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MAPS.

Map of the Byraghur Reserve, Berar.
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" " Mhairwarra.
" Nilambúr Teak Plantation.
" Buxa Plain Reserve

NOTE.—The following papers, which were read at the Conference, either entirely or in part, have already appeared in print, or will eventually do so. It has not, therefore, been considered necessary to publish them in this report —

1. *Mr. Brandis*.—"The Aim and Object of Forestry in India" will appear in the "INDIAN FORESTER."
2. *Mr. McKee*.—"On the Cultivation of Lac in the Central Provinces" appeared in the January 1876 number of the same journal.
3. *Dr. Warth*.—"On the Impregnation of Wood" appeared in the July 1876 number of the same journal.
4. *Lieut. de Wolski*.—"On the Working of Wire Rope Tramways" will be published by the Author.
5. *Mr. Smythies*.—"On Forest Terminology" appeared in the January 1876 number of the "INDIAN FORESTER."

ERRATA.

- Page 1. Add under "VI, Government of the Punjab," "Mr. C. B. Leupolt, Executive Engineer Simla."
- Page 40, line 26 from bottom, for *guardsmen*, read *guards, men*.
- Ibid*, line 7 " insert comma after *Conservator*.
- Page 62, line 31 from top, for *coute qui coute*, read *coûte que coûte*.
- Page 63, line 13 " for *feet* read *inches*.
- Page 64, line 31 }
Page 65, line 33 } " read *Arbor-tristis*.
- Ibid*, line 34 " read *Vaklii*.
- Page 69, line 2 from bottom, for *nertiæ* read *inertiæ*.
- Page 71, line 34 from top, for *inches* read *feet*.
- Page 80, line 15 " for *Forset* read *Forest*.
- Page 81, line 18 " for *Govornment* read *Government*.
- Page 82, line 41 " for *inclinations* read *bearings*.
- Page 83, line 18 from bottom, for *Herrn* read *Herr*.
- Ibid*, line 19 " read *Herr Oberforstrath*.
- Page 84, line 4 " read *Bestandeskarte*.
- Page 86, paragraph 9, last line, for *Specialkarte* read *Bestandeskarte*.
- Page 94, line 4 " read *Lagerstromia*.
- Ibid*, line 5 " read *Semecarpus Anacardium*.
- Page 115, line 17 " read *dealbata*.
- Page 123, line 10 from bottom, for *on* read *no*.

APPENDIX I.

THE following papers were contributed to the Conference, but were not read for want of sufficient time.

The influence which Forests exercise on the climate of countries, by M. J. CLAVÉ, being a résumé of an article in the Revue des deux Mondes, 1st June 1875, by Lieutenant-Colonel Pearson.

It is proposed in the following paper to consider the influence which forests may exercise on the climate of a country, and especially on its rainfall; but before proceeding any further, it will be best, in order to clear the ground for the better understanding of the subject, to give a short explanation of the laws (so far as they are known) which govern the great movements of the atmosphere surrounding our globe. This atmosphere extends generally to the height of about 40 miles above the earth's surface, but this height is neither everywhere nor always the same. It may be compared to a sponge filled with water which, when it is subjected to any compression, voids a portion of that water in the form of rain, its dilation being followed by the contrary effect, that is, by the absorption of more moisture.

In the higher regions of the atmosphere the air is exceedingly rarified and the temperature very low; but the temperature and density of the air both increase simultaneously in proportion as the earth's surface is approached. The weight of the atmosphere is measured by the barometer, the height of the mercury in the tube indicating the height of the atmosphere above us at the time being; and since in any fluid body the particles or atoms at once commence to force their way from the points where they are in excess to those where they are wanting, when the barometer is low, that is, when the height of the atmosphere above us is below the mean, currents of air or winds are produced, in order that an equilibrium may be restored.

The air always contains a certain quantity of watery vapour, and this is greater in proportion as the temperature of the air is higher. If the atmosphere becomes cooled, a portion of that vapour is condensed, and falls to the earth in the form of rain.

The sun's rays in the neighbourhood of the equator warm the masses of gaseous vapour in contact with the earth; when warmed, these become dilated, and imbibing moisture from the sea by the process of evaporation in the same way as a sponge sucks up water, rise to the higher regions of the atmosphere. There these great bodies of heated air and water form a gigantic belt called "a cloud ring" round the earth in the neighbourhood of the equator; and as they become massed and pressed together, they glide away towards the north and south, down the convex sides of each atmospheric hemisphere, while the cold air from the poles rushes back to occupy their place, in the same way as the difference between the temperature of a heated room and the outside air produces a draught in the chimney of a house. Thus a double current of air is produced in each hemisphere,—namely, one from the equator to the poles in the higher regions of the atmosphere, and the other from the poles to the equator in the lower regions. Were the earth stationary, these currents or winds would blow always directly north and south; but since the earth rotates on its axis from west to east, and since its motion is more rapid at the equator than near the poles; in the northern hemisphere, each particle of air, in advancing northwards, becomes deflected more and more towards the east, so that the current of air, which blows from the equator to the poles, becomes successively, first, a south-west, and then a west wind. But the body of air which is travelling continually northwards finds, the farther it goes, a narrower space to occupy, owing to the gradual narrowing of the parallels of longitude as the north pole is approached; and the consequence is that it is driven back on itself, and so becomes, as it were, broken up, escaping in various directions, and forming irregular currents or winds. At the same time the return current from the pole to the equator meets parallels of longitude where the rapidity of the earth's rotation increases in proportion as the equator is approached; thus it becomes deflected more and more to the west, and tends to become an east wind; and as the space which it has to occupy enlarges itself, the current itself becomes in consequence more feeble and regular. So we find near the equator trade winds and monsoons which blow for months together in the same direction, while in the higher latitudes we find a more irregular atmospheric action in proportion as we approach the poles.

Again, according as these currents or winds traverse continents or oceans, they imbibe either heat or moisture in greater proportion and become dry or moist winds, bringing with them either fine weather or rain,—so of the mass of vapour which is drawn by the sun's rays from the ocean in the neighbourhood of the equator, a portion falls immediately in the form of rain, consequent on its condensation by cold in the higher regions of the atmosphere; and the rest is driven, as shown above, towards the temperate regions of Europe, where it turns into rain and falls to the earth as often as the lowering of the temperature or other local circumstances produce condensation. The return current from the pole, having thus got rid of nearly all its moisture, in its passage across the earth's surface, becomes a hot or dry wind, and thus is fitted once more to absorb moisture, which it does in the neighbourhood of the equator; and so it comes to pass that the great meteorological actions of the atmosphere are continually repeating themselves.

In our hemisphere there exist two great main equatorial currents, one of which has its origin in the Pacific, the other in the Atlantic Ocean.

The latter of these follows very nearly the course of "the Gulf stream" in the sea, being deflected to the east as it proceeds northwards, and becomes a west wind by the time it reaches Sweden and the Gulf of Finland.

Arrived in these regions, and its temperature having been sensibly cooled, it becomes changed into a polar current, and after traversing Eastern Europe and a portion of Asia, returns to the equator as a north-east wind.

Such, then, is the general direction of the great aerial currents; their regular course, however, is affected within certain limits by causes which are as yet but very imperfectly understood. Among these disturbing causes are cyclones or circular storms which seem to be eddies or whirlpools which the great atmospheric currents create along their ever-moving sides; of their exact nature no doubt now exists, as they have been proved to be currents of air or storms revolving with great rapidity around centres of barometric depression, which themselves remain calm. These centres have at the same time a progressive motion, and, as their rotatory direction is always the same way* in either hemisphere, the direction that their centre bears from any given point can easily be ascertained through the successive shiftings of the winds and their main danger thus avoided by a careful observer. It would seem that, as a general rule, cyclones are formed near the equator and in this hemisphere travel northwards, following the coast of America till they reach Europe, which they cross sometimes as far north even as Iceland and finally wear themselves out in the extreme eastern parts of Asia, where in the China seas they are especially dangerous. Of late years arrangements have been made to telegraph their approach across Europe which must have tended to save thousands of human lives.

Without going further into the subject of meteorology or following out the speculations which some have entertained on the influence of the moon on the changes of the weather, it may be accepted as a general law that the heat of the sun causes the absorption of vapour by evaporation, while the lowering of the temperature causes the rain to descend through the action of condensation. We will now endeavour to trace how far forests have any influence in bringing about and regulating these actions.

II.

The influence of forests in affecting the climate of countries has been exceedingly contested; denied by some, it is admitted by others, who are, however, by no means agreed as to the manner in which that influence is exercised.

The fact is, that the phenomena through which it is manifested are exceedingly complex and often disguise each other, so that, to understand their effects at all clearly, a careful examination of each action of these phenomena is necessary.

