized to a certain depth irrespective of the varying constitution of the strata. Then as the rocks are followed or crossed westward the alteration becomes more frequent, decided, and deeper-seated; though still, all over the field, ridges, humps, and bosses of the living rock rise up from the surrounding more or less decomposed low-lying rock areas.

"This generally irregular and fitfully altered condition of the gneisses begins at an elevation of about four hundred feet above the sea, and thus it extends as a sort of fringe of varying width along the low slopes of the mountains. At a yet lower level, say from two hundred to one hundred and fifty feet, and so nearer the sea coast, there is a better defined belt of more decidedly lateritized form of weathered gneiss, in which the unaltered rock occurs less frequently, and then always in more or less flatly rounded humps and masses, which never rise above a general dead level. This belt is, in fact, a country of undulating downs or tolerably uniform level stretches of forest land. Occasionally, it also shows a plateau surface or it is broken into small and low flat-topped hills. Always it is very deeply indented by river or stream valleys, or even by some of the backwaters which have high and steep shores.

"It is remarkable of this coastal belt of country that its laterite (an altered or ferruginously infiltrated condition of weathered or decomposed gneiss) is not to be distinguished from any other laterite, except that which is made up of obviously detrital material. Whatever the laterite of Travancore or Malabar may have been originally, it is a useless form of the rock, being crumbly and soft as a general rule, and oftener of a red colour than brown. The character of the climate does, in fact, appear to militate against the changing of the red peroxide of iron in the rock to the brown peroxide, during which change the proper cementing and hardening of the sound rock, such as that on the east coast or in the Deccan is evidently brought about."*

Regarding South Travancore, Mr. Bruce Foote writes:—

"In no part of the peninsula, is there a greater and finer display of the ancient crystalline rocks than in the southern Ghats in their southern half, and in the great spurs and outlying masses on their western or southern side. The disposition of the beds in South Travancore shows the existence of a great synclinal curve, probably an ellipse, the major axis of which passes through or very near to the great mass of Mahendragiri; while the north-western focus (if the ellipse be a complete one) will be found somewhere to the north-eastward of Allepy. I had inferred the existence of this great synclinal ellipse from studying the course of the great gneiss beds on the eastern foot and flanks of the mountains southward of Courtallum, and Mr. King's examination of the gneiss

* General Sketch of the Geology of Travancore, W. King D. A., D. Sc. — Records of the Geological Survey of India, Vol. XV.

country across the Shencotta pass and southward to Travancore independently demonstrated the existence of the central part of this huge synclinal fold. The topographical shape of the ground points strongly to the fold being a true ellipse, the extreme north-western extremity of which is probably hidden under the alluvial bed north of Allepy, while the extreme south-eastern apex lies most likely in the sea to the E. N. E. of Cape Comorin. The curve of the coast from Cape Comorin north-westward to close up to Trivandrum coincides with the south side of the great synclinal, and the different ridges inland also coincide absolutely with the strike of the harder beds of the series. Several southerly dips were noted in the rocks on the coast westward of Kolachel which looks as if the axis of an anticlinal had there been exposed, but they may possibly only represent trifling vandyke-shaped bends or crumples, in the side of the great synclinal. To the north of the area under consideration the rocks roll over northward into a great anticlinal fold.

"The true bedding of the gneiss on a large scale is extremely well displayed in the great outlying mass known as the Udagiri or 'Muroovattoor' mountain. Both strike and dip are admirably seen from the Travellers' bungalow at Nagar-koil. One of the finest examples of a sheer naked wall of rock to be seen in Southern India is shown in the tremendous cliff forming the south-east front of the Thiruvana Malai, the great eastern spur of Mahendragiri. This bare precipice must be fully 2,000 feet or more in height, many hundred feet in the central part being absolutely vertical, or even overhanging a little. As might be expected, this great mass has attracted much notice; it forms the Cape Comorin of some sailors, and of Daniel's famous view of that Cape, though in reality some 16 miles from the nearest point on the coast and 28 miles from the Cape itself. Even the Hindu mind has connected this noble mountain with the name of Hanuman, the famous monkey God, who is said to have planted one foot on each of the two peaks and to have jumped across the Gulf of Mannar and alighted on Adam's Peak, a standing jump of 220 miles and odd being a trifle for the long-tailed divinity. Another grand precipice occurs on the south-east face of the Taduga Malai at the western end of the Arambuli Pass. The cliff-faces in both these splendid scarps coincide with the great planes of jointing.

"The predominant character of the gneiss rocks in this quarter is that of well-bedded, massive, quartzo-felspathic granite gneiss, with a very variable quantity of (generally black) mica and very numerous small red or pinkish garnets. This is the characteristic rock at Cape Comorin and very generally throughout South Travancore, and Tinnevely District as well.

"Scattered grains of magnetic iron are commonly met with in the weathered rocks. No beds of magnetic iron were noted by me, but some may very likely occur, and would go far to account for the numerous quantity of black magnetite sand cast up on the beach at frequent intervals along the coast and of which the source is at present unknown, unless it has been brought by the south-westerly current prevailing during the south-west monsoon. The source of the garnets which form the crimson sand which is of nearly equally common occurrence, is not far to seek, for it is hardly possible to find a bed of rock which does not abound in garnets. The so called 'fossil-rice' found at the extreme point of land close to the Cape is merely a local variation of the quartz grains set free by degradation of the rock. They assume the 'rice' shape after undergoing partial trituration in the heavy surf which beats incessantly on the southern coast.

"The sub-aerial decomposition of the felspatho-ferruginous varieties of the gneiss produces in the presence of much iron a pseudo-laterite

rock very largely developed over the gneissic area described by Dr. King in his Sketch of the Geology of Travancore under the name of lateritised gneiss, a rock which is popularly called laterite in Travancore and Kabuk in Ceylon. In numberless places this peculiar decomposition of the gneiss, which is preeminently characteristic of very moist climates, has altered the rock *in situ* to variable but often considerable depths, and the original quartz laminae of the gneiss remain in their pristine position, and often to all appearance unaltered, enclosed in a ferruginous argillaceous mass formed by the alteration of the original felspar, mica, garnets and magnetic iron. The colour of this generally soft mass varies exceedingly from pale whitish pink to purple, red and many shades of reddish brown and brown, according to the percentage of iron and the degree of oxidation the iron has undergone. The bright colours are seen in the freshly exposed Kabuk or pseudo-laterite, but the mass becomes darker and mostly much harder as the hæmatite is converted into limonite by hydration, and more ferruginous matter is deposited, as very frequently happens, by infiltration. The pseudo-laterite formed by accumulation of decomposing argillo-ferruginous materials derived from distant points is to be distinguished generally by the absence of the quartz laminae as such. The quartz grains are generally much smaller, and are scattered generally through the whole mass of new-formed rock. One excellent example of the pseudo-laterite formed by the decomposition *in situ* is to be seen in a steep bank in the Zoological gardens in Trivandrum, close to the Tapir's den. Equally good examples are very common in many of the cuttings along the high road east of Trivandrum.

"The washed-down form of pseudo-laterite often forms a rock intermediate in character between a true sub-aerial deposit and a true sedimentary one, and consequently by no means easy to classify properly. In fact, in a country subject to such a tremendous rainfall, the sub-aerial rocks must, here and there, graduate into sedimentary ones through a form which may be called 'Pluvio-detrital.' Such pluvio-detrital forms occur very largely in South Travancore, but it is impossible in most cases to separate them from the true sedimentary formations they are in contact with."*

The Varkala or Cuddalore Sandstone Series.—To quote Dr. King again :—

"The next succeeding rock formations, namely, the Quilon and Warkilli beds, occur as a very small patch on the coast between the Quilon and Anjengo backwaters. The Quilon beds are only known through the researches of the late General Cullen who found them cropping out at the base of the low laterite cliffs edging the backwater of that place, and again in wells which he had dug or deepened for the purpose. I was myself not able to find a trace of them†. They are said to be argillaceous limestones, or a kind of dolomite in which a marine fauna of univalve shells having a eocene *facies* was found; and they occur at about forty feet below the laterite of Quilon, which is really the upper part of the next group.

"The Warkilli beds, on the other hand, are clearly seen in the cliffs edging the seashore some twelve miles south of Quilon, where they attain a thickness of about one hundred and eighty feet, and have the following succession in descending order :—

* Records of the Geological Survey of India, Vol. XVI.

† Mr. Logan says that these have since been satisfactorily identified as occurring at a place called Parappakkara on the Quilon backwater about 6½ miles north-east of the Residency.

Laterite (with sandstone masses).
 Sandy clays (lithomarge).
 Sandy clays (with sandstone bands).
 Alum clays.
 Lignite beds with logs of wood &c.).

"The bottom lignite beds rest on loose white sand, and nothing is known of any lower strata.

"It will be seen how this set of strata has an upper portion, or capping of laterite, which is however clearly detrital. On the landward edge of the field of those Warkilli beds, there is in places only a thin skin, representative of these upper beds, of lateritic grits and sandstones lying directly on the gneiss, which is itself also lateritized; and it is very hard as may be supposed, to distinguish the boundary between the two unless the detrital character of the former deposits is well displayed. Thus the upper part of the formation has overlapped the gneiss. It is also this upper portion which overlies the Quilon beds, which are also apparently overlapped.

"These Warkilli beds constitute, for so much of the coast, the seaward edge of the plateau or terraced country above described, and they present similar features. The Warkilli downs are a feature of the country—bare, grass-grown, long, flat undulations of laterite, with, about Warkilli itself, small plateau hills forming the higher ground—one hundred and eighty to two hundred feet above the sea. These downs, too, and the small plateaus or flat-topped hills, are partly of the Warkilli laterite and partly of the lateritoid gneiss.

"Whatever form of denudation may have produced the now much-worn terrace of the gneissic portion of the country, the same also had determined the general surface of the Warkilli beds. Indeed, it gradually dawned on me while surveying this country, having the remembrance of what I had seen of the plateaus and terraced low lands in Malabar in previous years, that here, clearly, on this western side of India is an old marine terrace which must be of later date than the Warkilli beds. These are, as I have endeavoured to show in another paper,* of probably upper tertiary age and equivalent of the Cuddalore sandstones of the Coromandel. Hence this terrace must be late tertiary or post-pliocene, and it marks, like the long stretches of laterite and sandstones on the eastern side of the country, the last great or decided elevation of Southern India, prior to which, as is very probable, the Indian land rose almost directly from the sea by its Western Ghats and had an eastern shore line which is now indicated very well by the inner edge of the Tanjore, South Arcot, Madras, Nellore and Godaveri belts of laterite and sandstone.

"Mr. Foote has already generalised in this way for the eastern side of Southern India in particular; but I think he makes the elevation too great, including, as he does in his laterite deposits, patches of the laterite gravels and rock masses ranging up to a height of five hundred feet at least which are not so definitely part and parcel of the proper coastal developments."

The following account of the Cuddalore Sandstone series, marine beds, blown sands, coral reefs and soils is extracted from the very exhaustive paper on The Geology of South Travancore by Mr. Bruce Foote from which we have already quoted:—

*The Warkilli beds and reported associated deposits at Quilon—Records of the Geological Survey of India, Vol. XV.

"A very careful examination of the beds near Quilon by Dr. King who had the advantage of seeing the fresh cuttings made through plateaus of these rocks in connection with the new tunnel at Warkilli has unfortunately thrown no positive light on their true geological position. The vegetable remains associated with lignite beds at base of the series proved insufficient to allow of determination of their own character and consequently most unsuitable to assist in settling the homotaxy of the strata they occurred in. The sedimentary beds forming the belt of small plateau fringing the coast of South Travancore must, on petrological grounds, be unhesitatingly regarded as extensions of the Quilon beds, or Warkilli beds of Dr. King. None of these formations which I traced from Villinjam, nine miles south-east of Trivandrum, down to Cape Comorin afforded the faintest trace of an organic body; thus no light was thrown on the question of the geological age or homotaxy, but somewhat similar sandstones and grits are found on the Tinnevely side of the extreme south end of the Ghauts range, and in a coarse gritty sandstone, much resembling some of the beds in Travancore, a bed of clay is intercalated, in which occur numerous specimens of *Arca rugosa* and *Cytherea* of a living species. The locality where these fossils of recent species were found occurs on the right bank of the Nambi-ar, about two miles above its mouth and a few hundred yards from the bank of the main stream. All the sub-fossil shells I found here are of living species; hence the deposits enclosing them cannot be regarded as tertiary; and if the agreement of these Nambi-ar beds with the Warkilli and South Travancore beds, on the one hand, and the Cuddalore, Madras, and Rajamundry beds be assumed, as they must be on petrological grounds, the Cuddalore sandstones and their equivalents elsewhere must be accepted as of post-tertiary age. As far as it goes the evidence is clear and distinct; but more evidence is required as to the age of some of the intermediate connecting beds, such as those south and east of Kudankulam.

"The typical section of the Warkilli Rocks near Quilon, given by Dr. King shows the following series:—

Laterite	...	...	...	30 to 40 feet.
Sands and sandy clays or lithomarge				58 "
Alum clays	...	...	...	25 "
Lignite beds	...	...	...	7 to 15 "
Sands ...	...	...	...	" " "
Total ...				120 — 138 "

with which we may compare the series seen in the fine section formed by the beautiful cliffs in Karruchel bay, 11 miles south-east of Trivandrum.

"The section here exposed shows the following series of formations:—

4. Soil—dark red, sandy loam, lateritic at base—8 to 10 feet.
3. Sandstone—hard, gritty, purplish or blackish—?
2. Sandstone—gritty, rather soft, false-bedded, often clayey in parts (lithomargic), variegated; in colour red, reddish brown purplish white yellow—40 to 50 feet.
1. Sandstone—gritty, rather soft, false-bedded, red, purple, pink, white, variegated; shows many white clay galls producing conglomeratic appearance in section—40 feet.

Base not seen, hidden by sandy beach.

"The total thickness of these beds I estimated at about 100 feet; the upper

part is obscure, from pluvial action washing down the red soil over the dark grits. The middle and lower parts of the section are extremely distinct, and the colouring of the beds very vivid and beautiful; but the beds are by no means sharply defined.

"The beds dip north-easterly (inland), and from the slope of the ground on the top of the cliff the angle of dip may be inferred to be from 25° to 30° . Further inland, near Pinnacolum, the dark gritty sandstones lie horizontally at a considerably lower level than at the top of the Karruchel cliffs, but rise again to the eastward. The middle gritty series is exposed along the western side of the Karruchel lagoon, but is highly lateritised by weather action. Three miles or so to the north of the lagoon, purplish gritty beds show strongly and form a small well-marked plateau overlooking the valley in which lies the village of Cottukal. That the gritty beds are sometimes replaced by clays is shown by the materials turned out of two deep wells sunk into the plateau at two points several miles apart; one of these wells lies rather more than half a mile to the northward of Mullur. Here the section, which is from 80 to 100 feet deep passes through mottled gritty sandstone and into blue and white mottled clay. The other section revealing clays below the gritty beds is a well sunk close to the new road from Valrampur to Puvar.

"A section in the low cliff forming the small bay immediately east of Villinjam shows a mottled vermiculated clayey rock showing mostly no bedding at all. Traces of bedding are, however, revealed as the cliff is followed southward by the appearance of thin bands of grit near the base of the section which rests on the underlined quartzo-felspathic garnetiferous gneiss. This mottled clayey rock I believe to represent the bluish white mottled clay turned out of the lower parts of the well section near Mullur before referred to. It is locally considerably discoloured and stained by the percolation of water through the overlying pseudo-lateritic dark-red sand. As will be seen by any one who follows the coast line these Warkilli sandstones rest upon a very rugged and broken gneiss surface. Many great tors and knolls of granite gneiss protrude through the sandstone plateau or tower over them from adjacent higher ridges, which have been completely denuded of the younger rocks.

"The greater part of the surface of the tract occupied by these Warkilli beds west of the Neyar is thickly covered by sandy loam, generally of dark red colour, which conceals the sub-rock very effectually, excepting where the loam is deeply eroded. A well marked patch of purplish grit forms a knoll, about a mile south-west of Valrampur. Traces of the former more easterly extension of these beds are to be seen at intervals along and to the north of the Trivandrum-Tinnevely road between Valrampur and Neyatankarai.