There are four separate actions of nature through which it may be said that forests influence in some way or other the physical condition or climate of a country: *first*, there is a chemical action through the leaves in decomposing the carbonic acid of the air; *second*, a physical action in retaining moisture in the earth and in checking the violence of the wind; *third*, a physiological action in transmitting to the air, through the leaves, a portion of the moisture which the roots draw from the earth; and *fourth*, a mechanical action, through the roots, in retaining in its place the earth, especially on the sides of mountains and hills. Let us examine briefly each of these.

It is well known, as regards the first, that the carbonic acid of the air is decomposed through the action of the leaves of trees causing an assimilation of carbon in the woody tissues of their trunks and the throwing-off of oxygen into the atmosphere. It is argued that this must cause a lowering of the temperature, inasmuch as the wood, to give out heat when it is burned, must necessarily absorb it while it grows; so that forests are, in fact, great condensers for extricating and storing up caloric, to be given out again at a future time of need.

Facts seem to confirm this theory, and several works have been written to prove its truth. MM. Becquerel and Bossingault instituted a series of observations which they published,† proving that the temperature of forest-covered countries is from 6° to 7° Fahrenheit (2° Reaumur) lower than that of countries which are denuded of wood. The observations of M. Mathieu of the Forest School at Nancy and of M. Fautrat are more recent and more exact.

M. Mathieu established three stations, each with a complete set of instruments, for measuring the rainfall, temperature and moisture of the atmosphere in the neighbourhood of Nancy so far back as 1866, since which date observations on these points have been noted down and collated by him,—observations which, extending as they do over a period of nearly ten years, are exceedingly valuable. One of the stations selected by M. Mathieu is in the middle of the forest of Haye, about five miles from Nancy; a second is just on the border of the forest at "la Belle Fontaine," and at about the same distance from Nancy; and the third is at Amance, in an open, but moderately-wooded, though purely agricultural, district, 10 miles from Nancy. The results which M. Mathieu has obtained are singularly uniform, and they have been reproduced so often that even so careful and conscientious an

* It is ascertained that cyclones rotate with the hands of a watch in the southern hemisphere, and in a contrary direction in the northern.

† Des Climats et de l'Influence qu'exercent les Sols Boisés et Non Boisés, par M. Becquerel, 1853.

observer as M. Mathieu considers that they may be held to be dependent on a general law of nature. They may be summed up as follows:—

- 1st—That the mean temperature in a forest is *always* lower than in an open, unwooded tract of country.
- 2nd—That this difference is less sensible in winter than in summer.
- 3rd—That in a forest the maximum temperature of day and night, taken together, is always lower, and the minimum temperature always higher, than in the open.
- 4th—That in a forest the changes from heat to cold, and *vice versa*, operate more slowly.
- 5th—That the day and night temperature is more nearly alike, also that the change of temperature from one day to another, and from one season to another, operates less rapidly in a forest than in the open.
- 6th—That sudden changes of temperature, when they do come, being more gradual, are less felt in the forest than in the open.

And in regard to details:—

- 1st—That throughout the year 6 per cent. more rain falls in the forest than in the open;
- 2nd—That, of the rain which falls throughout the twelve months of the year, about 10 per cent. is caught by the leaves in a forest and does not reach the earth.
- 3rd—That the evaporation in the open country is five times as great as in a forest, in consequence of which the soil in a forest notwithstanding the diminished amount of rain which reaches the earth, retains its freshness and moisture long after that in the open has become thoroughly dried up.

M. Mathieu's observations then lead to the conclusion that, while, on the one hand, forests tend to lower the general temperature of a country and so to promote the fall of rain at regular intervals and in moderate quantities, on the other hand, they ward off sudden meteorological changes, which are dangerous, inasmuch as they cause sudden and heavy falls of rain, which result in floods and other like disasters.

The observations of M. Fautrat, though extending over a much shorter period of time, have a greater value than even those of M. Mathieu, in regard to the direct action of forests in regulating the temperature through the decomposition and assimilation of carbon and the emission of oxygen in the air. Apprehending that objections might be raised as to the value of M. Mathieu's observations, on the ground of the distance of his stations from each other, as well as of one of them from the forest, M. Fautrat, whose observations were made at Fleurines, in the forest of Halatte, erected his instruments almost close together: one pluviometer was placed 25 feet above the tops of the trees inside the forest, and the other in the open plain, but close to the border of the forest, 250 yards only from the first, and at the same height from the ground. During the eight months over which the observations extended 11·80 inches of rain were measured in the pluviometer inside the forest, while only 10·95 inches were measured in the other, which was outside, being an excess in favour of the former of 8 per cent., while the amount of moisture in the air above the forest, as compared to that above the plain, was as 63 to 61.

Furthermore, of the 11·80 inches of rain which were registered in the forest pluviometer, only 7·07, or about 60 per cent., reached the ground; while at the same time the evaporation was five times as great outside the forest as inside it. These results, being obtained at stations situated so near each other, are exceedingly striking, as they tend to prove a considerable direct influence in forests on the amount of rainfall and moisture.

It will be observed that M. Fautrat's observations give an excess of 2 per cent. over those of M. Mathieu in the amount of *excess* rainfall in forests. It is probable that this is owing to the fact that M. Mathieu's observations extend over the whole year, including the months during which the trees are denuded of leaves, when the particular influence now under discussion is necessarily *not* exercised at all, while M. Fautrat's observations were taken for a period of eight months only, during the greater part of which the trees were in leaf. The difference between the amount of rain caught by the trees, as shewn by M. Mathieu and Fautrat, must be thus accounted for, as, by including the winter months, the average is of course considerably lowered.

M. Cautegril, Inspector of Forests at Carcassonne, near Toulouse, in the extreme south of France, also carried out a series of similar observations with pluviometers scattered at different stations over his department (Aude), and with precisely similar results.

Again, it is certain that several descriptions of trees, notably pines and firs, as well as the Australian eucalypti, and the Indian neem, are powerful agents in deodorizing and purifying the air by the chemical action of their leaves, and thus checking malaria. In this way many cities which were previously extremely unhealthy have been rendered not only habitable but salubrious by the planting of trees. Indeed, wherever forests have a prejudicial effect on the health of places, it will generally be found to be caused by the rank undergrowth, and not by the trees.

Let us pass on now to the physical action of forests on the air. This may be said to be two-fold: 1st, by preventing the loss of moisture through evaporation and so promoting its absorption by the earth; and 2nd, by acting as a barrier to the violence of storms. It has been shewn above that so great is the protection afforded to the earth in a forest by the leafy canopy which covers it, as well as by the bed of dead leaves on its surface, that only one-fifth of the moisture is lost by evaporation, as compared with the loss by the same action in an unwooded plain, and that this is the case, although a considerably smaller portion of the rain which falls actually reaches the earth. The bed of dead leaves in the forest acts like a sponge, soaking up and retaining the rain and regulating its distribution, or through the roots of the trees,

which act like vertical drains, promoting its descent into the lower strata of the earth, there to nourish the springs. More specially in the mountains is the benefit of forests, when they act thus, felt; as the melting of the snow often sets at liberty within a very short time a large amount of water, which, if not so caught and absorbed, would run off unprofitably, and often would cause terrible and destructive inundations.

For proofs of the former it is only necessary to turn to countries which are denuded of trees, as is the case with Central Asia and Upper India. The vivid description of a dust storm in the desert by the great traveller Vambéry is hardly needed by those who have seen a dust storm in the North-West of India, to enable them to realise the power of the wind in a country where its violence is unbroken by the presence of trees, and it is well known that violent hail storms are never known in well-wooded countries. Indeed, hail is formed by the intense cold produced by rapid evaporation, which absorbs the latent heat contained in the drops of rain as they fall rapidly through the strata of over-heated air. As has been shewn above, in a forest, on account of the greater degree of moisture in the air, evaporation goes on much more slowly than in the open, and consequently the conditions necessary for forming hail are not present.*

But, thirdly, forests have a physiological effect on the atmosphere, inasmuch as they withdraw from the soil a certain amount of moisture, a portion of which only is assimilated in the woody tissues of the trees, while the rest is thrown off into the air by the transpiration of the leaves. This action probably acts as a natural balance to the greater amount of moisture which the presence of a forest retains in the soil. Instances without number may be adduced of this action on a large scale, notably in the Dunes of Gascony south of Bordeaux,—at Sologne,—and at St. Amand (Nord), where plantations of firs on a large scale have had the effect of draining the marshy lands in their vicinity. But the phenomena connected with this portion of the subject have been insufficiently studied, and there is but little really known as to the difference between the action of forests through evaporation and that of ordinary field cultivation, nor even as how far the effects produced, as cited above, may be due to the direct action of the roots as drains, and not as absorbents. It is hoped that further enquiry will be directed to these points.

Lastly, a few words must be said as to the mechanical effect of the roots of trees in retaining the soil in position, especially on the sides of mountains and valleys,—and so in preventing their denudation. This effect of forests, being self-evident, has been, unlike the first three, but little disputed.