"In the tract lying east of the Neyar few sections exhibiting the grits &c., were met with, and all were small and unsatisfactory. The surface of the country is either largely covered with the deep red soil or else the extremely broken surface of the gritty beds is extensively lateritised. The appearance of the country, when seen from elevated points is, however, characteristically very different from the gneiss and Kabuk tract lying to the northward. This may be well seen from Colatoor Trigonometrical station hill, as also from the high ground close to Cauracode, but yet more striking from the Kodalam Pothai, a hill 2 miles west-north-west of Paurashalay. Sections in which the fine character of the rock is to be seen occur on the high ground close to the junction of the new roads leading from Puvar and Martanda Putentorai respectively to Paurashalay, also to the southward near Shoolaul, where a large rain gully cuts deeply into the grits and underlying clayey beds; also along the ridge of high ground north and

north-east of Yeldasaput. Traces of the former eastward extension of the grits were noted on the eastern flank of the Kodalam Pothai and on high ground half a mile or so to the northward of the Cutcherry at Paurashalay. The beds composing this patch of Warkilli rocks have undergone greater superficial denudation than those in the Karruchel patch to the north-west.

"In the small patch lying east of the Kulitorai river some instructive sections of hard rock grits and underlying clayey grits of the usual, reddish, bluish, and white mottled colour are to be seen south of Killiur. Some of the sections show regular miniature 'canons' 15' to 20' deep, with vertical sides and numerous well-formed pot-holes. Hard purplish grits show on the surface between Killiur and Pudukaddi and soft mottled grits in a well section close east of the D. P. W. bangalow at Tengapatnam. At the southernmost point of Killiur patch, the grits become coarsely conglomeratic over a small area. A little to the north of this the grits, when resting on the basset edge of a bed of granular quartz rock, present the characters of a perfect arkose, made up of the angular gneiss debris. In places this arkose might be most easily mistaken for a granitic rock.

"A distinctly conglomeratic character is shown by the grit beds close to Madalam. This Madalam patch of Warkilli sandstones is on its southern side deeply cut into by a gully which exposes regular cliffs with from 35 to 40 feet of coarse or conglomeratic mottled grits, capped by thick red soil. The grits contain many large clay galls and lumps of blue or mottled colour.

"In the Kolachel patch the grits are extremely well exposed in deep cuttings (miniature canons) made by the stream rising just west of Neyur. They are of the usual mottled description. Where seen at the eastern side of the patch near the Eranil Cutcherry they are quite conglomeratic. They are exposed also in a gully crossing the road which runs north from Kolachel to join the main road, and in a well section on the high ground a mile north-eastward of the little town. The south-eastern part of the patch is entirely obscured by a great thickness of dark red soil. They peep out, however, below the red soil at the western end of the great tank 3 miles south of Eranil.

"A very thin bed of conglomeratic grit underlies the teri, or red sand-hill, capping the high ground north of the Muttum headland. Further east a few poor sections only of whitish or mottled grit prove the extension of the Warkilli beds in that direction, nor are they well seen again till close into Kotar, where they show in various wells and tanks, but are still better seen in a deep rain gully south of the Travellers' bangalow at Nagarkoil and in a broad cutting immediately to the east of the bangalow. The variegated gritty sandstones here seen are very characteristic, and strongly resemble some of the typical varieties in South Arcot and Madras districts.

"To the south of Kotar the grits are to be seen in stream beds opening to the Purrakay tank, and in a series of deep rain gullies on the eastern slope of a large red soil plateau to the south-west of Purrakay.

"A small patch of gritty sandstones of similar character to the above occurs immediately north and north-west of Cape Comorin. As a rule, they are badly exposed, being much masked by the red blown sand of a small teri. The most accessible section is a small one seen in the bottom of a good sized bowrie, a little south of the junction of the roads coming from Trevandrum and Palam-cotta. This section can only be seen when the water in the bowrie is low. A considerable spread of similar greyish or slightly mottled grits is exposed about half a mile to the north-east of Covacolum and $1\frac{1}{2}$ miles north-west of the Cape. Lying between the two exposures just mentioned,

but separated from either by spreads of blown sand, is a different looking vermiculated mottled grit of much softer character. This is extensively exposed in the banks of a nullah and head water gullies falling into the Agusteshwar. The colour of this soft grit ranges from red, through buff to whitish. The beds roll to the northward. This grit is full of vermicular cavities filled with white or reddish Kankar (impure carbonate of lime). The grit seems to graduate upward into a thick red gritty soil full of small whitish red, impure (gritty) calcareous concretions. There is good reason, however, for thinking that this graduation is merely apparent, and that the red gritty soil is only the base of a red sand-hill, or *teri*, undergoing change by percolation of calciferous water. A hard brown grit is exposed for a few square yards just north of the junction of the two roads above referred to. This rock has, except in colours, considerable resemblance to the red-white grit just described, and both probably overlie the pale mottled grits near Covacolum.

"The last patch of grits to be mentioned forms almost the extreme easterly angle of the Travancore territory and lies to the eastward of the southernmost group of hills and along its base. Not many sections of the grit are here exposed owing to a thick red soil formation which laps round the base of the hills, and is only cut through here and there by a deep rain gully or a well. The grits here seen are like those exposed near the Travellers' bungalow at Nagarkoil; but show much more bedding and are almost shaly in parts. The colour of the grit is white, pale drab or grey mottled with red and brown in various shades. They lie in depressions in the gneiss, and were either always of much less importance and thickness than the beds to the west, or else have been denuded to a far greater extent. They are best seen in gullies to the south-west and west of Russhun Kristnapur, 7 miles north of Cape Comorin, and in the beds of the small nullahs west and north-west of Comaravarum opposite the mouth of the Arambuli pass. None of these Warkilli grit beds occurring between Trevandrum and Cape Comorin have yielded any organic remains as far as my research has gone, and I fear none will be obtained by subsequent explorers. The alum shales occurring in Dr. King's Warkilli section have not been traced in South Travancore, and I had not the good fortune to come across any lignite. It is said to occur not unfrequently to the south of Kolachel, and to be turned up by the people when ploughing their fields. I have no reason to doubt this, for it is extremely probable that some of the clayey beds should contain lignite. From the configuration of the ground, too, the paddy flat along the southern boundary of the Kolachel grit patch would coincide in position with some of the clayey beds near the base of the series which are lignitiferous at Warkilli; and why not at Kolachel?

"The recent discovery of lignite in the Cuddalore sandstones at Pondicherry adds greatly to the probability of the correctness of Dr. King's and my conclusion (arrived at by us separately and independently before we had an opportunity of comparing notes) that this gritty bed in Tinnevely and Travancore should be regarded on the grounds of petrological resemblance and identity of geographical position as equivalents of the Cuddalore sandstones of the Coromandel Coast.

Marine Beds.—"At Cape Comorin and two other places along the coast to the northward are formations of small extent but very considerable interest, which, by their mineral constitution and by the abundance of fossil marine shells they enclose, show themselves to be of marine origin, and thus prove that the coast line of the Peninsula has undergone some little upheaval since they were deposited. These beds are to be seen close to the Cape at the base of a small cliff which occurs immediately south of the Residency bungalow and only about two hundred yards west of the Cape itself. The rocks seen in

the surf and immediately behind it on the beach are all gneiss. The base of the small cliff is composed of friable gritty calcareous sandstone, full of comminuted shells. The base was not exposed at the time I examined the section, some heavy gale having piled up the beach sand against the foot of the cliff, and for this reason it was impossible to trace the probable connection of the sandstone with another exposed at a slightly lower level at a few yards distance to the west. This lower bed is similar in mineral character, but very hard and tough, and offers great resistance to the surf but has nevertheless been deeply honeycombed and in places quite undermined. The roofs of the miniature caves thus formed have in some cases fallen in, but have been partly re-cemented by deposition of the calcareous matter in the lines of fracture. To return to the cliff section, the basement sandstone is overlaid by a similar but slightly harder yellowish friable bed, which contains many unbroken shells (all of living species), in addition to a great quantity of comminuted ones. The base of the lower bed is hidden by sands, but from the proximity of the gneiss it cannot exceed 5 or 6 feet in thickness, while the overlying shelly bed measures about the same. It is overlaid in its turn by a massive bed, 6 to 10 feet thick locally, of a kind of travertine formed of altered blown sand, composed mainly of fully comminuted shells. This travertine contains immense numbers of shells and casts of *Helix vittata*, the commonest land shell in the south. Owing to the soft character of the marine sandstones, the cliff has been much undermined by the tremendous surf which breaks on this coast in bad weather, and great masses of the hard travertine of the *Helix* bed have fallen on to the beach, forming a partial breakwater against the inroads of the sea.

"The shells contained in the upper sandstone bed were all found to be of living species, where sufficiently well preserved for specific identification; the majority of the specimens are too ill preserved for specific identification. Four miles north-north-east from the Cape, stands the little stone-built fort of Wattakotai, which is built upon a small patch of calcareous sandstone, full of marine shells, exposed in the most along the north face of the long curtain wall which joins Wattakotai fort with the extensive series of fortifications known as 'Travancore lines'. The marine limestone may be traced for nearly half a mile inland in the bottom of the moat. This marine bed is overlaid by a very thin bed of travertine limestone full of *Helix vittata*; it has been cut through in the formation of the moat. The thickness of the shelly marine bed is unknown, but the *Helix* bed is not seen to exceed 10" or 1' in thickness. As far as seen in the very small exposure, both formations lie nearly horizontally. Another small exposure of the marine bed occurs at the western end of a little backwater to the north of the fort. The sandstone here contains many well-preserved marine shells, all of living species; but further west, where the bed is exposed below the *Helix* bed in the moat, the enclosed shells are all broken and comminuted. The surface of sandstone, as seen at the end of the little backwater, is raised but a very little distance above the sea-level, probably not more than 4 or 5 feet at the outside. The rise of the ground along the moat is extremely small, and even at the furthest point from the sea at which the sandstones are exposed the elevation is probably not more than 10 or 12 feet at most, which would correspond with the top of the sandstones as seen in the little cliff at Cape Comorin.

"About two miles north-east-by-north of Wattakotai fort a small patch of white shelly limestone occurs peeping out of the low belt of blown sand which fringes the coast at that spot. The village of Kannakapur which lies immediately to the north is the last within the Travancore boundary. The limestone only

stands out a few inches above the surface of the surrounding sands, and no section could be found to show its thickness, but in point of elevation above the sea-level it agrees perfectly with the Waitakotai and Cape Comorin beds. The limestone which is fairly hard is quarried for economic purposes, and unless a good deal more of the bed than now meets the eye remains hidden under the sands, it will, before many years are over, have been removed by human agency.

"The shell remains occur as impressions and casts of great beauty and perfectness, but the shelly matter has disappeared entirely, being probably slightly more soluble than the enclosing limestone. The limestone contains a large number of specimens of *Helix vittata* which were evidently carried out to sea and there entombed in a shallow water formation. To any one who has noticed the enormous numbers of this *Helix* living in this neighbourhood, and in the southern districts generally, the large numbers of it occurring fossil in this maine bed will be a matter of no surprise.

Blown Sands.—"Two very marked varieties of Æolian rocks occur along or near the coast of South Travancore, as well as along that of Tinnevely. They are the red sands, forming the well-known teris of Tinnevely, where they are developed on a far larger scale, and the white sands forming the coast dunes. In South Travancore, as far as my observation went, the red sand hills are no longer forming; all are undergoing the process of degradation by atmospheric agencies at various rates of speed. The red sands have in many places ceased to yield to the influence of the winds and have arrived at a condition of fixity and compaction caused by the action of rain falling upon the loose sands percolating through them and during heavy showers flowing over their surfaces and washing the lighter clayey and smaller, though heavier, ferruginous particles down the slopes of the hills or into hollows on the surface, where, on drying, a fairly hard, often slightly glazed, surface of dark red loam has been formed. This loam is very fairly fertile and soon becomes covered with vegetation, which further tends to bind the mass together and render the surface secure from wind action. The loose sand, deprived of the clayey and finer ferruginous particles, would, unless unusually coarse in grain, be carried off by high winds elsewhere or remain in barren patches on the surface. I believe this process has gone on extensively over many parts of South Travancore, and explains the existence, on the surface of the country and resting indiscriminately on the gneiss and the younger rocks as the Warkilli sandstone, of the great thick sheets of pure red loam which have not been brought there by ordinary aqueous deposition nor formed *in situ* by the decomposition of the underlying rocks. The percolation of the rain water through the mass has in many places given rise to the formation of concretionary ferruginous masses, which are often strongly lateritoid in their aspect. The quantity of clayey matter and of iron ore in the form of magnetic iron is very great in the sand of many of the teris. The greater quantity of the water falling on the teris, as on their blown sand surfaces, escapes by percolation, and it is a common phenomenon to find springs issuing around the foot of the sand mass during the rainy season and becoming dry in the hot or rainless season.

"The teris in South Travancore which still retain their character as accumulations of moving red sands are four in number and all very small, the largest not measuring one sq. mile in area. They are all close to the coast and with one exception stand high and conspicuous to ships passing along at a fair distance. The largest and most conspicuous is that at Muttum which caps the high ground with a new lighthouse. The process of fixation has gone on here largely and the moving sands cover a much smaller space than does the fixed portion. The same may be said of the teri resting on the south-eastern extremity of the Kolachel sandstone plateau. To the north-west of Kolachel are two much smaller

teris at the distance of 3 and $5\frac{1}{2}$ miles respectively. In both of these also the area of the fixed sand far exceeds that of the loose. Especially is this the case in the more northerly teri near Melmadalathorai. Here the fixed part has undergone tremendous erosion and is traversed by long and deep rain gullies, with vertical sides up to 20 or 25 feet high. Gullies on a yet larger scale are to be seen at the south-east corner of the Kolachel sandstone patch and at the eastern side of the Muttum patch. Very large but shallower gullies are to be seen at the south-east corner of the Nagarkoil patch, where there is a very large fixed teri.

"The small teri immediately behind the Cape Comorin is a very poor specimen of its kind, and, in fact, hardly deserves to rank as one owing to its pale colour and poverty in iron sand, but it will not do to class it as a Coast dune, as it consists mainly of silicious sand, while the true dune at the Cape consists mainly of calcareous sand composed of comminuted shells, corallines, nullipores &c.

"The sand of the typical teris is silicious or ferruginous (magnetic iron), the former being well rounded and coated with a film of red-oxide of iron, which is removable by boiling in Nitric acid for a few seconds. Common as garnet sand is on the beaches of South Travancore, I never yet found a grain of it in the teri sand, where the latter was pure and had not been mixed with beach sand.

"The coast dunes of South Travancore are, except close to the Cape, in no way remarkable. A large patch of small hillocks to the north-west of the mouth of the Kulitorai river was caused by the wind shifting a great mass of sand turned out when the new canal was dug and heaped up on the north bank of the canal.

"Some tolerably high ridges occur three miles south-west of Kolachel. The sand here contains so much fine magnetic iron that it looks in parts of a dark grey colour, shading here and there almost into absolute black.

"A considerable quantity of blown sand fringes the coast from the Muttum headland eastward to Cape Comorin, and between Pullum and Culladevella forms some considerable hills. At Covacolum the highly calcareous beach sand which forms many low hillocks has been solidified in several places into coarse shelly limestone. The *Helix* bed at Cape Comorin already referred to, when treating of the Marine beds, is really an altered sand dune, the calcareous matter of which has, by percolation of acidulated water, been dissolved and re-deposited, on evaporation of the water, as a sub-aerial travertine. Countless thousands of *Helix vittata* and a considerable number of shells of *Nanina tranquebarica*, the two commonest land shells in this part of India, have been enclosed and fossilised in the formation of this travertine, which is evidently in constant progress. The immense wealth of shell fish of all kinds, added to large quantities of corallines and nullipores, incessantly thrown up by the surf, furnishes an abundant supply of calcareous sand for the formation of this travertine, which forms a bank more than a mile long and rising some 80 feet or more above the sea at its highest point. Its inland extent cannot be ascertained, as it is covered by loose sands. It probably only extends 300 to 400 yards inland and abuts against a low ridge of gneiss.