The works of the French Forest Department, in the Hautes and Basses Alpes, are now generally cordially acknowledged even by their former most sturdy opponents—the sheep farmers and municipal councils of those Departments—where the grazing interests are so strong that, to increase the area of grazing ground, the forests had been gradually almost destroyed. So great indeed were the devastations from which these Alpine districts suffered through the denudation of the mountain sides and the consequent formation of torrents, that intervention of the most prompt description became necessary to prevent the destruction not only of the grazing grounds themselves, but of the rich valleys below them. The Government has now at a vast cost undertaken the replanting and regrassing of these mountains on a most extended scale, and many thousand acres are, every year, being placed out of danger by the works undertaken. Already the beneficial effect of what has been done is felt in the diminution of the violence of the torrents, and, as the trees grow up, the benefit will be far more widely felt. It may be observed that during the present summer, where so much mischief has been done in the south of France by inundations, the Durance, which rises in the mountains east of Avignon and which on former occasions has been the worst and most dangerous of all the rivers in the south of France, on account of the inundations it has caused, has scarcely been heard of, and it is around the head waters of this river that the chief plantation works have during the last ten years been carried on; a better proof could not be adduced of the value of these operations.

III.

From what has been said above it will be seen that the action and influence of forests on the climate and physical condition of countries is yet but imperfectly understood; nevertheless, it seems clear that such an influence exists, though it varies in different countries, according to their different physical conditions, being more marked in hot climates than in cold ones.

It is certain that forests tend to lower the temperature. There is evidence of this in the fact that in the time of Cæsar, when the greater part of France was covered with forest, large rivers like the Rhone, were commonly frozen over in the winter, so that, as the great commentator relates, they bore his armies, which were able to cross them. It may be also allowed that in countries denuded of wood the rain falls, if not in less quantity, yet more seldom and with greater violence, and so does less good than in wooded countries. The reason of this probably is that in an open country the sun rapidly heats the air, which absorbs the watery vapours without condensing them, and does not void them again in the form of rain, except on the pressure of contrary currents, or on some such atmospheric disturbance, while in a wooded regions the temperature is naturally lower, so that the vapour, being condensed as it is absorbed, falls regularly in the form of rain, without waiting for some disturbance of the air to cause it to descend. It is evident also that both the leafy heads of the trees above and the mass of vegetable mat-

* I was in the Tyrol in July 1875, when a most terrible hail storm devastated the country around Salzburg, cutting down the whole of the crops over an area of several hundred square miles. It was singular to observe how the ravages of this storm, which originated within the mountains, were confined to the plains only, no hail having fallen in the forest-covered valleys of Reicherhall and Hallein.

ter which covers the surface of the soil below in a forest, tends to prevent evaporation, and so preserves the moisture in the earth, and prevents the too sudden running-off of the water, while the roots, which do the duty of vertical drains, enable the rain to penetrate the soil to its lower beds, whence it re-appears again in the form of springs, which nourish the rivers and streams and so in turn the whole surface of the country, so that forests may be held to be great storehouses of the rain, from whence it may be drawn forth and utilised as it is wanted.

This result, when carried to excess, becomes an evil, similar to that caused by the total absence of forests. For when forests cover the whole surface of a continent, as is the case with the great marsh forests of America and Central Africa, the ground becomes so saturated with moisture that it is unable to absorb any more rain, and in consequence great stagnant marshes are formed, which either do not dry up at all, or only disappear on the return of the fine season. It is from the similarity of the results where forests are in excess, and where they are wanting altogether, that some confusion is liable to arise in treating a subject which at best is exceedingly complex and is as yet but imperfectly understood.

So far as has been shewn here, our present knowledge of the subject would seem to permit us to go, without trespassing into the limits of speculation—for only so much has been admitted as would seem to be clearly based on evident facts.

It must be allowed, however, that a number of observers, some of them of eminence in the scientific world, contest the truth, at least in a certain degree of the direct influence of forests on the climate of countries, and more especially on the rainfall. Before concluding, it will be proper, therefore, to examine the arguments which have been adduced on the opposite side.

In a work* lately published by M. Belgrand, Member of the Institute of France, and Engineer-in-Chief to the city of Paris, this subject is treated. M. Belgrand does not absolutely deny the influence of forests on the river system of a country, but he considers that they affect them only in a small degree. He divides all soils into absorbents and non-absorbents, and he thinks that inundations only occur in places where the soil is of the latter quality, and that at all events inundations depend much more on the character of the soil of a country, than on whether it is covered with forests or not. But it may be observed that a great part of the argument in favour of forests consists in the fact that they are absorbents, and that they are a natural aid to the soil in this very essential quality. Again, while M. Belgrand admits that more rain falls in the wooded districts of the Upper Seine basin than in those which are bare of trees, he asserts that he can discover no difference in the general action of the streams which have their origin respectively in both localities. He admits, however, that forests are useful in preventing the cutting-up into ravines of the sides of the valleys and hills. So again the same gentleman, while he admits that forests may exercise some influence on surface springs, denies that they can have any effect on the deep soil springs which alone never dry up. He asserts that all rain water which penetrates the earth is stopped by the first non-absorbent stratum that it meets, and that it only reappears at the surface where that stratum crops out in the general slope of the country. In fact, he considers that the deep springs which never dry up are only produced at points where faults in the formation enable the water to penetrate the non-absorbent strata. Without contesting the truth of these observations, it may be said that they do not affect the general position that has been assumed in this paper as to the action of forests; since it is clear that if forests favour the infiltration of water into the soil, they must, at the same time, assist the formation of springs, whether these be near the surface, or whether they rise in the lower stratas, and, as M. Belgrand asserts, often at long distances from the forests.

M. Marie Davey, the Meteorologist charged by the French Government with the work of collating the reports on the state of the atmosphere sent in daily to Paris from all the French Departments, as well as from all the principal foreign observatories, is the type of another class of objectors. This gentleman, believing, as he does, that all movements of the atmosphere are dependent on certain great general laws, refuses to concede to forests, any influence whatever on the climate of a country, except such as is of a purely local and secondary character.

In his opinion their main use is a mechanical one in retaining the soil in its place on the slopes of valleys and mountains.

But, in conclusion, it seems to have been clearly proved that wherever countries have been denuded of trees their climate has been radically changed. Not to repeat again the case of France, Asia Minor may be quoted as a country which, in the era when it was covered with forests, was richly cultivated, and supported easily a very high rate of population, but which at the present day, owing to the destruction of the forests, has become so arid that the crops fail to come to maturity, and thousands of human beings are now perishing from hunger and want. What again would be the condition of the Upper Provinces of India, denuded as they are of trees, unless they were nourished by a very complete system of canal irrigation? As it is, years in which famine is with difficulty staved off by no means unfrequently occur. There is a curious, but very conclusive, instance which is cited by M. Cautégril, in the Cannap, a river which has its origin in the Black Mountain, in the Department Ande, in the Pyrenees, and which is used to drive a large number of cotton mills. Some years ago the Commune determined to get rid of the forests which surround the head waters of this river, but, the consequences of this proceeding having manifested themselves in the shutting-up of the mills during a considerable portion of the year, the authorities became alarmed, and the re-planting of the hills was determined on. Already, though the plantations have scarcely arrived

* La Seine, Etudes Hydrologiques, &c., par M. Belgrand, Paris.

at any considerable size, the river fills regularly as usual, and the mills are working throughout the entire year as they did before.

It is hoped that enough has been written above to shew that, while the influence of forests on the climate and physical condition of a country is undoubted, our knowledge of the subject is still exceedingly imperfect, and that the science of forest meteorology is in its infancy. Precise and systematic observations on the daily temperature, the rainfall, and on the springs and drainage, in both wooded and unwooded districts, carefully made and compared, will alone give the data requisite to arrive at a better understanding of the phenomena connected with the presence of forests in a country. It is hoped that in an age when so much is being done to promote the scientific investigation of all questions which bear on the well-being of countries and their populations, this all-important subject will receive the attention which it merits.

Mr. Fernandez communicated the following extract from the "Revue des Eaux et Forêts" in connection with the same subject.

"M. Tissandier, the well-known savant and aéronaut, in a paper read before the Paris Academy of Sciences on October 10th, 1873, gave an account of the observations he made during his recent balloon ascent. Among other things, he remarked that, when the balloon passed over a forest, the hygrometer rose with extreme rapidity, 35 degrees for instance, towards the maximum of humidity, and fell to the same point as before on leaving the wood."

Descriptive sketch of the Nasik Forest Circle, Bombay, by Mr. R. C. WROUGHTON.

The Nasik circle consists of the collectorate of Nasik (comprising eleven talukas) and the independent State of Peinth. It contains 6,873 square miles, and has the Great Indian Peninsula Railway running through its entire length from north to south.