Coral Reefs.—"A few tiny fringing reefs are to be seen half to three-fourths of a mile west of the Cape, half in the surf at low tide, and wholly in it at high tide. They are now to be considered as dead reefs, abandoned by the polypes that built them. I examined most of them carefully, without finding any live coral, and was inclined to doubt the correctness of my inference, drawn from their tabular shape and many shallow basin-like cavities; but later on, when

examining some identical fringing reefs off the Tinnevely coast to the south of Kudankulam Trigonometrical station (the south point of the Cape Comorin baseline), I found a considerable quantity of live coral lining the sides of the little basins and equally large quantities of coral quite recently dead in adjoining basins.

"A great deal of shell debris, sand and broken stone, is included in the mass of the reefs which in several places have formed around masses of rock standing in rather shallow water, and joined up many loose blocks of stone tossed on to them by the surf into tremendously coarse conglomerates. Some similar reefs but of rather larger size, occur along the coast to the north-east of Cape Comorin; in these the tabular mass extends from 10 to 40 and 50 feet in width, from the shore to the constantly surf-beaten outer edge. In one or two places parts of the reef had evidently been founded on sand, which had been washed away, leaving an unsupported surface of many square yards in extent which the surf of the next high tide or first gale of wind would either break up or else again support with sand washed under it. These little reefs are worthy of much closer examination than I was able to bestow upon them.

"The coral fauna of the Cape Comorin sea is on the whole a remarkably poor one, as far as one may judge by what is to be found thrown up on the beach. Dredging might reveal much more, but unfortunately no boats are found there, only Kattumarams (Catamarans) which would not be the most convenient form of craft from which to carry on scientific observations. The sea here is, however, so very rich in animal life in many forms, that it could assuredly afford a rich reward to any one having a suitable vessel at command. I obtained in a very short time, a far larger number of species of shells here than at any other place on the Indian Coast.

Soils.—"The prevalent soils (of South Travancore) are red ones varying in the quantity of their ferruginous element. The red soils seen inland near the main trunk road are chiefly formed of gneissic debris by sub-aerial decomposition. The origin of the deep red sandy or clayey loams has already been discussed. They occupy no inconsiderable area. True alluvial soils occur very rarely, if at all, now-a-days; those which fill the bottoms of the many valleys and creeks in which paddy is cultivated being greatly altered from their original condition by centuries of cultivation, and the addition of various mineral, vegetable and animal manures. Estuarine beds full of sub-fossil shells, *Cytherea*, *Pottamides*, *Melania* &c., of living species are exposed in the salt pans at the mouth of the Kolachel nullah.

"The Alluvium in the valley of the Paleyar, which flows south from the west flank of Mahendragiri past Nagarkoil is, where pure, a coarse gritty silt."

Smooth Water Anchorages. There are two anchorages on the Malabar Coast, known to mariners from early times. The bottom of these anchorages consists of a very fine, soft, unctuous mud which has over and over been supposed to act as a barrier against the force of the waves of the sea. Ships can not only ride safely in these roads, but they can also sometimes take in fresh water alongside, the sea beneath them being so diluted with fresh water from inland sources. At times the smooth surface on one of the banks may be broken by huge bubble "cones" as they have been called, of water or mud from the sea-bed, and even roots and trunks are reported to have floated up with these ebullitions.

Again the banks of mud are not fixed in position but move along the coast within ranges of some miles in extent; or one of them remains comparatively stationary while the other moves, and these movements do not take place year by year with the monsoons but continue over many years. Similar, though insignificant, patches of smooth water banks are found in various points along the Malabar Coast. But the best-marked and most generally known are those near Cochin and Alleppey. That near Cochin or the Narakal bank may be said to lie between Cochin and the Cranganore river $11\frac{1}{2}$ miles to the north. For many years its position has been about the middle of the range. The Alleppey bank ranges from a mile or two north of Alleppey to Poracad, a distance of 12 to 15 miles. It is now at the southern end of this range and indeed is often called the Poracad mud-bank. The mud-banks lie close along the beach but extend some miles seaward presenting a more or less semicircular or flat crescentic edge to the long rollers and tumbling waves of the monsoon weather.

Ordinarily the sea is tolerably smooth only rolling on the shore with more or less of a surf, and these patches are only to be distinguished by the soundings of mud below them. It is only a few days after the bursting of the monsoon, when the whole line is affected and the mud in these particular places stirred up, that the patches are distinguishable. Then the muddy waters calm down and remain so for the rest of the monsoon.

The mud itself is essentially characteristic and unique. It is of a decided dark green colour slightly tinged with brown, very fine in texture, very soft and oily feeling, altogether just like a very fine soft ointment or pomatum. After a time it dries and hardens, loses its oily feel and becomes harsh like ordinary mud. Its oily consistency has been proved beyond doubt; the specimens analysed have been found to give off, when subject to distillation, some brownish yellow oily matter lighter than water and looking not unlike petroleum. The muds also contain a considerable quantity of foraminiferal and infusorial remains.

Capt. Drury thus wrote on the origin of these banks:—

"The origin of this deposition of so large a quantity of mud in the open sea about two or three miles from the shore and so many miles from any bar or outlet from the backwater has never been satisfactorily accounted for. From the circumstance of there being no natural outlet for the vast accumulation of waters which are poured down from the various mountain streams into the basin of the backwater nearer than thirty-six miles on either side, it is not improbable that there exists a subterraneous channel communication with the sea from the backwater through which the large quantity of mud is carried off and thrown up again by the sea in the form of a bank."

Mr. Crawford, for a long time Commercial Agent at Alleppey, was of opinion that the perfect smoothness of the water in the roads and at the Alleppey beach was attributable not so much to the softness of the mud at the bottom as to "the existence of a subterranean passage or stream or a succession of them which, communicating with some of the rivers inland and the backwater, became more active after heavy rains particularly at the commencement of the monsoon than in the dry season, in carrying off the accumulating water and with it vast quantities of soft mud". He found that at the periods of deficient rain the mud-banks were less effective as anchorages. He also observed that after or during heavy rains the beach suddenly subsided, slightly at first but gradually as much as five feet, when a cone of mud suddenly appeared above the water, bursting and throwing up immense quantities of soft soapy mud and blue mud of considerable consistence in the form of boulders with fresh water, debris of vegetable matter decayed and in some cases fresh and green.

Mr. Rhodes, the successor of Mr. Crawford, confirms the above observation and states that he has seen mud volcanoes bursting up in the sea during the rainy season, which appeared "as if a barrel of oil had suddenly been started below the surface". He thinks that the mud thus formed is gradually floated away to the southward by the littoral current and fresh banks are formed whenever the hydraulic pressure of the inland backwater increases sufficiently to overcome the subterranean resistance of the stratum of fluid mud which is formed at certain places; and as a further proof, he adduces the fact that the extent of the mud-bank at Alleppey increases and diminishes as the level of the inland water rises and falls, as was most observable in 1882.*

The range of the coast exhibiting the phenomena is about 92 miles long, tolerably straight, without any indentation giving the form of a bay except at the extreme ends, viz., at Quilon and Cranganore. There is no indication of a bay near Alleppey, the name 'bay' having perhaps been adopted from an imaginary bay of smooth water enclosed within the semicircle of breakers outside. The shore line is straight, low lying or only a few feet above sea level and made up of alluvial deposits and sand. Between Alleppey backwater

* In regard to the formation of the bank, Mr. Philip Lake of the Geological Survey in his Note on the Mud-banks says:—"The chief point then in which I differ from previous observers is in considering that the Alleppey bank is formed not from the backwater mud but from an older river deposit found only at particular points along the coast. This would explain its non-appearance at other points where the conditions seem equally favourable. With regard to the existence of subterranean channels, it may well be doubted whether any could exist in such unstable deposits as are found here."

and the sea there is no visible communication, the principal rivers that enter it flowing northwards behind the range of the mud-bank. To all appearance the flat lands of the coast are entirely recent alluvial deposits consisting of layers of sand and mud overgrown with vegetation. The lumps of blue clay described by Mr. Crawford as turned up in the cones of Alleppey, answer to the lumps of clay of the lower part of the Varkala cliffs already described. Mr. Crawford also mentions his having passed through a crust of chocolate-coloured sandstone or a conglomerate mixture of the sandstone and lignite corresponding to certain rocks at Varkala.

It is clear that both the Alleppey and Narakal banks have practically the same constitution, behave similarly and have the same accompaniments with the exception of the violent discharges of mud or oil which are confined to the Alleppey bank.

It has already been remarked that the mud of these banks is full of organic matter and that it contains a sensible amount of oil probably partly derived from the decomposition of organisms. The mud is easily stirred up on all seasons and never settles down into a uniformly compact deposit but the upper stratum is in a greater state of liquidity than its lower depths. It occupies particular areas and within these well defined limits its movement is from north to south.

Regarding the water over the mud, Dr. King says* :—

"It is only known to calm down during the S. W. Monsoon. The calming of the anchorages does not take place until after the monsoon has commenced and there has been a stirring up of the sea and mud. The quieting of the waters is intensified according to the amount of rainfall during the monsoon; but even if no rainfall, there is a certain amount of quiescence. The calmness continues throughout the monsoon, apparently without any fresh stirring up of the mud. In one locality at least, the water is subject at times to violent agitation through the bursting up of gigantic bubbles of water, mud or gas,—it is not quite clear which; and these features also appear to be intensified during heavy rainy weather in the monsoon periods. The water over the banks becomes considerably freshened even to the extent—as I was told by Mr. Crawford—of being drinkable; also according as the monsoon rains are light or heavy. At such times, also, the water gives off fetid odours, and the fish inhabiting it are killed off in large numbers; but whether owing to the freshening of the sea-water, or the exhibition of poisonous matter and vapour in the water, is not clear; perhaps this destruction of life may be due to both causes.

The soothing of the troubled waters of the sea must surely be due to the oily constitution of the mud. An experiment performed sometime ago in the harbour of Peterhead, when a stream of oil

* Considerations on the smooth-water anchorages, or mud-banks of Narakal and Alleppey on the Travancore Coast—Records of the Geological Survey of India, Vol. XVII.

was cast upon the heavy seas at the harbour's mouth with such success that vessels were enabled to run in with comparative ease, clearly proves this. Thus the action of oil on troubled waters is confirmed not only by tradition and anecdote but by actual fact; but the long continuance of the quiescence without any fresh stirring up is not easily accounted for. The amount of oil derived from the decomposition of the animal and vegetable matter of the organisms in the mud would be hardly sufficient to account for the features exhibited; hence we must look to other sources for the oil and even for the continued supply of mud itself which is evidently carried away and distributed by littoral currents.

The consensus of opinion certainly leads to the conclusion that there is an underground discharge of water at any rate into the sea from the lagoon and river system behind the Alleppey-Poracad Coast during flood-time, the inland waters being at a higher level than the sea. This passage of underground waters must, more particularly during heavy rains, force cut large quantities of the mud on which the Alleppey Poracad land rests like a floating bog, as it were, elastic and capable of yielding to pressure or exerting pressure by its own weight, while a continuous stream of the same oil and mud may be kept up under the lower pressure of the ordinary backwater level. In the monsoon time the heavy floods, which however occur only at long intervals, cause great discharges of mud, oil and gases, and at such times new banks might be formed, the old ones being distributed down the coast by littoral currents and finally dissipated into the open sea.

The presence of petroleum has to be accounted for by the fact that besides the alluvial deposits large lumps of clay or compact mud, more or less decayed, and vegetable remains are brought to the surface during the prevalence of the violent ebullitions. Such clays are met with in the Varkala deposits associated with lignite beds, in which occur trunks and roots of trees in every stage of decay. It is probable that the Varkala deposits may extend north under the Alleppey Poracad alluvium and even again at Narrakal, where also fragments of similar clays are thrown up by the sea; and that it is in these deposits as being deeper-seated, older and lignitiferous that the earth-oil is generated.

Thus according to Dr. King, the mud banks, their smoothening influence, and their position within certain ranges of the coast, may be entirely due to the following causes:—

"1. The discharge of mud from under the lands of Alleppey, Poracaud and Narrakal, being effected by the percolation or underground passage of lagoon water into the sea.

2. The presence in this mud of oily matter, derived perhaps in part from the decomposition of organisms, but principally from the distillation of oil in sub-jacent lignitiferous deposits belonging presumably to the Warkilli strata.

3. The action of littoral currents which, slowly and through long periods of years, carry the mud down the coast to certain points whence it is dissipated seawards,—by the Quilon river at Narrakal, and at Poracaud because it is there beyond the range of replacement."

Economic Geology. According to Mr. Bruce Foote, valuable minerals and metals are conspicuous by their absence in South Travancore and this remark may be truly applied to the whole of Travancore.

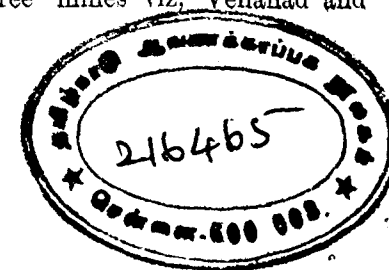
The development of the gold industry in Southern India having raised hopes of gold likely to be found among the quartz out-crops of Peermade and the adjacent country, Dr. King was requested to examine those parts and report on the same. His report is conclusive. He says:—

"These out-crops are not reefs as usually understood but are true beds of quartz rock lying between and running with other beds of the country rock which is of the crystalline or gneiss series. Reefs or veins of quartz generally run across the country rock as in Wainad or in the Kolar region of Mysore. Secondly the size of these out-crops is small, only one of them being sufficiently large to allow any expectation of what might be called a good tonnage of stone. Thirdly, and most important of all, the quartz of the out-crops, though it shows on a close assay traces of gold, is certainly not rich enough to be called auriferous quartz in the usual acceptance of the term."

He found on examination that the ordinary crop of the Peermade Hills consists of a thin bed of quartz rock, largely made up also of felspar. He says that in all of the main outcrops of Peermade,

"the rock is more or less of the same constitution, that is, a quartz rock with very often a good deal of felspar distributed through it in small crystalline masses sometimes as large as peas, generally coarsely crystallised dull white and glassy quartz; and less often a more compact rock like that of vein or reef. It is generally of a white colour, but at times it is stained red or even a golden yellow from ferruginous matter and scattered through it, there is often a small quantity of iron pyrites or frequent small particles of magnetic iron ore."

PLUMBAGO.—General Cullen was the first to discover graphite in 1845. In 1855 Dr. Royle discovered some specimens which were lamellar and soft but brilliant. Some samples were forwarded from a place south of Trivandrum for examination but were considered too soft and scaly for the manufacture of pencils. The matrix appeared to be a pseudo-laterite formed of decomposed gneiss *in situ*. Deposits were also found near Velland, the veins in which plumbago occurs being said to cross the strike of the gneiss. The plumbago found here is much purer than others. Mining work is carried on in three mines viz, Velland and



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Cullen mines in Oozhamalakal Proerty, Nedumangad Taluq, and the Venganur mine in the Kottukal Proerty, Neyyattinkara Taluq.

The total output of plumbago during the last four years was as follows :—

		1901	1902	1903	1904
Vellanad	Tons	1526	2401 $\frac{3}{4}$	1828 $\frac{1}{4}$	1571 $\frac{1}{4}$
Cullen	..	906 $\frac{1}{2}$	2173 $\frac{1}{2}$	1421 $\frac{1}{2}$	1431 $\frac{1}{2}$
Venganur	..	57 $\frac{1}{2}$	...	144	248
Total		2490	4575 $\frac{1}{4}$	3393 $\frac{3}{4}$	3251 $\frac{1}{4}$

Messrs. Parry and Co. and The Morgan Crucible Company who work these mines pay a nominal Royalty to the Government of 4 or 6 Rs. per ton according to the quality of the plumbago mined.

IRON—Iron ore is found throughout Travancore in large quantities but as imported iron is much cheaper than the locally manufactured iron, the industry is given up. In the Shencottah Taluk iron is obtained as black sand in the brooks in Pulangudiyiruppu and Achanputhur villages. It is said that two persons working daily can take up 7 $\frac{1}{2}$ Kottas or 126 Parahs of the sand in a month, and that 4 Parahs of this sand smelted with 40 Parahs of charcoal and ashes yield about 80 pounds of iron. The selling price of this iron is 4 Rs. while the cost of manufacture comes to about 5 Rs. Hence the industry has been given up. It is also found at Pralakat in Cheranallur Proerty, Kunnattur Taluk, where an unlimited quantity of the ore is obtainable. Here the out-turn is said to be 10 lbs. for every 100 pounds of the ore. Iron ore is reported to be found at Aramboly in large quantities at a depth of 15 or 16 feet. This place was once noted for its iron smelting industry. As large quantities of foreign iron began to be imported the industry had to be given up here also.