The following is a statement of the population of the towns and villages of the circle:—

More than	...	200 inhabitants, but less than 500 inhabitants		610 villages.
Ditto	...	500	ditto ... 1,000	624
Ditto	...	1,000	ditto ... 2,000	265
Ditto	...	2,000	ditto ... 3,000	93
Ditto	...	3,000	ditto ... 5,000	17
Ditto	...	5,000	ditto ... 10,000	15
Ditto	...	10,000	ditto ... 15,000	3
Ditto	...	15,000	ditto ... 20,000	1 village.
Ditto	...	20,000	... ..	1
				1,629 villages.

Besides these, the late census gives 607 hamlets and 69 deserted villages and 100 deserted hamlets; but, with few exceptions, the lands of these last are cultivated by the inhabitants of neighbouring villages.

The total population of the collectorate amounts to 734,386, of which 139,418 are classed as agriculturists.

The total number of houses is 133,848, which gives about 25,000 houses for the agriculturist class, and twice this may be taken as the full number dependent for timber on the local supply. Taking as a fair average that $\frac{1}{10}$ th of these require re-building every year, requiring each 5 large uprights, 20 lesser ones, and some 150 light rafters, we have a demand for at least 800,000 rafters; of these, something less than 50,000 are teak, the remainder being jungle-wood. As the price of teak is somewhere about Rs. 22 or 23 per 100 rafters, and as only 30,000 are cut in Nasik Proper, it is easy to understand how there is rarely any balance in favour of Government at the end of the year.

The distribution of the 6,873 square miles of area is as follows:—

Assessed	{	Occupied	...	...	1,806,512 acres.
		Unoccupied	...	...	488,531 "
Unassessed		Unarable	...	...	898,045 "
or, deducting land occupied by roads, rivers, tanks, village sites, &c.,					843,113 "

The whole circle is situated on a volcanic rock (Trap), in some places cropping up at the surface, in others overlain by strata of what, in Scotland, is known as 'rotten rock,' *i. e.*, half decomposed rock, muram, or the above still further disintegrated, alluvium and humus, sometimes to the depth of 100 feet. The country is largely, if not well cultivated, and it is needless to say that the land set aside as forest is chiefly that where the rock comes to the surface, or at most is covered with a foot or two of muram.

The main geographical features of the circle are:—

The Saihadri Gháts, forming the western boundary of the Nasik collectorate.

The Sapt Shringh range running due east from the Gháts.

The Aouda Patta, the Alang Kulang, and the Anjaneri ranges in the south.

The Godavery (rising at the junction of the Anjaneri range and the Gháts) in the south, and the Girnah in the north, the Sapt Shringh range being the watershed.

From a forest point of view the circle may be divided into four well-marked tracts :

- | | |
|---------------------------|---------------------------|
| (1.) The Ghâts or Konkan. | (3.) The Desh. |
| (2.) The Ghât Mata. | (4.) The Deccan (Proper). |

The Ghât or Konkan comprises a strip a few miles broad along the head of the Ghâts, their slopes and the low country to the west. This tract has a very heavy rainfall,—from 100 to 200 inches. The forest vegetation consists of jungle-wood trees such as,—

Sadara	...	...	...	...	<i>Terminalia tomentosa,</i>
Tiwas	...	...	...	...	<i>Dalbergia ocojeinensis,</i>
Hed	...	...	...	...	<i>Nauclea cordifolia,</i>
Kanchan	...	...	...	...	<i>Bauhinia parviflora,</i>
Sair	...	...	...	...	<i>Bombax malabaricum,</i>
Kheir	...	...	...	...	<i>Acacia catechu</i> (as a timber tree),
Moho	...	...	...	...	<i>Bassia latifolia,</i>
Jambhul	...	...	...	...	<i>Eugenia jambolana,</i>
Mango	...	...	...	...	<i>Mangifera indica,</i>
Chinch	...	...	...	...	<i>Tamarindas indica,</i>

and innumerable others with a greater or less admixture of teak, growing to a fair size and naturally reproducing itself by seed. The distinctive feature of this tract, however, is the dense undergrowth of Karwand, Auli (*Phyllanthus emblica*), Apta (*Bauhinia racemosa*), the figs, the bamboo, and all the many kinds of annuals, biennials, &c.

The Ghât Mata tract is the strip of country lying immediately to the east of the Ghât tract. Its normal rainfall is from 30 to 70 inches. Here the teak never reproduces itself by seed now, whatever it may (indeed must) have done in times past (a riddle, of which I can find no solution). This is the region of teak coppice; there is no undergrowth but grass, and the soil during the hot weather is exposed to the full blaze of the sun. Portions of this region resemble the Konkan jungle, where the conformation of the ground gives shelter from the wind or causes an increased rainfall.

The Desh is the eastern portion of the circle to the north of the Japt Shringh range. The rainfall is from 15 to 30 inches; it is mostly a barren plain cut up by deep nalas, spotted over with isolated hills. The forest vegetation is dwarfed (with one honourable exception, the Anjan (*Hardwickia binata*), and consists of Corinda, ber (*Zyziphus Jujuba*), kheir (*Acacia catechu*), hiwar (*Acacia leucophlœa*) and many others. A peculiarity of this region is the great heat in the months of April and May.

The Deccan (Proper) rainfall is the same as that of the Desh. It is the home of the babhul (*Acacia arabica*), and grows no other tree except as an accident (fruit trees excepted). The soil is generally an alluvium more or less rich. At present the Forest Department has little or no land in this portion of the circle; but I hope that several kurans will be handed over to us when demarcation is carried.

I will now give a few details of each taluka:—

IGATPURL

Boundaries—

- S.—Alang, Kulang range.
- E.—Aouda Patta range.
- N.—Nasik taluka.
- W.—The Ghâts.

Area.—

572 square miles.

Assessed	...	Occupied	...	...	...	130,846 acres.
		Unoccupied	...	...	...	27,946 "
Unarable	...		...	...	...	62,926 (57,419) acres.

Financial Statement—

				Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	...	Rs. 1,755	92	723
1873-74	...	...	...	" 2,470	856	713
1874-75	...	...	...	" 2,709	235	745

Establishment—

- 1 Inspector @ Rs. 30
- 1 Forester " 8
- 3 Foresters " 7

Population—57,735, of which 23,068 agricultural.

This taluka has been demarcated some 26,000 acres being set aside as reserve, saddled with certain rights. The question of the legality of these rights is too long to be gone into here, but I believe that on single right enjoyed in this circle (except that of Holkar to graze a certain number of sheep) could be substantiated in a civil court; this, however, is of little account, for these privileges must be allowed or cultivation would stop. Besides these reserves, there is one imperial reserve of about 1,000 acres at the foot of the Patta fort. It is situated in a semicircle of perpendicular rock, leaving only the mouth (a mile and a half) to be guarded. From a forest point of view, there are three well-marked divisions of this taluka. The reserves along the Aouda Patta range come under my division of the Ghât Mata forests; but the presence of this range of hills parallel to the main line of Ghâts so tends to increase the rainfall, that the lower slopes of the range, though growing little but teak coppice of any value, have still a certain admixture of inferior trees (jambhul, &c.) and worthless undergrowth. The upper

slopes, or more properly terraces, are pure evergreen jungle, mango, jambhul, &c. The reserves along the Alang Kulang range contain no teak whatever, being pure evergreen jungle. The third division comprises the main line of Ghâts and belongs to my first general division. Here teak reappears in varying proportions, and seedlings, though scarce, can always be found.

The imperial reserve mentioned above is a very promising one; at present it contains much crooked hollow wood, but this is being rapidly cleared away. A few of the Ghât jungles, too, may be improved; but the remaining teak jungles, I fear, are too far gone to recover for a very long time, all attempts at plantation having so far failed. This is largely attributable to the weakness of the protective establishment, the seedlings not having had fair play. The evergreen jungle is practically worthless. Under the most favourable circumstances mango is not a valuable wood, but here it is in a situation such that carts cannot approach within nine or ten miles of it. Sowing bamboo seed is now being tried. This seems to be the only chance of ever obtaining any revenue from this kind of jungle, until roads, &c., are less rare, when perhaps, as charcoal, mango may find a market.

The establishment is—

1 Inspector @ Rs. 30
1 Forester „ 8
3 Foresters „ 7

NASIK.

Boundaries—

- S.—Igatpuri taluka (Anjaneri range).
- E.—Sinar taluka.
- N.—Dindori taluka.
- W.—The Ghâts.

Area—

375½ square miles.

Assessed	{	Occupied	166,284 acres.
		Unoccupied	28,793 „
Unarable		... ..	65,900 (62,172) acres.