At Myladi till about thirty years ago the people earned their livelihood by gathering iron ore at the foot of the Poranathumala after heavy showers when the ore is washed down from the top of the hill. This they used to remove in baskets to the nearest rock and holding up the baskets at sufficient height, allow the contents to drop down by degrees against the smart and steady breeze which carried away the sand and rubbish leaving the ore behind. They used to take the ore thus sifted to their houses where they smelt it into lumps of varying size and sell the same

to the blacksmiths, who turned them into agricultural implements &c. It is reported that tools made of this iron would last considerably longer than those made of imported material.

LIMESTONE—This is found in considerable quantities near Layam in the Tovala Taluq, Tirupurathur in Neyyattinkara and Kazhakkuttam in Trivandrum. It is dug out from pits varying from about 5 to 8 feet and it is reported that limestone of a superior quality is obtainable at greater depths. The lime made here is chiefly sold to the Public Works Department. It is used for paving sides of wells and tanks and for making tubs.

GRANITE—The gneiss near Cape Comorin is generally like those of the Nilgiris but more quartzose. The Cape Comorin type of rock abounding in South Travancore is a well-bedded massive quartzo-felspathic granite gneiss abounding in small rich-coloured garnets. The rock also contains mica in glistening scales. Granite is used chiefly for metalling roads and erecting buildings, bridges &c. In the Chengannur Taluq which is noted for its excellent workmanship in granite, some good specimens of images, flutes, rose-water sprinklers &c. are made out of it.

The supply of beautiful building stones is practically unlimited in South Travancore but not much use is made of them except for temples and fort walls. The extensive Travancore lines are mostly built of gneiss, the Vattakotta Fort being a very fine sample of excellent well-cut masonry. To the extreme south end of the lines, blocks of marine sandstone have been employed in the walls to some extent but have been much affected by weathering.

MICA—This occurs chiefly in the Eranial Taluk. It is worked by regular mining operations. The out-put for 1899 was 12,706 lbs. The following is an extract from a letter from Messrs. Henry Grail and Co., London, dated 11th May 1900 regarding the quality and quotation of Travancore mica :—

“Several parcels of Travancore mica have been offered and sold here lately and to-day's values are as follows with a good demand and good prospects for the future.

Travancore amber plates free from specks &c.		
2 $\frac{1}{2}$ " by 3 $\frac{1}{2}$ " —	— 6d per lb.)	in good demand.
2 $\frac{1}{2}$ " by 4 $\frac{1}{2}$ " —	— 1/6 d per lb.)	
3" by 8" —	— 2/6 d per lb.	

Travancore amber mica would come into severe competition with Canadian, hence the necessity of careful preparation.”

But the mineral has already become very scarce, the income to the Sirkar in 1903—1904 being only about 30 Rs.

Before concluding this part of the subject, it may be well to state that according to the Royal Proclamation issued on the ^{14th June 1881} 2nd Mithunam 1056, Government have reserved to themselves the right to all the metals and minerals discovered on private properties. It has also been notified on the 30th July 1898 that prospecting for or mining of metals and minerals, whether in Sirkar or private lands, is strictly prohibited except under a license obtained from the Government in accordance with the rules in force for the purpose.

CHAPTER II.

Climate, Rainfall, and Meteorology.

“Sing a hymn, pleasing to Varuna the king. He sent cool breezes through the woods, put mettle in the steed (the sun) milk in the kine (clouds), wisdom in the heart, fire in the waters, lightning in the (clouds), placed the sun in the heavens, the Soma on the mountains.—He upset the cloud-barrel and let its waters flow on Heaven, Air, and Earth, wetting the ground and the crops.—He wets both Earth and Heaven, and soon as he wishes for those kine's milk, the mountains are wrapt in thunder-clouds and the strongest walkers are tired.”
(Rig Veda)

Climate. A warm humidity is one of the special features of the climate of Travancore. Small as the country is, its high mountain ranges, its valleys and plains and its coast-line greatly influence the atmospheric condition. The temperature varies according to the height of the locality above the level of the sea. But the most noticeable variations are common only in the mountains. The climate of the plains is much more constant and is subject to comparatively few irregularities. The thermometer rarely shows a higher reading than 90° and even in the coldest season it never falls below 70°. This uniformity of temperature is explained to be due to (1) the superheated condition of the surface soil, (2) the cool sea-breezes and the abundance of rain throughout more than half of the year and (3) the process of evaporation.

In the whole of Malabar and Travancore, there is no thick layer of cool earth on the surface capable of quickly absorbing the sun's rays, as in the Temperate Zone. Hence the surface soil becomes very heated and is constantly radiating its heat day and night, and consequently a uniform high temperature is maintained.

The cool sea-breezes, always saturated with moisture, blow steadily and regularly every day during the hot weather. These, combined with the abundance of rain that falls in the country, moderate the intensity of the heat and maintain a uniform temperature.

In the process of evaporation a large amount of heat becomes latent. This goes on in the hours of the hottest sunshine. As the country is well equipped with back-waters and rivers and as it is on the sea-board,

evaporation plays an important part in moderating the heat and reducing the temperature.

The hills present every degree of temperature from the fever heat at their base to near the freezing point upon the summit. At the foot of the hills and in places beyond the influence of the sea-breeze, the thermometer rises 5° or 6° higher. On the hills, the temperature varies with the elevation. In the Periyar valley near Peermade, the country being completely shut up by high land, the extreme range of temperature is very great, varying from little more than 45° to over 90° . As we go higher, the air is naturally much cooler. The Kanni Elam hills, one of the divisions of the Cardamom Hills, are about 3,000 to 3,500 feet high and are within the influence of the sea-breeze and consequently pretty free from bad fevers. But the Makaram Elam hills, though higher, are during some months very unhealthy. From July to January they are healthy and the temperature is low; but from the end of February or early in March, fevers of the worst type prevail and continue till June. On the High Ranges the thermometer ranges from 45° to 60° in March and April and between 29° to 60° in November, December and January. The meteorological effects of the whole of India, if not of the whole world, are thus presented to us in Travancore in a small compass. On some of the peaks we have the pinching cold of the northern regions of Europe. Lower down on an elevation of between three and four thousand feet (the Ashamboor or Peermade Range for instance), one meets with the bracing temperature of England. The genial warmth of an Italian sun with its clear and cloudless sky is experienced all over the country for a few weeks after the cessation of the monsoons. From January to May there is intense heat which in some Taluqs present the aspect of a true equatorial region and epidemics rage with virulence. The three months after the partial cessation of the rains are the most agreeable and salubrious, "the air being cool and refreshing and the face of the country clothed with a luxuriant verdure". The dewy season is not agreeable to the working classes. On the whole, the climate of Travancore is enervating, depressing the nervous system and retarding the recovery of strength when it has been prostrated by illness.

Seasons. Our ancient Sanskrit writers have divided the year into six seasons or *Rithus*, each comprising a period of two months. Of these the first, *Vasanta Rithu* or Spring, is the season of mirth and gaiety and begins in March. "The mango is then covered with fragrant blossoms of which Manmatha the Indian Cupid makes his shafts

and the landscape is gay with the beautiful and the sweet-scented flowers of the *kakke* or Indian laburnum. The southerly breezes that blow during the night are the voluptuous zephyrs of this vernal season." The next two months are designated *Grishma Rithu* or the Summer season. *Varsha Rithu* or the rainy season comes next. The South-west monsoon blows steadily during this period. During the next season, *Sarad Rithu* or Autumn, the fruits of the earth ripen. This season closes with the change of the monsoon. The *Hemanta Rithu* or Winter next sets in with chilly mornings and bright sunny days. The *Sisira Rithu* or cold season closes the circle of the year.

The year in Travancore may, however, be divided into four seasons, viz., the Dry or dewy season, the Hot weather, the South-west monsoon proper or wet season and the Retreating South-west monsoon period, based on the mean data of the meteorological elements given in the following tables, I and II, obtained from the Trivandrum Observatory.

TABLE I.

Months.	Mean pressure.	Mean temperature.	Mean aqueous vapour pressure.	Mean humidity.	Mean cloud amount.	Total rainfall.	Mean number of days on which thunder-storms occur.
	Inches.	Degree.	Inch.	Per cent.		Inches.	
January	29.725	76.5	.666	73.9	3.4	.702	2
February	.706	78.0	.685	72.4	3.6	.577	3
March	.689	80.3	.774	75.9	4.1	1.620	9
April	.642	80.7	.828	79.8	5.9	4.636	14
May	.632	80.0	.843	83.0	6.9	9.877	13
June	.635	77.5	.810	86.2	7.7	12.469	3
July	.613	76.7	.795	87.0	7.9	6.894	1
August	.667	76.7	.785	86.0	7.4	4.241	2
September	.678	77.0	.781	84.7	6.7	3.748	2
October	.685	78.9	.786	85.4	7.0	10.126	9
November	.698	77.0	.781	84.7	6.1	6.224	8
December	.711	76.4	.703	78.4	4.8	2.093	2
Year.	29.676	77.8	.770	81.5	6.0	63.207	5.7

The following table gives means for the four seasons corresponding to the data of Table I.

TABLE II.

Season.	Mean pressure.	Mean temperature.	Mean aqueous vapour pressure.	Mean humidity.	Mean cloud amount.	Total rainfall.	Mean number of days on which thunder-storms occur.
	Inches.	Degree.	Inch.	Per cent.		Inches.	
Dec. to Feb.	29.714	77.0	.686	74.9	3.9	3.372	7
March to May	.654	80.3	.815	79.0	5.6	16.133	36
June to Sep.	.656	77.0	.793	86.0	7.4	27.352	8
Oct. to Nov.	.692	77.0	.784	85.1	6.6	16.350	17

The dry season lasts from December to February, and is characterised by moderate humidity and cloud, and by very light rain and absence of thunder-storms. This is the dewy season or the cold weather, but referred to here as the dry season on account of the fact that the air contains the least aqueous vapour in this season.

The hot weather lasts from March to May, its most prominent features being moderately high temperature, occasional rain (increasing in quantity with the advance of the season) and frequent thunder-storms. Throughout this season, there is an intense and oppressive heat which is very intolerable in March and April. No doubt the season is slightly relieved by a few showers; but still the continued heat is insufferable and some of the places present the aspect of a true equatorial region from which it is not far distant. The country of Nanjanad though fully exposed to the severity of the sun's heat, is relieved of much of its intensity by the strong sea-breezes which sweep across the plains. During these months, in the lower hills, the violence of the heat is extreme. As we recede from the coast, the country becomes less healthy. During this and the previous season, fever, generally in the hills and in the valleys, and some of the epidemics, especially small-pox and cholera, break out occasionally with very great virulence. The borders of the lakes, however, always afford an agreeable climate.

The South-west monsoon proper or wet season continues from June to September, and is characterised by clouded skies, high humidity, copious

rain and absence of thunder-storms. Sometimes the monsoon commences towards the end of May and the regular rains are ushered in by thunder and lightning. Till the end of August the rains are very heavy and by September the rainfall becomes much lighter.

The retreating South-west monsoon period includes the months of October and November. Its chief feature is rain diminishing in amount with the advance of the season. The rains are, as a rule, preceded by thunder-storms of greater or less intensity. But the greater part of the rain registered in Travancore is brought by the S. W. monsoon. The amount varies considerably, being least in South Travancore, but gradually increasing along the sea-board to its northern limit. Towards the end of October, the N. E. monsoon begins and all through the month of November, a heavy shower is experienced in the afternoons though the mornings are generally fine.

By the beginning of December, the rains become less frequent and the country begins to dry up; by the end of December, the dry weather is fairly begun. Dewfall begins at nights in November and lasts till February. The sudden changes in the temperature of this season, from intense heat in the day to excessive cold in the night, often generate and foster the development of the epidemics, especially cholera. The land winds that prevail in the months of November, December and January produce many unpleasant ailments such as rheumatism, coughs, disordered stomach and pains all over the body. Jungle fever prevails near the foot of the hills; the moist heat at this part of the year is very depressing and is the cause of the above mentioned disorders.

Temperature*—DIURNAL VARIATION. In Trivandrum, the mean epoch of minimum temperature occurs at 4.51 A. M. on the average of the whole year. Thence the temperature goes on increasing till it agrees exactly with the mean temperature of the day at 8.16 A. M. and attains its maximum at 1.34 P. M. Thenceforward the temperature goes on decreasing till it is once more identical with the mean of day at 6.58 P. M. and finally reaches its minimum again at 4.51 A. M. The following table exhibits the diurnal oscillation of temperature at Trivandrum during the four seasons and for the whole year:—

* For the account of temperature, rainfall, winds, storms and earthquakes, I am indebted to Mr. Venu Pillai, Head Assistant of the Trivandrum Observatory.

TABLE III.

Season.	Mean temperature.	Diurnal range.	Variation from mean of day of		Mean epoch of		Epoch of zero variation from mean of day.	
			Minimum.	Maximum.	Minimum.	Maximum.	A. M.	P. M.
Dry	77.0	13.9	-6.8	+7.2	A. M. h. m. 5.5	P. M. h. m. 2.12	h. m. 8.34	h. m. 7.33
Warm	80.3	11.2	-5.2	+5.9	4.47	1.27	8.11	6.54
South-west } monsoon {	77.0	8.3	-3.8	+4.5	4.47	1.26	8. 6	6.39
Retreating } south-west } monsoon {	77.0	10.2	-4.7	+5.5	4.40	0.46	8. 3	6.41
Year... ..	77.8	10.7	-5.1	+5.6	4.51	1.34	8.16	6.58

ANNUAL VARIATION. Temperature increases with fair regularity from the middle of December to the beginning of April. It then falls, at first very slowly in April and May and then slightly more rapidly in June and the first half of July, to a secondary minimum in July (76.3°) on the 13th, differing only by 0.08° from the absolute minimum on the 16th and 17th of December.

During the remainder of the year, the mean daily temperature ranges irregularly within narrow limits (between 76.2° and 77.5°), indicating that the normal seasonal changes of temperature of this period are very small compared with the variations due to local and occasional actions or causes, such as rainfall &c. The chief feature of the progression of temperature during this period, however, appears to be that it increases slightly and somewhat irregularly from the 13th of July (76.3°) to the 28th of September (77.5°) and thence decreases with approximate regularity to the 15th of December. The following table gives, in brief, data of the chief maximum and minimum epochs of the variation of temperature during the year.

TABLE IV.

Epoch.	Character of phase.	Normal daily temperature on date.
16th and 17th of December ...	Absolute minimum ...	^o 76.21
2nd and 3rd of April ...	Absolute maximum ...	81.01
13th of July ...	Secondary minimum ...	76.29
27th and 28th of September...	Secondary maximum ...	77.46

It may be observed that the average or normal daily temperature is above the mean of the year for only 115 days, *i. e.*, from the 15th of February to the 9th of June and is below it during the remainder of the year. The mean diurnal range of temperature for the 12 months and for the year is given below :—

TABLE V.

Months.	Range.	Months.	Range.
	^o		^o
January ...	15.2	July ...	9.0
February ...	15.4	August ...	9.6
March ...	14.2	September ...	9.8
April ...	12.4	October ...	10.4
May ...	10.4	November ...	11.8
June ...	9.5	December ...	13.5
		Year ...	11.8

Table VI gives the mean actual daily and monthly temperatures at Trivandrum derived from the series of observations taken during the period 1856-1864, and Table VII gives the mean hourly temperatures for each month and for the whole year.

TABLE VI.

Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	76.99	77.20	79.73	80.48	80.34	78.14	76.75	76.49	77.15	77.26	77.55	77.04
2	75.98	77.67	79.51	81.36	81.14	77.74	76.79	77.15	76.71	77.64	76.85	76.56
3	76.18	76.98	80.34	80.64	80.63	77.09	77.38	76.76	76.80	78.07	76.88	76.44
4	75.73	77.15	80.20	81.31	80.80	78.46	77.29	77.22	76.36	77.32	76.83	76.50
5	75.88	77.08	80.01	80.62	80.81	79.02	77.45	76.94	76.97	77.14	76.51	76.53
6	76.07	77.38	80.07	80.32	80.09	78.25	76.74	76.54	76.80	77.01	76.09	76.91
7	75.93	77.45	80.30	80.65	80.33	77.32	76.71	76.70	76.89	77.16	76.80	76.41
8	76.69	77.40	80.40	81.34	80.65	77.57	76.21	76.53	76.85	77.21	77.38	75.60
9	77.50	77.44	80.43	81.41	80.75	78.09	76.03	77.14	76.21	77.64	77.79	76.37
10	77.12	77.22	79.94	80.57	80.64	78.10	75.95	77.10	76.68	77.34	77.78	76.02
11	77.19	77.13	79.94	80.69	80.97	76.97	75.17	76.31	76.97	77.66	77.65	75.76
12	77.12	77.13	80.53	81.10	80.58	77.54	75.13	76.46	77.01	77.66	77.99	76.31
13	76.96	77.51	79.95	80.78	80.38	76.90	74.75	76.49	77.23	77.31	77.88	76.31
14	76.21	77.77	80.15	80.97	81.04	77.75	76.52	76.74	77.29	77.11	77.69	76.34
15	76.45	77.68	80.73	80.94	80.08	77.64	76.30	76.37	76.92	77.07	77.28	76.49
16	77.04	78.28	79.61	80.91	80.70	78.40	76.73	77.39	76.16	77.14	77.54	76.55
17	77.01	78.11	79.98	80.70	81.12	77.18	77.37	76.28	76.84	76.96	76.36	76.24
18	76.65	78.09	79.98	81.01	80.23	77.18	76.41	76.31	76.33	76.42	76.05	75.65
19	76.47	77.77	79.43	80.95	79.45	77.54	76.78	76.18	77.02	76.04	75.93	76.29
20	76.04	78.37	79.62	80.07	79.35	77.40	76.94	76.06	77.43	76.05	76.39	76.33
21	76.18	78.96	79.63	80.67	79.35	77.81	76.75	76.76	77.75	76.08	77.24	75.76
22	75.96	78.74	80.15	80.63	78.55	77.81	76.75	76.76	77.55	76.59	77.62	75.96
23	76.21	79.47	80.29	80.95	79.24	77.80	76.88	76.42	77.48	75.81	76.89	75.97
24	76.70	78.95	80.55	81.70	79.96	77.59	76.92	76.95	77.48	76.71	76.98	76.40
25	76.04	78.54	80.42	79.28	78.74	76.93	76.93	76.99	77.42	76.71	76.98	76.40
26	76.11	78.34	80.90	80.49	79.26	75.71	77.19	76.86	77.67	76.86	76.47	76.70
27	76.66	78.99	81.41	79.46	79.36	76.82	77.13	77.26	77.56	76.86	76.95	76.77
28	76.45	79.93	81.12	80.19	79.34	77.45	76.93	77.07	76.81	77.28	76.93	76.93
29	76.53	—	81.52	79.84	78.76	77.53	77.34	76.95	77.47	77.12	77.65	76.95
30	76.88	—	81.81	80.56	78.77	76.41	76.78	76.80	77.57	77.03	77.17	76.90
31	77.65	—	81.13	—	79.47	—	76.70	76.37	—	77.60	—	76.77
Mean	76.50	78.02	80.32	80.69	80.00	77.55	76.96	76.70	77.03	76.84	77.03	76.41

TABLE VII.

Hours.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Mid-night	72.57	74.28	76.74	77.50	77.27	75.03	74.22	74.06	74.28	74.05	74.13	72.61	74.73
1	71.83	73.49	76.17	77.19	77.04	74.87	74.04	73.84	74.04	73.79	73.78	72.10	74.35
2	71.22	72.78	75.67	76.89	76.79	74.70	73.96	73.67	73.83	73.55	73.41	71.70	74.01
3	70.60	72.02	75.06	76.47	76.43	74.43	73.57	73.41	73.52	73.22	72.91	71.19	73.57
4	69.92	71.23	74.33	76.01	76.05	74.10	73.24	73.08	73.13	72.87	72.39	70.58	73.07
5	69.50	70.74	73.89	75.90	76.03	74.02	73.12	72.93	73.00	72.79	72.24	70.24	72.87
6	69.94	71.16	74.40	76.61	76.75	74.53	73.58	73.36	73.54	73.41	72.97	70.80	73.42
7	71.67	72.91	76.22	78.34	78.30	75.78	74.77	74.56	74.95	74.90	74.72	72.56	74.98
8	74.54	76.81	79.11	80.81	80.32	77.52	76.47	76.35	76.98	77.01	77.16	75.26	77.28
9	77.79	79.13	82.21	83.33	82.24	79.25	78.21	78.25	79.06	79.16	79.60	78.11	79.69
10	80.53	81.95	84.68	85.27	83.62	80.54	79.53	79.76	80.64	80.82	81.44	80.33	81.59
11	82.30	83.79	86.14	86.39	84.42	81.28	80.29	80.69	81.54	82.06	82.51	81.64	82.73
Noon	83.24	84.72	86.80	86.86	84.87	81.65	80.66	81.17	81.90	82.06	83.00	82.30	83.27
1	83.75	85.17	87.09	86.98	85.13	81.87	80.84	81.37	81.86	82.02	83.06	82.68	83.51
13	84.06	85.37	87.17	86.82	85.17	81.93	80.88	81.32	81.36	81.73	83.06	82.88	83.52
15	83.96	85.18	86.85	86.25	84.76	80.66	80.90	81.32	81.36	81.11	82.52	82.64	83.15
16	83.12	84.30	85.85	85.13	83.50	80.84	80.60	80.99	80.40	80.11	81.42	81.67	82.20
17	81.49	82.69	84.20	83.56	82.45	79.62	78.73	79.71	79.07	78.83	79.91	80.02	80.77
18	79.44	80.70	82.33	81.89	81.09	77.40	77.47	77.55	77.72	77.53	77.14	76.58	77.88
19	77.55	78.86	80.73	80.50	80.01	77.19	76.40	76.36	76.65	76.53	76.31	75.51	76.96
20	76.14	77.53	79.64	79.56	79.25	76.45	75.68	75.68	75.96	75.84	75.61	74.77	76.34
21	76.18	76.65	78.90	78.92	78.68	75.98	75.22	75.22	75.34	75.34	75.15	74.06	75.78
22	74.35	75.92	78.21	78.40	78.13	75.60	74.83	74.81	75.08	74.88	75.15	74.06	75.78
23	73.46	75.13	77.45	77.91	77.64	75.28	74.50	74.40	74.64	74.43	74.60	73.30	75.22

The following table gives the data for the diurnal variation of the amount of vapour present in the air and also for the diurnal variation of humidity for each of the four seasons of the year and the average for the year in Trivandrum :—

TABLE VIII.

Hour.	Cold weather-December to February.			Hot weather-March to May.			S. W. Monsoon-June to September.			Retreating S. W. Monsoon-October and November.			Year.	
	Vapour pressure.	Grains of vapour in cubic foot of air.	Relative humidity.	Vapour pressure.	Grains of vapour in cubic foot of air.	Relative humidity.	Vapour pressure.	Grains of vapour in cubic foot of air.	Relative humidity.	Vapour pressure.	Grains of vapour in cubic foot of air.	Relative humidity.	Vapour pressure.	Relative humidity.
0	701	754	861	825	880	889	799	858	940	786	844	940	779	905
1	695	748	871	817	878	897	796	854	943	781	839	944	776	912
2	685	738	875	810	873	901	792	851	945	773	831	945	769	915
3	688	722	875	810	867	908	787	846	947	761	828	948	759	918
4	683	705	874	803	859	916	781	840	951	756	814	951	751	922
5	652	694	870	801	858	918	779	838	951	753	811	949	746	921
6	641	694	870	801	858	918	779	838	951	753	811	949	746	921
7	640	692	852	804	860	901	781	840	904	762	818	892	752	865
8	646	696	811	806	855	857	781	840	855	769	822	836	756	808
9	653	700	749	802	848	726	787	839	806	775	824	789	757	749
10	657	699	680	798	840	678	788	837	769	778	825	739	757	704
11	657	694	592	798	838	656	788	837	750	781	827	719	758	680
12	662	698	582	802	842	651	789	837	742	783	828	713	761	673
13	672	708	583	810	850	653	791	838	739	786	831	714	765	675
14	684	721	588	814	854	656	790	837	738	787	832	719	769	675
15	694	731	599	817	858	656	788	835	745	788	834	761	772	685
16	702	742	624	819	862	690	789	838	766	791	839	761	776	709
17	711	754	667	824	870	729	793	834	802	796	846	803	781	748
18	720	766	720	830	879	774	800	853	845	803	856	847	789	795
19	728	777	769	836	887	812	807	861	881	808	863	883	795	835
20	730	781	803	838	891	837	810	867	905	808	864	904	797	861
21	726	777	822	835	888	853	809	866	918	803	859	916	794	876
22	717	770	885	830	884	865	805	862	926	797	855	924	788	886
23	708	761	848	827	881	878	801	859	933	791	849	933	783	896

Rainfall. The territorial distribution of rainfall in Travancore exhibits two well-defined characteristics. One is the gradual diminution of rainfall from Parur to Cape Comorin, and the other the gradual increase of the fall proceeding from the coast towards the mountains. Besides, it is also true that up to a certain height the rainfall over the mountains gradually increases in amount. Considering the variation of the mean annual rainfall, Travancore may be divided into three narrow belts, namely, (1) the littoral or the lowland, (2) the submontane or the central and (3) the mountainous or the upland belt. The littoral belt has an average annual rainfall of 67·6 inches, the submontane 92·9 inches and the mountainous or the upland 110·1 inches. Thus it is seen that the amount of the precipitation of vapour increases from the coast towards the ghauts, the weight of the fall over the mountains being a little less than twice the weight of the fall near the coast.

The S. W. monsoon winds blowing over the Arabian sea take a north-westerly bend before they come into contact with the coast lands of Malabar and are felt as north-north-westerly to west-north-westerly winds in Travancore. The direction of the wind partly depends upon the trend of the coast-line, and the rainfall will depend on the angle which the monsoon currents make with the ghauts. It is not improbable that the maximum of precipitation occurs at the place of incidence of the monsoon current on the Malabar coast, which may vary in position from year to year. The law of the variation of rainfall along the coast is one of gradual decrease from this point, as the current reaches nearer and nearer to the Cape. A slight variation from this rule resulting in a diminution of the amount of rainfall at Shertallay, Kartikapalli and Karunagapalli is also perceptible, but it is difficult to offer an explanation for this diminution. The mean annual rainfall at some important stations on the coast is given below:—

	Inches.		Inches.
Parur ...	117·2	Chirayinkil ...	66·9
Shertallay ...	93·2	Trivandrum ...	64·7
Alleppey ...	114·2	Neyyattinkara ...	59·4
Ampalapuzha ...	91·2	Rajakamangalam ...	44·1
Kartikapalli ...	83·7	Tamarakulam ...	38·1
Karunagapalli ...	77·8	Variyur ...	32·6
Quilon ...	91·1		

The mean falls of the four Administrative Divisions are as follow :—

	Inches.
Kottayam	115·1
Quilon	90·3
Trivandrum	69·8
Padmanabhapuram	38·4

The Kottayam Division receives three times as much rain as the Padmanabhapuram Division, while Trivandrum has nearly 77% of what Quilon receives. Though the most favoured locality in Travancore as regards rainfall is apparently the Cardamom Hills, data are wanting to corroborate the belief. Of individual stations, Peermade has the greatest rainfall averaging to 198·4 inches annually. Todupuzha has the next greatest amount, viz., 145·2 inches. The least recorded fall is seen at Aramboly where it averages to 29·1 inches.

Annual variation.—The annual variation of rainfall in Travancore follows a regular curve that has two maxima and two minima. The absolute maximum and minimum occur in June and January respectively, while the secondary maximum and minimum fall respectively in October and September. The least amount of rainfall is received in the month of January. Precipitation then goes on moderately increasing till the commencement of the S. W. monsoon, which takes place generally about the last week of May. June is preeminently the month of maximum rainfall throughout Travancore. Then a slight diminution takes place in the amount of the rainfall received in the several stations during the months of July and August, and the secondary minimum is arrived at in the month of September. There is a sudden increase in the amount of rainfall in the month of October. This rain is locally known as *Thulavarsham*. The fall then decreases slowly in the month of November and rapidly through December and January, which last is the driest month of the year. More than 87% of the annual rainfall is received during the prevalence of the S. W. monsoon, viz., from May to November.

Periods of deficient rainfall.—As for periods of deficient rainfall, it is on record that the year 1860 was a year of famine in South Travancore. The rainfalls in Trivandrum for 1855 and 1870 also indicate years of scarcity. Beyond this, it is impossible to accurately determine the years of deficient rainfall before 1885, as it was only from that year that an extensive system of rainfall observations was begun. During the year 1884, however, rainfall records were received from 13 stations,

and the amount of rainfall in all of them was far below the normal, the actual amount in one of them being 64% less than the normal. In 1886 and 1890 the fall was below the normal at 27 and 30 stations respectively out of the 36 stations at which rainfall was gauged. At the stations at which the rainfall was below the normal, the deficiency was 28% of the normal in 1886 and 23% of the normal in 1890. In 1894 and 1895 the rainfall was below the normal by 518·25 and 565·37 inches respectively i. e., by 17·0% and 18·6% of the normal. Out of the 36 stations, 30 stations in 1894 and 31 stations in 1895 had rain below the normal. In the years 1892 and 1893, a considerable deficiency in the amount of rainfall seems to have taken place in the Padmanabhapuram Division alone. The actual amounts received were 65·6% of the normal in 1892 and 53·3% in 1893. Thus it may be inferred with a fair degree of accuracy that the years 1886 and 1890 were years of deficient rainfall throughout Travancore. The biennial period of 1894 and 1895 must also have been more than usually dry throughout Travancore. The years 1892 and 1893 seem to be years of drought in South Travancore though the intensity of the drought may have been feeble.

A table giving the mean monthly and annual rainfall at 36 stations in Travancore is given below:—

TABLE IX.