Population—

90,271, of which 15,724 agricultural.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73	Rs. 3,445	.....	719
1873-74	„ 3,741	3,033	607
1874-75	„ 1,938	189	737

Establishment—

1 Inspector @ Rs. 30 per mensem.
2 Foresters „ „ 8 „
2 Foresters „ „ 7 „

This taluka has been demarcated, about 25,000 acres being set aside as forest reserve. There is only one small patch of bamboo jungle of about 700 acres unsaddled with rights. By gradually buying up some eight or nine hundred acres in the immediate vicinity a very profitable reserve might be formed, bamboos having a high commercial value. The forest consists of a strip of jungle wood forest along the Anjaneri range, valuable as a fuel reserve for the town of Nasik, and another narrow strip along the Ghâts coming under my first division. There is also a patch of some few hundred acres of teak coppice jungle; but this has been so drawn upon to supply the demands of the Nasik market that it will take many years to bring it into decent order again. At present, the crooked stumps are being sold out as soon as possible for firewood, charcoal, and for wheelwrights' work. The Ghât reserves are beyond the reach of the market, and for many years will only be called on to meet the local demand. The firewood reserves are by no means in a flourishing state, there being as much, if not more land bearing nothing but grass, as under trees. These reserves will be gradually fenced up with sabri and broadcast steadily, and will soon greatly improve. There is no jungle east of Nasik. Besides Nasik, there are no large markets, though the camp and depôt at Deolali causes a steady demand for firewood.

DINDORI.

Boundaries—

- S.—Nasik taluka.
- E.—Niphad and Chandor talukas.
- N.—Sapt Shringh range.
- W.—The Ghâts.

Area—

560 square miles.

Assessed	...	{	Occupied	176,697 acres.
			Unoccupied	51,799 „
Unarable	...	..	... ..	64,686 „

Population—

68,626, of which 10,445 agricultural.

Financial Statement—

				Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	...	Rs. 4,961	779	904
1873-74	...	...	...	" 4,472	1,029	831
1874-75	...	...	...	" 4,248	797	860

Establishment—

1 Inspector @	Rs. 30
1 Forester "	" 10
1 Do. "	" 8
3 Foresters "	" 7

The demarcation of this taluka was carried out in a most desultory manner; it took four years to complete, and each year's work was done by different officers, consequently the result is patchy and anything but satisfactory, and it has been found impossible to give complete effect to the proposals even up to date. The land was merely set aside as forest reserve, nothing being settled as to what existing rights were, and even without any arrangement being made for the proper acquisition of occupied and *inam* lands included in reserve. Some 35,000 acres were placed in reserve, out of which four imperial reserves will probably be formed, one the Dehera reserve, running round the foot of the Dehera fort. The forest belongs to my Ghât Mata class, modified by the presence of the short range of hills, of which Dehera fort is the chief feature. Teak grows well from stools and even sometimes from seed, and there is a close undergrowth, most valuable as firewood for the Nasik market, from which it is only distant some nine or ten miles, and to which it is joined by a capital fair-weather road. The Umbrali reserve, of which the vegetation is of the same class as that of the above, is situated in ravines and nalas on the south bank of the Parwi river, about six or seven miles further from Nasik, on the same road (Peinth road) as the above, than which it also contains very much less undergrowth. This is a very small reserve of less than 500 acres. The Nanasi reserve, on the slope of and below the Ghâts, contains fine teak jungle, reproducing itself by seed, and mixed with evergreen trees and undergrowth. This reserve is of little importance now, there being no market for its produce, but a ghât through the centre of it, joined by a road to Dindori, or the Peinth road, has been sanctioned, and will be commenced during the present year, when this will become an important reserve, sending all its produce to the Nasik market, from which it is distant about 25 miles. And, lastly, the Ambe-Wani reserve, a pure teak coppice without any undergrowth but grass. This is unfortunately a long straggling block, running through the lands of some eight or ten villages over a series of low hills and nalas. The teak on the higher parts is very poor and thin, while in the nalas it is very fine. Both Ambe and Wani are large villages situated on the eastern boundary of the Ghât Mata region, and are consequently the natural markets for the Deccan tract. A depôt has now been formed at Ambe. This reserve promises to be of great value. The remainder of the reserves of this taluka are scattered about all over its area, west of a line drawn through Dehera, Dindori, Ambe, and Wani. East of this there are a few babhul kurans, but of small size.

KALWAN.

Boundaries—

- S.—Sapt Shringh range.
- E.—Baglan taluka.
- N.—Khandesh.
- W.—The Ghâts.

Area—

Assessed ...	{ Occupied	...	...	...	...	66,920	acres.
		Unoccupied	...	...	...	34,820	"
Unarable		...	...	...	...	79,552 (75,073)	acres.

Financial Statement—

				Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	...	Rs. 2,575	120	815
1873-74	...	...	...	" 4,303	713	723
1874-75	...	...	...	" 2,723	572	709

Establishment—

1 Inspector @	Rs. 30
2 Foresters "	" 8
1 Forester "	" 7

This taluka was formed last August twelve-month from the Abhona Petta by the addition of the Baglan taluka. I have been unable to obtain figures for the new taluka; those given above are those for the Abhona Petta. Demarcation has been carried out, but the proposals have not yet received the sanction of Government. 86,526 acres have been set aside as reserve. The whole of the forests of this taluka are, on account of the poverty of the population, saddled with rights and privileges. There is no imperial reserve nor any reserve sufficiently valuable to make it worth while to buy up existing rights. Teak coppice is scattered all over the taluka, the best being in the immediate neighbourhood of Sapt Shringh. The whole taluka is hilly, and cart carriage almost impossible. There is only one ghât into the open country by which the Kalwan teak could be brought out, and that is, a very inferior one, and until the country is opened up there can be no market for the Kalwan teak beyond the local demand for house-building. In the strip of country immediately at the head of the Ghâts, curious to

say, there is no teak. The population is composed largely of Bhils and Konkans, both naturally poverty-stricken races. They can do no plough cultivation for want of cattle, and consequently the right to *dalhi* one acre of forest land free of assessment was granted to them by the Collector of Khandesh in 1832. The Bhils around Sapt Shringh and in the more open parts are, however, now much better off. The construction of roads and the introduction of a system of irrigation has given many means of earning a livelihood denied their more jungli brethren. It is proposed to take away from these men the privilege to *dalhi*. The poorer classes on the Ghâts, however, must *dalhi* or die, and consequently the privilege must be continued to them at least for the present.

BAGLAN.

Boundaries—

N.—Khandesh.
E.—Maligaum taluka.
S.—Sapt Shringh range.
W.—The Ghâts.

Area—

Assessed ...	{ Occupied	199,096 acres.
	{ Unoccupied	60,971 "
Unarable ...	... ..	140,507 (127,596) acres.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73 ... ..	...	...	...
1873-74 ... ..	...	...	...
1874-75	359	10	110

Establishment—

1 Forester @ Rs. 10
1 " " 7

This taluka, like Kalwan, has been demarcated, but the proposals have not been sanctioned. It is proposed to reserve 107,940 acres. The forest of this taluka comes under the Desh class. It contains practically no teak. The chief forest tree is the Salai, *Boswellia thurifera*, for which it is to be hoped that some day some use will be found. The Salai is mixed with stunted Kheir and ber bushes and many kinds of thorny bushes for which Khandesh has always been famous. The ghât portion resembles that of Kalwan and *dalhi* is equally practised. The land reserved has been so simply with the hope of stopping the denudation of the hills which is every year becoming more apparent in the sudden flushes and floods of the Girna River. The Anjan *Hardwickia* appears in the north-east corner, but in no appreciable quantity; it remains to be seen if it will, under more favourable circumstances, spread further over this jungli, but timberless, tract.

MALIGAUM.

Boundaries—

N.—Khandesh.
E.—Nandgaum taluka.
S.—Chandor taluka.
W.—Baglan taluka.

Area—720 square miles.

Assessed ...	{ Occupied	186,474 acres
	{ Unoccupied	155,259 "
Unarable ...	... ..	119,970 (106,662) acres.

Financial Statement—

	A. Expenditure.	B. Expenditure.
1872-73 ... ..	...	103
1873-74	15	103
1874-75 ... ..	...	51

Establishment—Nil.

This taluka has not yet been demarcated. It contains no teak whatever, its only timber tree being Anjan. In a commencement of demarcation made last year one imperial reserve of some 15,000 acres was marked out at Galna on the Khandesh boundary. Here the Anjan grows freely from seed; 3/4rds of the proposed reserve bears Anjan naturally grown from seed. Anjan leaves unfortunately are splendid fodder for cattle, and when grass is scarce, *i. e.*, for three months of the year, the Bhil herdsman hacks down half an acre of Anjan seedlings in order that his cattle may graze more at their ease. The result is acres on acres of the most miserable-looking, gnarled and twisted pollards that can be conceived. The remainder of the taluka (for the Anjan only grows here) is the typical Desh jungle thorn-bushes, nalas, sheet-rock, and boulders. Maligaum used, in former days, to be an important military station, but has now dwindled away. The native town is still, however, one of the largest in the district.