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Parur	0.04	0.37	1.55	4.27	9.37	34.88	24.71	14.49	8.82	12.77	4.81	1.16	117.24
Alangad	0.02	0.37	0.70	1.94	4.54	23.08	20.41	9.49	3.26	7.17	2.83	0.49	74.30
Kummad	0.10	0.61	0.87	2.97	3.91	18.73	20.52	9.96	5.26	6.62	5.12	0.98	75.65
Mavattupuzha	0.32	0.49	1.71	6.79	7.61	28.06	27.31	16.11	15.71	15.71	7.59	1.85	123.03
Todupuzha	0.18	1.35	2.63	10.06	10.33	31.00	30.75	19.82	12.31	18.03	7.23	1.53	145.22
Vaikam	0.25	0.54	1.27	3.33	8.09	24.98	17.28	8.33	6.07	9.87	3.73	1.37	85.31
Shertalay	0.25	0.73	1.27	3.61	8.97	25.38	20.39	9.37	5.50	10.65	5.28	1.83	93.23
Etumamur	0.27	0.41	1.60	7.43	8.98	31.91	23.82	12.09	5.54	10.50	5.83	1.74	110.12
Minachil	0.60	1.45	4.31	10.53	11.83	28.34	26.28	17.21	9.93	17.69	8.54	2.98	139.69
Kottayam	0.33	0.39	2.77	5.85	9.46	26.97	20.95	12.86	7.90	14.12	6.21	2.52	110.33
Pennade	0.39	1.18	2.60	7.37	11.06	46.02	47.20	33.70	17.48	22.23	7.55	1.66	198.44
Changanachery	0.26	0.67	2.68	6.79	9.67	25.98	19.38	10.51	7.09	16.30	6.83	3.17	109.33
Alleppey	0.69	1.08	2.30	6.03	11.09	26.60	19.85	10.61	7.53	16.26	9.32	2.86	114.22
Amthalapuzha	0.37	0.71	2.32	5.60	7.85	19.84	15.43	8.67	8.18	14.57	5.84	1.84	91.22
Tiruvalla	0.17	0.76	1.61	4.77	8.43	24.53	18.30	8.76	6.66	10.48	5.20	1.80	91.47
Chengannur	0.44	0.98	3.33	7.17	8.93	23.94	16.53	9.81	7.78	13.35	6.97	2.37	101.60
Karikapalli	0.02	0.64	1.47	3.66	7.75	21.30	14.52	7.56	5.39	13.22	6.05	2.09	83.67
Mavelikara	0.16	0.74	1.16	5.13	7.57	23.64	18.31	10.56	7.27	15.38	7.42	2.33	99.67
Karunagapalli	0.19	1.11	1.30	4.32	6.88	18.43	12.63	6.31	6.69	13.16	5.10	1.67	77.79
Kumattur	1.33	1.33	2.02	7.27	7.78	21.06	15.65	8.83	6.60	13.27	5.88	2.15	92.17
Shencottah	0.28	1.61	2.29	3.48	1.35	5.99	4.78	2.18	1.49	6.29	7.31	3.38	41.43
Pattapuram	0.56	1.90	3.22	8.13	8.41	20.39	15.85	9.88	7.33	15.45	7.86	2.14	101.12
Kottarakara	0.23	1.57	2.92	8.86	7.70	23.17	14.04	8.35	6.68	14.38	7.31	1.87	97.58
Quilon	0.34	0.90	1.94	5.64	9.91	19.27	12.97	8.49	6.55	16.33	7.12	1.69	91.15
Chirayinkil	0.49	0.83	1.08	4.00	5.78	18.24	9.95	4.24	3.73	11.81	5.39	1.39	68.93
Nedumangad	0.68	1.62	2.14	8.50	8.30	18.43	9.51	5.26	5.38	15.06	9.91	3.43	88.42
Trivandrum	0.50	0.72	1.37	4.65	6.99	13.28	6.73	4.29	3.38	12.20	6.02	2.71	62.94
Neyyattinkara	0.62	0.62	1.52	5.10	6.34	12.70	6.04	2.76	2.42	11.38	7.06	2.88	59.44
Vilavankod	0.22	0.57	1.14	3.05	2.81	7.49	3.05	1.29	1.47	8.07	5.23	1.65	36.04
Padmanabhapuram	0.86	1.11	1.88	5.74	4.02	8.85	3.61	1.88	1.94	10.78	8.57	2.73	51.97
Eraniel	0.27	0.50	0.98	3.38	2.40	7.14	2.11	0.94	1.29	6.57	5.71	1.62	32.91
Rajakamangalam	0.93	0.43	1.71	3.91	2.88	8.53	2.88	2.03	1.60	9.55	6.98	2.63	44.03
Agastisvaram	0.82	0.70	1.37	3.56	1.70	6.20	2.31	1.42	0.94	8.57	7.16	2.86	37.61
Tamarakulam	0.72	0.37	1.78	3.04	1.37	6.15	2.09	1.45	1.22	9.89	6.76	3.27	38.11
Variyur	0.95	0.37	1.56	3.06	0.94	5.12	1.60	0.94	0.59	7.15	7.56	2.74	32.38
Aramboly	0.83	0.55	1.27	3.11	0.87	3.72	1.65	0.78	0.93	6.90	6.33	2.21	29.15

N. B. † The mean of these stations is derived from 20 years' observations (1883-1902).
 Do. Do. Do. (1884-1902).
 The mean of the rest is derived from 18 years' observations (1883-1902).

Wind. About the general character of the air movement at Trivandrum, Mr. J. Elliot writes* :—

“During the period from November to April when north-east winds generally obtain in the south and centre of the Bay (of Bengal) and the air movement is continued across the Deccan, Mysore and South Madras as north-easterly to easterly winds, Trevandrum is sheltered by the high Travancore hills from these winds. The air motion at Trevandrum during this period consists of an alternating movement between land and sea (*i. e.*, land and sea-breezes) and of a feeble general movement from directions between north and west common to the Konkan and Malabar coasts at this period. The direction of the movement is apparently determined in part at least by the trend of the coast. During the remainder of the year, from about the middle of May to November, South-west monsoon winds of greater or less intensity prevail in the Arabian sea. They usually set in on the Travancore coast in the last week of May. They have their greatest extension and also the greatest intensity in the months of July and August. They begin to fall off in strength in September and continue to decrease in intensity in the south of the Arabian Sea in October and November, but withdraw gradually during these months from the north and centre of the sea area, being replaced by light variable winds. During the period of the full extension of the South-west monsoon over the north of the Arabian sea into upper India in July and August, the current in the south-east between the Laccadives and Maldives and the Malabar coast not only falls off to some extent, but in the lower strata instead of rising directly and surmounting the Travancore hills it tends to be deflected towards the south by these hills and to pass south-eastwards along the coast and join that part of the current which passes to the south of Ceylon and enters the Bay. There is hence a slight northerly shift of the winds on the Malabar coast from the beginning to the middle of the South-West monsoon.”

Variation of wind velocity. The annual variation in the strength of the winds in the south and centre of the Arabian sea is reflected in the winds at Trivandrum. The air movement is least at Trivandrum in December, or at the end of the S. W. monsoon. It increases slightly during the next three months and rapidly from April to July and is absolutely greatest in August. It falls off very rapidly in October and November attaining the minimum in December.

The diurnal variation of velocity differs considerably in character at different seasons of the year. From November to April it is determined by the alternating movement of the sea and land breezes. There are hence during this period two maxima and two minima, the former corresponding with the greatest intensity of the land and sea breezes, and the latter with the average of the shift from one to the other which, of course, varies considerably from day to day. The day maximum of the sea-breeze is very strongly exhibited as is also the evening minimum. The morning maximum and minimum of the land-breeze are, as might be expected, less marked than the corresponding phases of the sea-breeze, but are clearly shown. They are most

* Indian Meteorological Memoirs; Part I., Vol. X.

pronounced in December, January and February; and it is hence in these months that the land and sea breezes are probably most prominent and form the chief feature of the air movement. The land winds are strongest at about a little after sunrise and the sea-breeze at 2 P. M. or at nearly the same instant as the maximum of temperature. The morning minimum is accelerated as the season advances, whilst the evening minimum is retarded. The effect of the increasing temperature from January to April is hence to lengthen the period of the sea-breezes and diminish that of the land-breezes (by a total amount of 5 hours) between January and April. The diurnal variation during the remainder of the year, May to October, consists of a single oscillation, the maximum velocity occurring from about 2 P. M. and the minimum shortly after midnight. The ratio of the maximum to the minimum velocity in the diurnal variation is fairly constant throughout the period.

The following is a picturesque description of the setting in of the monsoon in Travancore by Mr. J. A. Broun F. R. S., a late Director of the Trivandrum Observatory:—

"There is no place in India where the magnificent phenomena which precedes the bursting of the monsoon can be seen and studied with more ease than on the Agustia Peak. For a month or more before the final crash of the tempest, the whole operations of the great atmospheric laboratory are developed at our feet, while the summit of the mountain itself is rarely visited by the storms which rage over its western flanks. In the morning, chains of finely formed cumuli seem to rest over the sea horizons of Malabar and Coromandel. Frequently it is evident that what appears a serried file of cloud masses is only cumuli irregularly distributed over the country; their shadows, projected near noon, spot and chequer the plains and the undulating country below from sea to mountain. Early in the morning the vapours begin to rise near the western precipices; the cloud accumulates and seeks to pass by the lowest cols into the eastern valleys; it seems opposed by a repulsive influence, for no breath of air is felt; it ascends at last, after noon, in mighty masses crowned with cirrous clouds which spread eastwards like an immense parasol over our heads. Then the lightning begins to play, darting in varied and ramiform circuits from cloud to cloud; the thunder rolls, at first in sharp separate crashes, and at last continuously; the rain is heard drenching the forests below. After an hour, or several hours, according to the distance from the monsoon, the clouds quit the mountains, move more westwards, and then disappear; the sun shines out again over the western sea, assuming before setting the most fantastic forms; the stars sparkle in all their beauty, and the morning again appears with its chains of clouds on the horizon. As the time for the monsoon draws near, the cloud masses seek with more and more energy to pass the mountains eastwards; sometimes two such masses present themselves,—one creeping up an eastern valley, the other entering the col from the west. Nothing can be more interesting than to watch this combat of the vapours. Day by day the western clouds enter a little farther; at last they come driven on by a giant force,—rise to the tops of the mountains, and pour over their walls into the eastern hollows, like the steam from a great caldron; they plunge first downwards Niagaras of cloud,

and then as they curl upwards, they disappear, absorbed in the hotter eastern air. The storm, with deluges of rain, sweeps over the mountain, and the monsoon reigns over the low lands of Malabar."

Storms. The storms that usually frequent the Indian Peninsula and the adjacent seas belong to the class called "Cyclones". In a cyclone, the wind blows in spiral curves, more or less circular in form, round a centre of low pressure, increasing in force as it approaches the centre. The whole cyclone thus constituted, besides turning round a focus, has a straight or curved motion forwards, so that, like a great whirlwind, it is both turning round, and, as it were, rolling forwards at the same time.

It is an important feature of the climatology of Travancore that it is mostly free from the track of storms of any kind. The chief causes that contribute towards this end are its geographical position and its natural features providing it with a mighty wall of mountains on its eastern border. It is well known that the immediate vicinity of the Equator is never frequented by cyclones. According to Mr. Elliot, Lat. 8° N. appears to be the boundary line to the south of which cyclonic storms are seldom or never generated. Further, cyclones do not form so generally on land as over sea-area, and Travancore is effectively protected by its mountains from the few storms that, having originated in the Bay of Bengal, enter the Arabian sea across the Peninsula. Mr. Elliot says:—"It is probable that it is only storms which extend to an exceptional height into the upper atmosphere which surmount this obstacle.....It may be taken as generally true that any storm crossing the Peninsula into the Arabian sea, no matter what its original or subsequent intensity, will have relatively little influence on the weather over the narrow strip of land intervening between the Ghauts and the Arabian sea or over the sea adjacent to the west coast of the Peninsula." This is because of the circumstance that on the storm encountering the Ghauts, the whole of the lower circulation is broken up, and the descent subsequently effected is carried out slowly, not by the sudden and abrupt descent of the disturbance, but by a gradual downward extension of the cyclonic motion into the unaffected surface strata of the air. Hence it is not till the cyclone has advanced to some distance from the coast-line that the full effects of the phenomenon are experienced, and that the storm becomes fully recognisable. Thus the occurrences of storms in Travancore are few and far between. Besides, it is only a heavy torrential rain accompanied by a

* Trivandrum Magnetical Observations, Vol. I.

barometric depression that is often felt on land as the effect of the passage of many a cyclone through the Arabian sea near the Travancore coast.

Two instances can, however, be traced of severe storms that have been felt in Travancore, one in April 1779 and the other in December 1845. About the middle of April 1779 a hurricane was felt off Anjengo in which the East India Company's ship *Cruiser* was lost. At the close of November 1845, a cyclonic storm was formed over the Bay of Bengal, which passed across the Indian Peninsula and travelled north-westward into the Arabian sea. That this storm raged throughout Travancore can be inferred from the following excerpts:—

TRIVANDRUM.— The wind blew very strongly at 1 A. M. of the 3rd December, and a violent gale lasted from 2-30 A. M. to 3 A. M. The wind then abated for half an hour after which it recommenced with greater violence than ever, and continued till about day-break. Three inches of rain fell during the second. The barometer fell three-tenths of an inch between 8 A. M. on the 2nd and 2 A. M. on the 3rd, while it rose upwards of 0·3 inch during the next 7 hours. The barometric readings at Trivandrum during the passage of the storm are given below.

November	29th	...	...	29·930
"	30th	...	...	29·864
December	1st	...	...	29·844
"	2nd	...	...	29·960
"	3rd	...	...	29·990
"	4th	...	...	29·928
"	5th	...	...	29·854
"	6th	...	...	29·822

QUILON.— The Master Attendant wrote:— "The gale commenced at 10 P. M. of the 2nd and continued till 7 A. M. 3rd."

ALLEPPEY.— The Master Attendant wrote:— "A gale of wind with rain commenced about midnight, 2nd, and continued till day-light, 3rd, when it blew a hurricane."

Mr. Bailey wrote to General Cullen from Kottayam:—"We were visited at Kottayam, on the morning of the 3rd instant by the same gale of wind to which you refer. Many trees were blown down, or rather broken off near the roots. A good many tiles were blown off the roof of our printing office. Many persons had very narrow escapes, and three individuals at some distance from us lost their lives, and it is supposed many more."

Earthquakes. Earthquake shocks of greater or less intensity have passed through some portion or other of the Travancore territory on the following dates:—

1.	February	1823
2.	19th September	1841
3.	23rd November	1845
4.	11th August	1856
5.	22nd August	1856
6.	1st September	1856
7.	10th November	1859
8.	8th February	1900
9.	28th May	1903

A short account of the occurrence of each of these earthquakes is given below:—

FEBRUARY 1823. This shock was felt at Palamcottah slightly, and by the Rev. C. Mault at Nagercoil, and, an account of the shock as felt at the latter place was published in the Madras Government Gazette, by Captain Douglas, then stationed at Nagercoil. Nothing further is known of this earthquake.

19TH SEPTEMBER 1841. The shock as felt at Trivandrum seems to have been pretty severe, as the people at church at the time of the shock, immediately left it, fearing that the building might come down on them. The vessel supplying water to the Wet Bulb thermometer in the Observatory was shaken off its stand and broken, and several mud houses were thrown down in the Fort and elsewhere. It began in the east and passed off to the west. This shock was felt throughout South Travancore and at Palamcottah. The time noted at the Trivandrum Observatory was 11 h. 20 m. A. M.

23RD NOVEMBER 1845. Rev. B. Bailey (in a letter to General Cullen dated 8th December 1845) wrote:—"On Sunday the 23rd ultimo (November) we were visited at about 2 o'clock P. M. by a slight shock of earthquake, succeeded by a rumbling noise resembling that of distant thunder...when my house was shaken to the foundation and the whole of the beams and timber gave a sudden crack as if the house rocked east and west. The shock was felt all over Kottayam". This shock does not appear to have been perceived at Trivandrum.

11TH AUGUST 1856. A shock was felt on this date at 5h. 51m. 25 s. A. M. as noted down by the Assistant on watch in the Observatory. The

shock lasted 20 seconds. The magnetic instruments do not seem to have had any vibration or change of mean positions. The shock has also been felt at Parassala, Quilon, Courtallam and Pallam. It was not felt near Cape Comorin nor at Nagercoil and Agastyamala. Mr. Broun considered that the shock must have come from a direction between north and west.

This earthquake was thus described by Mr. Broun in a letter to the *Madras Athenaeum* in 1856:—

“The Assistant in the Trivandrum Observatory having the watch on the morning referred to (11th April 1856), was entering an observation when he heard a low rumbling sound which he thought at first was distant thunder towards the north-east; in about 3 seconds the rafters of the building began to crack, the windows to rattle and a mirror resting on the table to shake; he immediately looked at the clock and found the time 5h. 51 m. 30s. which allowing for the clock error would give the mean Trivandrum time of the commencement of the sound 5h. 51 m. 25s. He then went out to look towards the north-east and immediately thereafter the sound ceased with a louder ‘boom’; on looking again at the clock the time by it was 5h. 54 m. and he estimated the duration of noise and shock at nearly 20 seconds. He now examined the magnetical instruments, but could perceive neither vibration nor change of mean position. It is not impossible however that the magnets might have had swinging or dancing motions without being remarked by the observer as vibrations round a vertical axis only are noted. An examination by myself since, of the observations made before and after the shock, confirms the fact of the steadiness of all the magnets. The velocity of the winds from north-west was nearly as usual at the same hour; the sky was nine-tenths clouded, the clouds moving from north-west, the temperature of the air was nearly 73°, the maximum temperature of the day being nearly 78°. The shock it seems was felt at Quilon ‘about six o’clock’ and Mr. Liddell at Charlies Hope near the road between Quilon and Courtallam says, ‘we had a smart shock of an earthquake about 10 minutes before six on Monday morning.’