NANDGAUM.

Boundaries—

- N.—Khandesh.
E.—The Nizam's Territory.
S.—Yeola taluka.
W.—Maligaum taluka.

*Area—*40½ square miles.

Assessed ...	{ Occupied	...	...	...	...	80,745	acres.
	{ Unoccupied	...	...	...	...	86,666	"
Unarable ...		...	...	...	...	79,716	(75,260) acres.

Financial Statement—

					Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	...	...	305	...	120
1873-74	...	...	...	...	246	150	117
1874-75	...	...	...	...	186	352	125

Establishment—

1 Forester @ Rs. 10.

This taluka has not been demarcated, but at least 100,000 acres should be set aside as fuel reserve for the railway. There is no timber tree in the taluka except a little Anjan in the north. Besides the railway, there is no market for the produce of this taluka except a fitful demand at Yeola.

YEOLA.

Boundaries—

- N.—Nandgaum taluka.
E.—Nagar.
S.—Niphad taluka.
W.—Chandor taluka.

*Area—*419 square miles.

Assessed ...	{ Occupied	...	...	...	...	134,011	acres.
	{ Unoccupied	...	...	...	...	15,891	"
Unarable ...		...	...	...	...	36,117	(35,654) acres.

Financial Statement—

					Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	...	...	72	...	...
1873-74	...	...	...	...	46	155	...
1874-75	...	...	...	...	45	...	...

*Establishment—*Nil.

This taluka is a purely Deccan one (every inch of cultivable land is occupied and passed on from father to son, the assessment being paid whether the land be cultivated or no). It has not been demarcated, but there is nothing to take but a few kurans. Yeola is one of the largest towns of the district, and there is the ordinary demand for firewood for household purposes, but nothing more.

CHANDOR.

Boundaries—

- N.—Sapt Shringh range.
E.—Yeola taluka.
S. & W.—Niphad and Dindori talukas.

*Area—*282½ square miles.

Assessed ...	{ Occupied	...	...	...	129,806	acres.
	{ Unoccupied	...	...	...	8,059	"
Unarable ...		...	...	...	50,561	(48,248) acres.

Financial Statement—

					Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	...	...	...	...	...
1873-74	...	...	...	...	942	89	...
1874-75	...	...	...	...	153	...	...

*Establishment—*Nil.

This taluka is undemarcated. The northern jungles on the slopes of the Dhorab, Raj, Indraé, Chandor and other forts of the Sapt Shringh range belong to the Ghât Mata class, while the rest of the taluka belongs to the Deccan division. The teak jungle is very poor indeed, though the great demand for teak makes it valuable. There is no market at present for firewood.

NIPHAD.

Boundaries—

- N.—Yeola taluka.
W.—Nagar.
S.—Sinar taluka.
E.—Dindori and Chandor talukas.

*Area—*330½ square miles.

Assessed ...	{ Occupied	...	...	...	153,945	acres.
	{ Unoccupied	...	...	...	915	"
Unarable...		...	...	...	29,163	(28,671) acres.

Financial Statement—

				Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	Rs.	2	...	...
1873-74	...	...	„	551	586	...
1874-75	...	...	„	46	...	...

*Establishment—*Nil.

This taluka is undemarcated ; it belongs to the Deccan class. There are a few kurans to be taken up, the produce of which will find a market on the railway which traverses the taluka.

SINAR.

Boundaries—

N.—Niphad taluka.

E.—Nasik taluka.

W. & S.—Nagar.

*Area—*506 square miles.

Assessed	{	Occupied	...	...	...	...	199,546 acres.
		Unoccupied	...	...	...	...	5,412 „
Unarable	...	...	...	...	...	...	96,870 (96,327) acres.

Financial Statement—

				Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	Rs.	663	...	120
1873-74	...	...	„	507	137	123
1874-75	...	...	„	637	300	120

Establishment—

1 Forester at Rs. 10.

Demarcation proposals have been submitted for this taluka, but not yet sanctioned. The 100,000 acres of unoccupied land is situated on the range of hills dividing it from Nagar to the south. There is no vegetation whatever ; even grass only grows in small patches. The whole range is one sheet of rock. Acres of forest of the Ghât Mata class, containing a little teak and a great deal of tiv and kheir, have been set aside as a fuel reserve for the Deolali Camp.

PEINTH STATE.

Boundaries—

N.—The Sulgana State.

E.—The Ghâts.

S.—Thana.

W.—The Dharampur State.

*Area—*960 square miles.

Assessed	{	Occupied	...	...	...	...	182,077 acres.
		Unoccupied	...	...	...	...	12,021 „
Unarable	...	...	...	...	...	...	72,077 (65,330) acres.

Financial Statement—

				Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	Rs.	8,181	1,463	1,553
1873-74	...	...	„	22,224	2,044	1,561
1874-75	...	...	„	22,658	1,359	1,488

Establishment—

2 Inspectors	@ Rs.	30
1 Karkun	„	15
2 Foresters	„	10
2 „	„	8
2 „	„	7

The Peinth State has not been demarcated, and the work when undertaken will be found a most difficult one. The fields are bordered with undergrowth, which, from the top of the Ghâts, gives the country the appearance of one vast forest. The census gives a population of 47,033, of which only 7,601 are agricultural. According to this every man must cultivate from 250 to 300 acres (even supposing the whole agricultural population to be men only), which is absurd. I believe the Kolis, Konkans, and other wild tribes have not been included—Dalhi rab, with a large proportion of capital-less cultivators, must, of course, be the rule. The forest might contain splendid timber indeed ; Peinth teak was long well known. Now, reckless cutting by greedy contractors, clearing of the undergrowth for rab for increased cultivation have very nearly ruined the forests. The State, however, has one great stand by. *viz.*, its bamboos. The whole Deccan is supplied by Peinth. But even this supply must soon fail, unless measures of conservation be taken. The revenue system in Peinth is that known as *autbandi*, consequently no numbers are marked off, and I have seen acres of bamboos, the thickness of one's thumb, cut down and burnt where they lay, thus destroying immature produce and producer, the ground to be probably thrown up a few years later and covered immediately by a dense undergrowth of useless vegetation to the exclusion of better kinds. The whole State is an intricate net-work of hill ranges and deep ravines. In the last few years it has been a good deal opened up ; but it must be very much more so, and above all a good road made to the coast before the true value of its forests can be realized. Teak and bamboos, and a little sissu, is the only material which it pays to export to Nasik, though the coast is the chief market, especially now that the Dharampur State has been gutted and obliged to cease cutting for a series of years.

On the expediency of enlisting Village Officers for the protection of Forests, by NARAYEN ANANT OKEDWAY, Bombay Forest Department.

Without touching upon the influences of forests or mentioning the benefits which a country derives from their growth, both of which are well known, I proceed to the subject in hand.

2. The subject of enlisting village officers for the protection of forests in the Bombay Presidency, where forests are interlaced with cultivation, is so important that it would be detrimental to the interests of both Government and the public if measures be not soon adopted to gain such important aid. My experience leads me to believe that, for the proper protection and management of forest property which, as observed above, is interlaced with occupied lands, it is most essential to secure the good-will and co-operation of the inhabitants of forest villages. Paid servants of Government will not be able to preserve the State forests without their assistance, however efficient by qualification and large in number they may be.

I am of opinion that the village officers, from the position they hold in the village community, are best suited for the work of preserving forests. This work should be entrusted to them and the superintendence vested in the paid servants of the Forest Department.

3. There is another reason for calling for assistance from village officers for the protection of forests. At present a forest officer, may he be a District Forest Officer or Conservator, not being vested with the powers of a police officer, cannot legally arrest a person removing wood from the forest. He must catch him in the act of cutting with an axe in hand, and there must be at least two witnesses besides to prove his guilt; nor can he, without a warrant from a Magistrate, search any house, however strong the suspicion or reliable the information he may have received as to the house containing stolen wood from Government forests. Owing to this, convictions are scarcely ever obtained, and perpetrators of forest thefts remain unpunished.

When forest offenders are thus left unpunished, conservancy is at an end; but if the good will and co-operation of village officers be secured, then much good may be effected. The same view was, I believe, entertained by Dr. Gibson, as is shewn by the *kabulayats* (agreements) taken by him in several collectorates, which were generally drawn up in the names of the then village officials, and where they declined, in the names of other individuals, but the principle on which he proceeded being faulty in some respects, as will be shewn hereafter, the above agreements did not produce the expected result.