“I was on the summit of our highest mountains, the Agustier Malay (about 30 miles W. N. W. of Trivandrum) on Monday the 11th but did not perceive any shock. The testimony on the whole seems to indicate a southerly and easterly point as the direction of the origin, all agreeing that the sound was heard before the shock was perceived”.

22ND AUGUST 1856. The shock was felt at 4 h. 25 m. 10 s. P. M. The magnetic instruments were found dancing up and down with sharp jerks and a brass weight hanging in a closed box was observed by means of a telescope to dance perceptibly 15 m. after the shock. The shock passed from west-north-west to east-south-east. The Bifilar magnetometer vibration at 4 h. 30 m. was 5.0 scale division, whereas at the hours before and after, it was only 0.6 scale division. This shock was also felt at Quilon about 4 h. and 16 m. and at Pallam. No shock was felt at Ccchin or at Courtallam, nor to the south of Trivandrum.

1ST SEPTEMBER 1856. The time of the shock was 12 h. 44 m. 58 s. noon*. The direction of the shock as ascertained by a lead weight hung by a silk thread 17 feet long was from N. 30° W. to S. 30° E. The Bifilar magnetometer vibrated through 14.6 scale divisions at 1 h. 30 m. This shock was felt at Cape Comorin, Nagercoil, Neyyur, and the Tinnevely District. It does not seem to have been felt at any place north of Trivandrum.

10TH NOVEMBER 1859. A shock was felt at 10 h. 31 m. 47 s. A. M. both the Unifilar and the Bifilar magnetometers were observed to dance up and down. The long pendulum referred to above had a slight motion from N. 30° W. to S. 30° E.

8TH FEBRUARY 1900. A pretty severe shock was felt at 2h. 56 m. A. M. On this date the magnetic instruments were not observed. The shock was felt to pass from N. to S.

28TH MAY 1903. A slight shock was felt at 2h. 46 m. P. M. The magnetometers were visibly affected, and the Bifilar vibrated through 10.7 scale divisions.

Besides the above, the magnetic instruments in the Observatory have often indicated the occurrence of earthquakes elsewhere but not felt in Travancore. The most important of such indications were those of the shock that passed through the Districts of Madura and Tinnevely on March 17th 1856 and the famous Calcutta earthquake of 12th June 1897. An examination of the magnetometer observation on the night of the 17th March 1856 at Trivandrum and Agastyamala shows that the shock may have passed the line of the Ghauts and Trivandrum before 11 h. 30 m. P. M. Mr. Broun says, “the time of the night and the little habit the natives have of observing, may partially explain the fact that the shock was not felt at Trivandrum”.

* In a letter published at Page 113, Vol. I New series, of the *Madras Journal of Literature and Science*, Mr. Broun, the then Government Astronomer gives the time as 15 m. 0 s. after noon.

CHAPTER III.

Flora.

"Righteous Rama, soft-eyed Sita, and the gallant Lakshman stood
In the wilderness of Dandak,— trackless, pathless, boundless wood,
But within its gloomy gorges, dark and deep and known to few,
Humble homes of hermit sages rose before the princes' view.

* * * * *
Creepers threw their clasping tendrils round the trees of ample height,
Stately palm and feathered cocoa, fruit and blossom pleased the sight,
Herds of tame and gentle creatures in the grassy meadow strayed,
Kokils sang in leafy thicket, birds of plumage lit the shade,
Limpid lakes of scented lotus with their fragrance filled the air,
Homes and huts of rustic beauty peeped through bushes green and fair,
Blossoms rich in tint and fragrance in the checkered shadow gleamed,
Clustering fruits of golden beauty in the yellow sunlight beamed!"

Ramayana (R. C. Dutt).

The special characteristics of Travancore flora are its diversity, beauty and economic value. The peculiar climate of the country, its rich forest soil and the extraordinary rainfall foster the growth of the several species of the indigenous trees and shrubs. From the middle of June to the middle of December the hills and plateaus are filled with rank vegetation and present a rich green appearance. During this period several valleys are impervious to men and some glens are inaccessible even to day-light. Hundreds of shrubs rise in the shade of the gigantic trees and entwine themselves with the climbing creepers that almost cover the trees. The rains cease with the beginning of December and most of these shrubs and creepers probably die before January closes. In the hot months, the dried underwood may be seen burning on all the hill tops. These fires are sometimes caused by excessive heat of the sun but more often by the hill Kanis for purposes of cultivation.

Of the forest trees, the Teak is the most valuable, being fit for all purposes where strength and durability are required. The Poon is found in the less accessible spots and is specially fitted for masts by its height and straightness. The Anjili affords excellent planks which are largely used in house-building. The stately Cotton tree is generally used for boat-making. The Arayanjili and the Caryota yield good fibres specially adapted to the manufacture of cordage and ropes. The Bamboo and the allied reeds are plentiful on the river banks. The wild Mango, the wild Jack, and the black, red and iron wood trees are common everywhere; those yielding gamboge, dragon's blood, *Muttippal* and other

kinds of aromatic gums are met with amongst the species of resin trees. Travancore seems to be the home of the Palm of which there are at least six species in the forests, two cultivated—the *Borassus flabelliformis* or Palmyra palm and the *Corypha unbraculifera* or the Talipot palm, and four wild—the *Pinanga dichronii*, *Caryota urens*, *Bentinckia condapana* and *Arenga wightii*.

The plains are not so thickly wooded and in certain places are bare as in parts of South Travancore, though this part of the country and the adjacent districts of Pandi must have been at one time covered with dense jungle. The low country trees are of the ordinary type and there is a lamentable absence of good fruit trees. The Jack and the Mango, generally of the inferior sort, are met with in every compound and garden. The Palmyra abounds in South Travancore as does the Cocoanut in Central and North Travancore; the Tamarind is but poorly represented considering the facilities for its growth. The Bamboo is practically unknown in the plains though the banks of rivers and channels afford fine soil for its growth. The avenue trees are chiefly Banyan, Arasu, Poo-arasu, Ichi and Naval interspersed occasionally with the Mango, Jack and Tamarind. There is a large variety of medicinal plants, and those yielding fibres, gums, resins, and dyes, a reference to which will be made later on.

Mr. T. F. Bourdillon, the Conservator of Forests, after commenting on the similarity of the flora of Travancore and Assam thus observes in an interesting article on the Flora of Travancore* :—

"From this it is reasonable to infer that one continuous forest of uniform character stretched from the west coast of India to Assam and Burma, and that the plants now found in the opposite extremes of India are the descendants of a common ancestor. The forests that still remain are the relic and the development of the great forest that covered the continent, and in the interests of science, the preservation of these remains from complete destruction has not come a day too soon."

Of the general characteristics of the Travancore flora, he writes:—

"Undoubtedly the most remarkable feature of the forests of Travancore is the extent and variety of the Flora. Many writers have commented on the small number of the species in temperate and arctic climates as compared with the variety of species in tropical countries from the time that Darwin published his 'Voyage round the world.' Readers of that inimitable work will remember his description of the dark and sodden forests that clothe the Island of Tierra del Fuego, composed of one species of tree only.

"The most recent authority who has referred to the subject is Gamble, in his preface to the new edition of his Manual of Indian Timbers. He there places

* The Malabar Quarterly Review - June 1903.

'the limiting number of species in the woody vegetation of India' at 5,000. This includes shrubs and climbers as well as trees. With this he compares the 397 species mentioned in the *Forest Flora of France*, which includes many quite small plants, and the 134 species mentioned in Hooker's *Student's Flora*, as occurring in England.

"Now in Travancore more than 600 species of trees are known to occur which attain a height of 20 feet and upwards, excluding climbers and bushes of all sorts, and so little do we know of the trees that inhabit the interior that it is very probable that another 50 to 60 species will be added to the list when all parts of the forests have been explored. We may say that in this State which covers an area of about 7,000 square miles, there are to be found no fewer than 700 kinds of trees or one new kind of tree for every 10 square miles. When it is remembered that about half of the area is open inhabited country, rich in paddy fields and coconut topes and watered by numerous lakes and rivers, the variety of species becomes the more remarkable. This variety is due no doubt to differences of elevation from 0—9,000 feet and to differences of aspect and of rainfall, for according to the locality, the rain falls in different months, and the amount varies from 20 inches to 300 during the year. But there is the result, this astonishing wealth of species, surely nowhere equalled in any other part of the world.

"In one respect this great variety of species may be looked on as an advantage, in another as a disadvantage. Among so many hundreds—nay thousands of trees and shrubs and herbs, there might be a large number capable of producing useful products—timber or fruits, gums, oils, or medicines. The field of work is wide—the results to be obtained both useful and interesting. Who will devote himself to the study? And it must be remembered that there is no finality about the work. We may examine one species of tree or plant and decide that it has no properties which will ever be of any use to man, and the timber, the fruit and the resin may be regarded in the present state of our knowledge as worthless. Let us therefore destroy the plant wherever found, to make way for the better. But next year some chemical discovery may bring to light the fact that this very despised plant has certain properties possessed by no others, such for instance as the peculiar property of dulling the taste of sweet things, possessed by the pretty little creeper *Cynneena sylvestre*. One of the commonest trees in our low country forests is the Charei or Chera, *Holigarna ferruginea*. From its stem, from its leaves and from its fruit issues a blistering juice, of which nothing is known at present except that when it touches the skin of certain persons, the results are swelling and much pain. The immediate conclusion to be arrived at is that such a tree should be exterminated wherever found, for its timber is soft and worthless and is not suitable even for fuel, but who can say that within a dozen years we shall not be asked to collect the acrid juice of this tree as a valuable medical agent? In this way the great variety of our Flora is interesting because it opens up such a wide field for study, and because it foreshadows the great possibilities and the great discoveries yet to be made.

"But from another point of view the variety is a disadvantage. In his report on the Forests of Ceylon written some 20 years ago, Mr. Vincent expressed the opinion that not more than 2 per cent of the species of trees to be found in Ceylon were of any commercial value, and judged by the standard of our present knowledge, the proportion of useful trees in Travancore is very small. There is an unlimited demand for certain timbers, but for others, hardly inferior to the favoured ones, and much appreciated in other parts of India, there is no demand. Who will be so enterprising as to experiment with the despised woods? Many times have we offered them for sale, and praised their good

qualities, but in vain. The ordinary timber merchant will buy the 20 kinds which he knows readily. All the rest are 'Palmarum', useless species to him and only to be consumed as fuel.

"It has often been said that the trees and plants of India have no flowers and that such flowers as they have are without scent, and that except for the mango and the pine-apples there is no fruit worth eating. This by comparison with Europe. But the comparison is hardly fair. The truth is that the wild products of the one continent are as good as those of the other. Our cultivated plants and fruits are indeed vastly inferior to those of Europe, and the reason is not far to seek. They have not been selected and improved in the way that they have been improved in Europe, because the class of market gardeners and florists, and that of wealthy landowners interested in scientific agriculture does not exist in India, but the material from which to evolve the better product is not wanting.

"It is in the spring time that in Europe the earth puts on her garment of beautiful flowers. Our spring time is in September. It is then that the grassy uplands are covered with balsams, with white and pink orchids and yellow stone-crop. Most of the herbaceous plants blossom then, the pleasantest time of the year when the rains have poured their water on the soil, and the air is cool with soft breezes. So far as the wild flowers go, I do not think that Travancore is far behind other countries. We have no primroses or violets with their sweet scent but we have many beautiful orchids and others such as lilies, and amaryllis all awaiting the art of the horticulturist to improve them almost out of recognition.

"As regards fruits, we have the wild Jack and Mango which bear insipid or acid fruit in the wild state. The difference between the wild and the cultivated forms shows what can be done by cultivation. One of our commonest trees in the forests is the Langan—*Nephelium longum*—which in China produces a fruit of great excellence. It is largely exported from that country. The wild fruit is the size of the top of the thumb, round and wrinkled. Its appearance would not lead one to suppose that it could ever be improved into a fruit for the dessert table. The hillmen recognise many other fruits as fit for food even in their wild state. Some of them are not bad eating, and are at least much better than the wild mango. Perhaps the best of these is the fruit of *Clausena willdenowii*—the 'Potti' of the Hillmen, of which Beddome said, it is 'very delicious, as large as a large cherry, succulent as a grape, and somewhat of the flavour of black currant'. The fruit is not unlike a white grape but instead of growing in bunches, 6 or 8 fruits grow along a common stalk. This and many other wild fruits are well worthy of improvement and cultivation but this *Clausena* in particular. It does not like being moved from the climate and surroundings in which it is generally found.

"The vegetation and Flora of Travancore are of exceptional interest first, because they are the relic and development of flora which was at one time uniform over a large part of India, secondly, because of the extraordinary variety of species occurring within a small area, and thirdly because many of these species have been taken as types of plants with which others from all parts of the world have been compared."

This chapter* is treated under the following heads:—

* The information for this chapter is based on Mr. Boardillon's exhaustive "Report on the Forests of Travancore" and his "Notes on some of the commoner trees of the Travancore forests", Drury's "Useful plants of India", and Balfour's "Timber trees of India". The draft as originally prepared, from which this one is condensed, has been kindly corrected by Mr. Boardillon himself.

- (1) Valuable timber trees
- (2) Trees yielding gums, resins, and dyes
- (3) Avenue trees
- (4) Cycads and palms
- (5) Bamboos and reeds
- (6) Fibrous plants
- (7) Medicinal plants
- (8) Flowering and Ornamental plants

Valuable timber trees. There are nearly 650 indigenous trees in the forests of Travancore. This number includes many species occurring in North India and others peculiar to Ceylon. The uses only of a very few trees are known in Travancore. Others are considered useless and are popularly known as *Palmarangal*. In other parts of India these trees are highly valued. As the trees which are now considered valuable are getting rarer, the latter trees will in future be looked upon by the people as valuable and will be utilized.

1. Teak, Tèkku — *Tectono grandis*.

This is rightly called "the monarch of the woods" as it is the most highly-priced timber under favourable circumstances and is perhaps the most useful of all the timber trees of India. It generally grows to a height of 80 to 100 feet to the first branch with a girth of 22 feet. In Travancore the tree seldom attains a height of more than 50 feet to the fork and a girth of 10 feet. It thrives best with a rainfall of from 120 to 150 inches and in a temperature ranging from 60° to 90° and attains its maturity in from 80 to 100 years and is sometimes found 400 years old. It grows in open forest, wants much room and light and never occurs in heavy moist forest from sea-level up to 8,000 feet elevation. The teak tree is usually found with such trees as *Dalbergia latifolia*, *Pterocarpus marsupium*, *Terminalia paniculata*, *Anogeissus latifolia*, *Schleichera trijuga*, *Gmelina arborea*, *Sterospermum xylocarpum*, *Careya arborea*, *Phyllanthus emblica* and others. It grows best at an elevation of 1,000—2,000 feet. The Idiyara valley has long been celebrated for the quality and size of its teak. Fifty or sixty years must pass after plantation before the tree can yield serviceable timber. The wood is brown in colour and when fresh sawn has the fragrance of rosewood—hard yet light, easily worked, strong and durable though porous. Its strength and durability are well known; for house-building and furniture it is the best of woods.

The Malabar teak is generally esteemed the best. For ship-building purposes, it is superior to every other sort of wood, being

light, strong and durable whether in or out of water and hence it is extensively used for that purpose. A cubic foot of seasoned wood weighs about 40 lbs., that of unseasoned 55 lbs. or more. Burma teak is much lighter and kole teak is heavier. A commercially valuable oil is extracted from the teak wood.

Kole teak is teak occurring in hard and unsuitable soil and hence growing not more than 3 feet in girth. Most of the teak in the low country is kole teak and its wood is close-grained and heavier than the ordinary teak.

2. Malabar Blackwood (Rosewood), Eattie—*Dalbergia latifolia*.

There are two species which yield blackwood, found in Travancore, viz., *D. latifolia* and *D. sissooides*. It attains an enormous size in Malabar and is often crooked. It is one of the most valuable trees of the Travancore forests. It is heavy and close-grained admitting of fine polish and is much used for furniture but seldom for building. The wood is white externally; in the centre of the trunk and the large branches it is purple or purplish black, often mottled or with light coloured veins running in various directions. The tree grows to a height of 60 to 80 feet and requires a temperature slightly cooler than that in which teak thrives, with a rainfall averaging from 50 to 150 inches. In strength it excels teak, but is very scarce and of slow growth, and less adapted for plantation than the teak. It does not seem to prefer any particular soil. It grows in the Travancore hills at an elevation of 0-3,600 feet and prefers a rather higher elevation than teak. One cubic foot of seasoned wood weighs 52 lbs; unseasoned 60-66 lbs.