4. Before pointing out the defects in Dr. Gibson's system and making proposals for the future organization of forest village officers, it is necessary for me to say a few words in explanation of the character of the tenures of several officers appertaining to a village. The patel, the kulkarni, and the mahar are considered, at present, the only hereditary officers of a village. The following are the duties which they perform: The patel, who is the headman of the village, is required to collect the revenue for Government, send the same to the taluka treasury and report to the mamledar whatever happens in the village worth taking official notice of. In matters relating to the police he makes his reports to the chief constable. The kulkarni writes the *dufter* (records) and keeps the accounts of the village; although he is paid more than the patel, still he is subordinate to the patel as a Government servant, and, in fact, is the patel's clerk. The mahar has to watch over the boundaries of the village and guard the crops whether cut or growing as long as they are in the field. He is required to carry the revenue of the village to the taluka treasury, and is also the official village messenger. Of the above officers the first two have each hereditary *watan*, that is to say, each of them receives a certain fixed amount in cash from Government for the services he renders, and in some cases enjoys a piece of land as inam; while the third officer, namely, the mahar, does not get anything in cash, but has only in inam a piece of land called *hadola*. There being many sharers in these *watans*, no one of the men is a permanent officer, but each comes into office according to his turn and serves for a period of five years. Some of the sharers hold so small a share in their *watan* that they hardly get an opportunity to come into office during the whole of their lives. It is no wonder that those in office have much influence with the villagers and are much feared by them, while the ex-officers or other co-sharers carry with them no influence whatever. Of the village officers the patel and kulkarni receive their wages for a period of five years on the average revenue of the past five years according to the following scale:—

	Patel.	Kulkarni.
On the 1st 1,000 rupees ...	3 per cent.	5 per cent.
„ 2nd „ ...	2 ditto	4 ditto
„ 3rd „ ...	1 ditto	3 ditto
„ 4th „ ...	1 ditto	2 ditto
On a sum exceeding Ra. 4,000 ...	1 ditto	1 ditto

5. I observe that these village officers shew a total disregard for the preservation of forests, while they exhibit interest in the discharge of their revenue duties. This disregard, I believe, is owing to their utter ignorance of the advantages derived from arboriculture, as well as to the loss they are made to suffer on account of land retained for forest, because under the

present system the assessment on these lands is not included in the revenue of the village on which their remunerations are calculated. To these remarks there are some exceptions. There are really some officers who, through the fear of being punished by the Collector, render efficient service to the forest department. These remarks are made in reference to the officers of those villages in which lands were long ago taken up for forest; but it must be borne in mind that the officers of the villages in which fresh lands will be reserved are likely to show more disregard and inattention to forest business, as people are becoming, day by day, more alive to their own immediate interests.

It is, therefore, necessary to devise some measures by which the village officers may not be put to any loss and the forest department may have every means at their command to increase the growth of forest on which the fall of rain to some extent depends, and the wholesale destruction of which has entailed barrenness and aridity on countries formerly renowned for their fertility, and caused the disappearance of springs and rivulets, as well as a very sensible increase of heat in the temperature.

6. Dr. Gibson, as before stated, took agreements only from parties then officiating, no consideration being shewn to the fact that they were then acting only for a time, consequently, when they fell out of office, they were not in a position to protect the property entrusted to their care, while those who succeeded them naturally thought that the agreements were binding only on the parties who had made them, and that they would receive nothing in return for their services. These men, therefore, had no interest in the preservation of forests, the consequence of which is their destruction;—hills which nature intended to be forest-clad have been stripped of trees. Had the parties entering into agreements been told that these documents would be considered to create a new hereditary watan, the agreements would have shewn it, and they (the parties) would have been of some use now to this department. The heirs and representatives of the original parties would have naturally come forward on their demise, and would have had their names entered in their stead. Under the present circumstances it must be presumed that no such intimation was given when agreements were taken up.

7. By the above agreements the share therein stipulated becomes payable only when forest revenue is realized. This has, in my opinion, principally marred their utility, because as forest revenue is collected at long intervals it becomes next to impossible to punish them for their negligence and fraud. To meet this difficulty

* *Vide* paragraph 5 of his report No. 209, dated 18th June 1870, published with Bombay Government Resolution No. 3756 of 6th August 1870.

Dr. Brandis, Inspector General of Forests, proposes* that a fixed sum according to the yield of a forest should be settled and paid annually to a rakhwadar, which should be decreased in case of negligence and increased for efficient service; but from what class of men the rakhwadar is to be selected is not stated. Taking for granted that he is to be one of the three village officers, still without the co-operation of the other two, he is of no use to the department, as in the case of a divided watan he is not likely to be serviceable except during the term of his office, the reasons of which have been already explained, and, therefore, need not be repeated here.

8. I have personally heard several village officers openly state that they are in no way responsible for the condition of the forests, as they are not paid for guarding them. High officials of Government also remark to the same effect. They consider that as Government have opened a separate department altogether for the management of forests, it is their business to protect them. Whether what they say is just and reasonable or otherwise is a question which I am unable to discuss, but if it be reasonable, some measures must soon be adopted to make the village officers responsible, for there is no other mode of preserving forest property safer and less expensive than the enlistment of the sympathies of these officers by conferring on each of them in the form of a watan a certain annuity which need not exceed the amount due on the assessment of the land occupied by forests, according to the scale under which they are paid in the Revenue Department. It has been already mentioned that the two village officers, the patel and kulkarni, receive their respective remunerations for a term of five years, calculated, as shown above in paragraph 4, on the average income of the village for the preceding five years; but the case of the third village officer, namely the mahar, is different; he does not receive anything of the kind, nevertheless, the services he renders to the village community as well as to the State, are by no means less important, and in my opinion his assistance is indispensably necessary for the proper preservation of Government forest, and therefore, he necessarily deserves some remuneration if he be called to render that assistance.

9. I beg, therefore, to propose that the above officers, patel, kulkarni, and mahar, of a village be appointed to look after its forest, and the first two be remunerated on the assessment of the land under forest at the rates they are allowed in the Revenue Department, while the third be paid either a fixed sum or at the same rate as the patel; that these proposals be made applicable to the lands already under forests as well as to those that will hereafter be taken up by this department. It will, no doubt, be impracticable to carry them out in the case of forest lands not assessed; where such difficulties exist it would be necessary to get such lands assessed under the existing rules. Land under cultivation is generally re-surveyed and re-assessed on the expiration of 30 years, the same rule should be observed in the case of land under forest. Such an agreement will hardly leave any ground to village officers for grumbling. If the proposals herein made be acted upon, the assessment on the forest land in each village will have to be added to the gross revenue of the village and the percentage remunerations calculated thereon; the forest department will have to provide for the increased percentage which will thus be paid.

10. The elections of patel and kulkarni take place every five years, when they are required to give in kabulayats for the due discharge of their duties. I do not think it necessary that

they should be called upon to give separate kabulayats for the correct performance of their forest duties; it would be sufficient if a clause regarding it be inserted in their kabulayats in the revenue department. Entrusting solely the custody of Government forests to the care of these officers would not conduce to good results if no supervision or control be exercised over them. The Conservator must have authority to fine them the whole or a part of the wages they receive in case they be found guilty of negligence or fraud. When an offence warrants either a heavy fine or dismissal, he should report the same to Government. At present no kabulayat is demanded from the third village officer (the mahar) in the revenue department, and I do not see the use of this department getting one from him if the power of punishing him for negligence, &c., be vested in the Conservator.

11. Should the above suggestions be carried out, they would, undoubtedly, contribute a great deal to the protection of Government forests with less expense and trouble. As the remunerations which the village officers would receive would form watans, they would, no doubt, discharge the duties appertaining to them diligently and satisfactorily. It is a well-known fact that the natives of India are very fond of watans, and ready to sacrifice all that they have to get the upper hand in a matter relating to them, however trivial it may be. I, therefore, do not think that they would act in a way to forfeit this newly-acquired watan.

12. A paper similar to this, but having a special reference to the Dekkan Collectorates only, was originally written for the last Allahabad Forest Conference, but it was not forwarded there as the subject did not appear in its programme. This paper was circulated for perusal and remarks to several experienced officers, both European and Native, who have favoured me with their opinions. Two of these officers, Messrs. A. H. Spry and W. Allen, have stated that there are a great many objections against the creation of forest watans, and in the face of these they do not think that Government would ever sanction them.

"If forest watans," Mr. W. Allen observes:—

"Are to be created, either an Act defining the powers of Government and the rights of the watandars as regards appointments, dismissals, duties, and emoluments, will have to be enacted, or else the kabulayats will be in reality a mere contract between Government and the appointee, and each such kabulayat would have to contain in detail all the provisions which an Act on the subject would contain; and Government would be at this disadvantage, that they would have bestowed an hereditary right which it would appear invidious subsequently to cancel after a few years by legislation, if the system did not work well or was no longer required, or if the Civil Courts in case of dispute happened to take a different view of the interpretation of the Kabulayat to that which was intended by Government at the time it was drawn up."