3. Ebony, Karungali — *Diospyros assimilis*.

This is a large tree 80 or 90 feet in height and 6 or 8 feet in girth growing in the Travancore forest at an elevation of 0-2,000 feet. It requires a considerable rainfall, but still it is very sparingly distributed. The heart-wood is black, hard and heavy, and is most valuable. In strength it excels teak. It is not much used as a building material for the simple reason that wood of this kind, more than 6 inches square, is very seldom obtained. When young the wood is white, but as the tree advances in age the black portion increases until at last in the later stages of its growth the black heart is of considerable size. But there is always a large quantity of sap-wood even in old trees. It is used chiefly for ornamental work, furniture, inlaying, mathematical instruments, rulers &c.

The tree is of very slow growth. More than 100 years should elapse

before an ebony tree attains a diameter of 1 foot. It is not suited for plantations. There are nearly 20 other kinds of Diospyros, but none of them have blackwood except *D. ebenum* which is extremely rare. One cubic foot of seasoned wood weighs 81 lbs; unseasoned 90-100 lbs.

4. Sandalwood—*Santalum album*.

This small tree (height never more than 20 feet) grows in the Travancore hills at an elevation of 3,000 feet, and is celebrated for its highly scented and valuable timber. It is very sparingly distributed in Travancore, being found only in the Anchanad valley. Three varieties of sandalwood are known in commerce, the white, the yellow, and the red—the two former coming under *Santalum album* now under notice. The timber is eminently fitted for carving and other ornamental work such as small boxes, walking sticks, pen-holders and other fine articles. From this wood is produced the paste Chandanam which is used by Hindus for their caste marks. A valuable oil is distilled from the wood, 1 pound of the wood yielding about 2 drams of oil. The fragrance increases as the tree advances in age.

This also is a tree of slow growth, reaching its full development in 60 to 100 years, by which time the tree will have a diameter of one foot of heart-wood. It is well adapted for plantations if suitable land is selected, i. e., land with good soil and elevation not less than 1,000 feet and a light rainfall of 20 to 50 inches.

5. Anjili, Ayani—*Artocarpus hirsuta*.

This lofty and handsome tree (height 100-150 feet, girth 16 feet) grows in the Travancore forests at an elevation of 0-3,000 feet. It yields the valuable wood so well known on this coast for house-building, furniture, frame works, boats etc. It grows very rapidly on yellow loam with a rainfall exceeding 60 inches, reaching its maturity in 25 to 40 years. Its wood is bright yellow turning to brown with age, very straight-grained and free from knots and takes a fine polish. The bark yields a brown dye and the fruit is edible. The tree is well suited for plantations. Weight of seasoned wood 42 lbs. a cubic foot; unseasoned 48 lbs.

6. Thambagam—*Hopea parviflora*.

This lofty tree (height 100 feet, girth 15 feet) thrives best in heavy forest at an elevation of from 300 to 3,000 feet. It is also found to some extent along the banks of rivers in the low country. The wood is close-grained, heavy and yellow becoming darker with age. It is used for bridges and buildings of all sorts and occasionally for boats. It stands

exposure when sawn into scantlings but cracks if sawn into thin planks. It is not attacked by white ants.

This tree grows nearly as fast as Anjili but is difficult to raise from seed. It is well suited for plantations.

7. Venga—*Pterocarpus marsupium*.

This is a large and very beautiful tree, especially when in flower at the beginning of the rains (height 80 to 90 feet, girth 10 feet). It yields one of the most abundant and useful timbers, the Venga wood of South India. It is widely diffused and is found in large numbers in the forests of Travancore. It grows best on stiff soil at an elevation of 0-3,000 feet and is found in company with Eattie, Thembavu and other trees. It is found in abundance where teak is scarce. It is a fast grower and attains maturity in about 60 to 80 years and grows to double that age, but is not suited for plantation as it is not gregarious. The timber is as strong as teak, heavier, and less liable to split after long exposure. The colour of the wood is dirty yellow darkening with exposure. It is never used for house-building in Travancore, as, when wet or unseasoned, it imparts a yellow stain and gives out to wet lime a dark rusty brown colour. It is specially useful for fine furniture and resembles fine Mahogany but must be well seasoned to avoid the yellow stain. Seasoned wood weighs 56 lbs. a cubic foot; unseasoned 65-70 lbs.

This tree yields a resinous substance which is exported in large quantities. This is the gum Kino of commerce used largely for dyeing and calico-printing.

8. Thembavu—*Terminalia tomentosa*.

This is another huge tree (height 80 to 120 feet, girth 12 feet) growing in open grass forest at an elevation of 0-3,000 feet in company with blackwood, teak and other trees. Its growth is fairly fast; it reaches maturity in 80-100 years and lives for more than 200 years. The wood is dark brown, hard and heavy, and is much used for house-building. In matured trees, the wood is exceedingly heavy, of the same weight as water and is not easily worked. It is a disappointing timber. Its strength and durability are uncertain or it would be used even more largely than it is. The weight of seasoned wood is 60 lbs. a cubic foot, and that of unseasoned 75-80 lbs.

The ashes of the burned bark produce a kind of chunam which contains much potash. The bark is used in tanning and the leaves for

manuring the paddy fields. The leaves form the food of the Tusser silk-worm. A dyeing substance is obtained from the bark of this tree which is used for brown colouring.

9. White Cedar, Vellai Agil—*Dysoxylum malabaricum*.

This lofty tree (height 120 feet, girth 16 feet) is found only on the West Coast of India from Canara to Cape Comorin and there, it is abundant and well distributed. It grows in moist forest at an elevation of 0-3,000 feet and attains its greatest size at an elevation of 1,400 feet. The wood is pale yellow with a smooth silky vein, sweet-scented and easily worked and is used for oil casks. It does not stand exposure. Seasoned wood weighs 42 lbs. a cubic foot; unseasoned 52 lbs.

The cedar is a tree of moderate growth, 500 years being the limit of its life; it grows more rapidly in its younger stages.

10. Red Cedar, Madagiri Vembu—*Cedrela toona*.

This large and valuable tree (height 60 feet) is abundant in Travancore. It grows at an elevation of 0-4,000 feet and is common on the Peermade hills. This is well suited for plantations and grows well with Anjili. The wood, coarse, red and sweet-scented, is used for furniture of all kinds, house-building and carving and is called the "Mahogany of India" which it resembles closely, though lighter and not so close in the grain. It admits of fine polish. It is used also for tea boxes, shingles and cigar boxes.

11. Ventekku—*Lagerstræmia lanceolata*.

This is a large tree with a straight stem, (height 120 feet, girth 12 feet), with a smooth, very pale bark scaling off in thin flakes not much thicker than paper and found only on the West Coast from Bombay to Cape Comorin. It grows to its largest size in the forests of the north at a low elevation of 200 to 300 feet; it is never found in the dense moist forests. It lives for more than 200 years but grows very slowly and is not therefore suited for plantations. The wood is light brown, straight-fibred and elastic but splits easily. It is not strong and does not stand exposure to the weather.

12. Jack, Chakka or Pilavu—*Artocarpus integrifolia*.

This valuable fruit and timber tree is much planted and grows largely all over Travancore. It grows best in rich red soil with a rainfall of not less than 50 inches. It grows rapidly when young, but after it has attained a diameter of 2 feet its growth is slow. It lives for more than 200 years. It is much cultivated in the low lands for fruits and along the

roads for shade. It attains a height of about 80-100 feet with thick spreading branches. The fruit is very large weighing from 30 to 40 lbs. The green fruit is used in curries. The tree bears fruit in about 7 years, the fruits appearing in all parts even at the very root. Hence the proverb:—“വേണമെങ്കിൽ ചക്ക വേരിലും കാത്തു.”

The wood is excellent and is highly valued; it is yellow when cut, afterwards changing into dull red or mahogany colour. It admits of fine polish. It is used both for building purposes and for furniture of various kinds, such as chairs, tables &c., musical instruments and ornamental work. Of late years jack wood has been superseded by blackwood in the matter of furniture making. The weight of seasoned wood is 42 lbs. a cubic foot; unseasoned 50 lbs.

There are several varieties of the Jack tree, but what is called Varikka or the honey jack is the sweetest and best. The fruits yield a good red dye.

13. Irul—*Kodaxylia dolabriformis*.

This tree is not found in South Travancore, but is common in North Travancore. It is a large tree growing to a height of 80-100 feet with a girth of 9 feet. It is always found in company with teak and requires a rainfall of not less than 100 inches. The wood is dark red, hard, heavy, durable and close-grained but not easily worked. It is used for boats, sleepers, posts, carts, house-building etc. It lasts a long time under water and is hence used in the construction of bridges, but in small scantling it is inclined to split and warp if exposed. It is however not much valued in Travancore. The weight of seasoned wood is 58 lbs. a cubic foot; unseasoned 70 lbs.

14. Mayila—*Vitex altissima*.

This is a large tree with a height of 80 feet and a girth of 12 feet, widely distributed throughout Travancore at all elevations between sea-level and 3,000 feet. It is a moderately fast grower. It increases in diameter 1 inch in 5 years and lives to be nearly 300 years old. The wood is hard, durable and flexible, with a coarse grain, is light brown in colour and does not split nor warp. It is highly esteemed in other parts of India for buildings, carts &c., but here in Travancore the people prefer other trees for such purposes. The unseasoned wood weighs 63 lbs. a cubic foot, and seasoned wood 53 lbs.

The Vernacular name covers two other varieties viz., *Vitex pubescens* and *V. leucorylon*.

15. Manjakadambu—*Adina cordifolia*.

This lofty tree (height 100 feet, girth 9-16 feet) is found only in the open moist forests between sea-level and 3,000 feet elevation; it is particularly abundant and reaches a very large size in the forests near Konniyur and in North Travancore. The wood is light yellow seasoning to nut brown, close-grained, smooth and light, and admits of a fine polish but does not stand exposure to water. It is used for building, furniture, boxes, turnings &c., in other parts of India, but in Travancore it is not much used. Weight of seasoned wood 42 lbs. a cubic foot; unseasoned 50 lbs.

16. Ceylon Oak, Puva—*Schleichera trijuga*.

This is a large handsome tree of slow growth (height 100 feet, girth 15 feet). It lives to a great age of nearly 300 years but is not suited for plantation as its growth is too slow and its value too small. It is found in Travancore with Irul, Maruthu &c., on the deciduous forests 0-2,000 feet. Its wood is strong and durable, seasons and polishes well and is used for carts, sugar and oil mills, and a variety of other useful purposes. Weight 67 lbs. a cubic foot.

17. Manimaruthu—*Lagerstræmia flos-regineæ*.

This is a medium-sized tree of very ornamental appearance on account of its handsome pink flowers, found along the banks of streams and in the open forests. It lives to be nearly 200 years old. Its wood is pale red, tough and very durable under water but it decays under ground and is seldom used in Travancore. Seasoned wood weighs 38 lbs. and unseasoned 48 lbs. a cubic foot. Silkworms feed on the leaves of this tree.

18. Mango, Mavu—*Mangifera indica*.

This useful tree is found wild in our moist forests at all elevations up to 2,000 feet. In the low country it is much planted for its fruit. It is not a very rapid grower and lives for a century and a half. The wild fruit is hardly edible but the low country fruit is very wholesome and when unripe is much used in curries, preserves &c. Its flowering time is January, February and March and the fruits ripen from May to July. There are several varieties found in Travancore. The wood, dull grey and porous, is very serviceable for planks when not exposed to wet and hence much used for house purposes. It can also be used for canoes as it bears the action of salt water well. Seasoned wood weighs 42 lbs. a cubic foot and unseasoned 55 lbs. The leaves form an excellent food for silkworms.

19. Malampunna—*Calophyllum tomentosum*.

This is a handsome tree of very large size reaching a height of 120

feet or more and a girth of 10 feet, found all through Travancore in the dense evergreen forests from 300 feet elevation to 400 feet. It requires a rainfall of not less than 100 inches and thrives on very poor soil where no other tree will succeed. The wood is reddish, loose-grained, long-fibred and elastic. In the coffee and tea plantations it is used for reapers, packing cases, rough planking and furniture; its chief use however is for spars of vessels, its great length, lightness, straightness and elasticity making it most suitable for this purpose; a single spar sometimes realises 1,000 Rs., but the demand is uncertain and unequal. The Pinnakai oil so largely used for burning lamps is made from the seeds of the Alexandrine Laurel, *Calophyllum inophyllum*, a small tree abundantly planted in the low country.

20. Cheeni—*Tetrameles nudiflora*.

This is a very lofty tree (height 120 feet) with grey shining bark and small flowers, widely distributed in Travancore. It requires a very heavy rainfall, grows very fast and lives for more than 200 years. Its wood, dirty white, exceedingly light, soft and even-grained, takes a good polish and paint and is used for canoes, boats and catamarans, carved toys &c., but it is neither strong nor durable and white ants eat it. This tree is not suited for plantations on account of its low value.

21. Pathiri—*Stereospermum chelonoides*.

This is another large and handsome tree (height 100 feet, girth 8 feet) with very beautiful pinkish flowers and occurs in Travancore from sea-level up to 3,000 feet both in the dense moist forests of the hills and in the open forests and in grass land, associated with teak and other trees. It is much planted on account of its ornamental appearance. Its wood, orange or reddish brown, is close and even-grained, elastic, durable and easily worked, gives a smooth surface and is used for house-building and for furniture and makes excellent fuel. This is a moderately fast growing tree and lives for more than a century. Seasoned wood weighs 48 lbs. a cubic foot; unseasoned 58 lbs.

22. Cotton Tree, Ilavu—*Bombax malabaricum*.

This large and stately tree (height 150 feet or more, girth 18 or 20 feet) with very large and showy flowers occurs in Travancore from sea-level up to 3,000 feet attaining its greatest height and girth in moist forests at the foot of the hills. Its wood is whitish, coarse-grained and brittle, but stands the action of water well and is hence used for floating rafts and packing boxes. Cotton or the wool of the pods is used for stuffing pillows, cushions &c. This is a fast-growing tree and lives for

more than 200 years. Silkworms feed on the leaves of this tree and the large honey bee makes its nest chiefly in this tree.

23. Karuntagara or Vaga—*Albizzia procera*.

This is a moderate-sized, fast-growing tree (height 60 feet, girth 6 feet), occurring in moist situations as on river banks. It flourishes best in open situations and is not found south of Trivandrum. The sap-wood is yellowish white and not durable while the heart-wood is brown, straight and even-grained, seasons well, works freely, and admits of fine polish and is hence good for furniture, boxes, agricultural implements etc. Weight averages 46 lbs. a cubic foot.

These are the most valuable timber trees of Travancore. Among the other useful trees employed in the low country and having some market value may be mentioned the following:—

1. Malakanjiram—*Anogeissus latifolia*.

This tree is common in the drier districts of South Travancore and on the Peermade hills near Kambam and in the deciduous forests near Konniyur. The wood is dark-coloured and strong and is used for bandy poles and agricultural implements. A valuable gum is obtained from its stem which is used in cloth-printing and its leaves are used for tanning.

2 Ironwood, Nangu—*Mesua ferrea*.

This tree is abundant in the evergreen forests from 0-6,000 feet. Its wood is very heavy, hard and durable; but for its great weight it would be more commonly used for building. It gives out great heat when burnt and makes first rate charcoal.

3. Nedunar—*Polyalthia fragrans*. This is a straight tree abundant in the forests of North Travancore. The wood is light and very elastic and is very well adapted for masts and yards.

4 Shurali—*Hurdwickia binata*. A very large tree yielding timber of an excellent quality for beams and a variety of uses, found only on the Western Ghats from South Canara to Cape Comorin. The wood is brown and exudes a sticky oil resembling Copaiba balsam for which it may be substituted.

5. Indian Copal, Payin — *Vateria indica*. This beautiful tree which is so much planted in gardens and along avenues for the fragrance of its flowers and which is very abundant in the moist forests, is sometimes cut for boats. It is better known for its gum called white dammer, an excellent varnish resembling copal.