In order that there may not be any misunderstanding in the matter, I think it necessary to say that, by the creation of forest watans, Government do not lose anything, because, prior to the organization of the forest department, the assessment on, or gross receipts of, the lands now under forest were included in the gross revenue of the village, and the remunerations to the patel and kulkarni calculated thereon; but now the case is different: village officers are put to loss, as the gross revenue of the village on which their remunerations are calculated, does not include the assessment on, or gross receipts of, the lands transferred to the forest department. With a view to compensate them for this loss, (exacting from them at the same time great responsibilities) the above proposals are made. If there be any objections in the way of giving them a fair trial, then, as a secondary measure, I would plead for a system of money payments to patels, kulkarnis, and mahars of forest villages. These payments would, of course, be according to the yield of the reserves in each village, and would not be paid till the expiration of each year, and then, should the village officers be found to have been remiss in their work, deductions could forthwith be made in proportion to the remissness proved. A great deal of emulation and incentive to exertion might also be excited by an occasional but judicious distribution of turbans, over and above their annual wages, to each of them who had shown any remarkable interest in looking after forests during their incumbency.

13. I have always felt that the work of conserving Government forests must be done through the village officers, and their charge may be safely left to them. Particularly if either of the schemes of remunerating them, as proposed above, be introduced, I am confident they will be only too willing to assist this department in the work of conservation.

14. Several persons having interests in forest matters suggest the investment of the chief executive officers of the department with magisterial powers in order to protect the interests of Government in forests in a better way than at present. I also think that the above suggestion would be productive of good results, but I would not on that account recommend its adoption under the present circumstances. The forest department is already unpopular, and it would be more so if its executive officers be allowed to dispose of criminal cases—in which they themselves or their subordinates are likely to be complainants, and difficulties with respect to obtaining labour for its several operations, as well as with respect to the protection of Government forests, would gradually increase. If people are thus once arrayed against the department its progress will be greatly obstructed. I am of opinion that the plan of appointing village officers as forest guards is more suited to the present circumstances than investing the executive officers with magisterial powers.

APPENDIX II.

Extract Report on the Forests in Rajputana, by D. BRANDIS, Inspector General of Forests, January 1871.

IN obedience to the orders of the Government of India, I marched through a portion of Rajputana in December 1869 and January 1870 on my way to the forests of the Bombay Presidency, and after carefully considering the results of my enquiries on that tour, beg now to submit the following report on the subject.

2. In Bhurtpur I visited a number of the wood and grass preserves belonging to the Raj. In Jeypur I examined the vegetation of the hills north of the town; made an enquiry into the cause of the shifting sands near the city, and submitted to the Agent to the Governor-General for Rajputana a report with suggestions for improving the present state of things.

3. From Jeypur I proceeded to the Sambhur Lake; thence passing through the northern portion of the Kishengurh State, I entered the British Province of Ajmere near its northern extremity. From here I passed a short distance through the Marwar territory, and thence proceeded to Pohkur. From Pohkur I ascended the Nag Pahar range; examined the so-called preserve on the top of it, and arrived at Ajmere on the 23rd. After examining the hills in the vicinity of Ajmere, I went on to Nusseerabad, and thence to Beawur and Todghur, in Mhairwarra.

4. From Todghur I proceeded to Bednore, the seat of one of the principal Meywar Thakurs, and after examining the hill jungles on his property, crossed to Humeergurh on the Bunass river, the seat of another nobleman, where I saw some excellent pieces of coppice, mainly consisting of a species of *Conocarpus** with small leaves. I then went eastward to the hills beyond the Betuchee river, a tributary of the Bunass, where I examined the large forest reserves of the Thakur of Bassi; thence to Chittore and Neemuch. From the latter place I went westward to the extensive jungles about Chota and Bara Sadri—two places which take their name from the Sadra or Hadra tree (*Terminalia tomentosa*) which, though near its northern limit in these parts, is abundant in the vicinity. Thence I marched across to Pertabgurh, and after passing through the Pertabgurh and Banswarra States, and the territory of the Thakur of Kishengurh, reached the Panch Mehals of the Bombay Presidency, encamping at Jhallode on 22nd January.

5. During this tour I thus became acquainted with a considerable portion of the British districts of Ajmere and Mhairwarra, and of the country along my line of march through the States of Bhurtpur, Jeypur, Kishengurh, Meywar, Pertabgurh and Banswarra. I passed through the territory of Marwar for only a short distance, and saw nothing of the other States of Rajputana.

6. Throughout the greater part of the Native territory visited by me, I found regular preserves set apart for the protection of game and the production of grass and wood. The botanical character of the trees and bushes in these preserves varies with the soil and other physical features of the locality, and with the situation of the district. Thus the large Ghunna near Bhurtpur, which occupies about 40 square miles, is mainly stocked with *Prosopis spicigera* in places with stiff and poor soil, with *Salvadora* on saline ground, and with *Babul* on the patches of lighter soil intervening; while on the lower and moister grounds there are fine groves of *Neem*, *Nauclea parvifolia*, *Ulmus integrifolia*, and other kinds. The dry hills round Jeypur are mainly clothed with trees of the small-leaved *Conocarpus* adverted to above.

7. The game preserves of Kishengurh consist mainly of *Prosopis*, *Capparis aphylla* (Kaer), *Boswellia thurifera* (Saler), *Moringa concanensis* (Seinjna), the *Conocarpus* before mentioned, and a species of *Cordia*; with clumps of a fleshy *Euphorbia* (*E. columaris*) on the more stony parts.

8. On the hills near Bednore there are a variety of shrubs, of which it may be sufficient to mention the small-leaved *Conocarpus*, *Acacia Catechu*, *Boswellia*, *Moringa concanensis* and *Ægle Marmelos*. In Humeergurh, and to the south of the river Bunass, the country is characterised by scattered forests, composed principally of the small-leaved *Conocarpus*. This tree generally covers the low hill ranges; it is more or less associated with a variety of other trees and shrubs, of which the chief are *Acacia Catechu*, *Zizyphus vulgaris* and *xylopyra*, *Bauhinia*, *Boswellia* and *Prosopis*.

9. South-east of the Betuchee Nala, the vegetation becomes more varied. The hills in the territory of the Bassi Thakur are covered with a luxuriant forest from 20 to 30 feet high, in which *Acacia Catechu*, *Conocarpus latifolia*, in addition to the small-leaved species, *Dalbergia latifolia*, *Ægle Marmelos*, *Acacia Sirissa*, *Emblica*, *Terminalia bellerica*, *Sterculia*, *Bauhinia* and *Bombax* are some of the principal trees, mixed with good bamboo (*Bambusa stricta*). The base of the hill on which the old fort of Chittore stands is clad with a fine, dense forest of *Conocarpus*, and the sacred forest groves which abound in these parts of Meywar consist chiefly of the same tree.

* This *Conocarpus* (now called *Anogeissis pendula*) which I have found in Meywar on the Jeypur hills, and on the Puchmurrees south of the Nerbudda river, has been called *Conocarpus acuminata*, but it is a different species from that found in Burma and Southern India, which is generally known under the name of *C. acuminata*.

10. To the south-west of Neemuch near Sadree, and in the States of Pertabgurh and Banswarra, the vegetation assumes a tropical character. Teak begins to appear in these districts, and *Terminalia tomentosa* and *Pterocarpus Marsupium* are the chief trees of the forest. Bamboos of considerable luxuriance are produced in profusion, forest land being here more plentiful, and cultivation more scattered as a rule; the only preserved spots are the sacred groves here called Malwans, and they are most rigidly looked after by the Bheel Chiefs. Here and there, however, I came upon hills covered with well-grown teak, not in any way regarded as sacred, which I was told the people abstained from cutting until the timber should grow larger and have a better marketable value, and also as a resource to fall back upon in case of famine or other misfortune. The Chiefs of Kishengurh (tributary to Banswarra) have, for a considerable time past, preserved a valuable teak forest on the road from Kishengurh to Rutlam, which I examined with great satisfaction on the 21st January.

11. The result of my enquiries has been that, in the States of Bhurtpur, Jeypur, Meywar, Kishengarh, Pertabgarh and Banswarra, as well as in the estates of the subordinate Thakurs and other noblemen in these territories, the custom prevails to preserve certain tracts of forest and grass lands to furnish cover for game, and as sources of a permanent supply of grass, wood and timber, or in the case of the sacred groves, for religious purposes.

12. The sacred forests are, as a rule, never touched by the axe, except when wood is wanted for the repair of religious buildings, or in special cases for other purposes. The other preserves are generally open under certain restrictions for the use of the surrounding population.

13. These restrictions vary in different localities, and in the same manner, there is great variety in the degree of protection afforded to these forests, and in the means employed to secure this protection. Thus, in the Bhurtpur Ghunna, any one may cut dry wood, and a certain class of poor people make a regular livelihood by collecting and selling firewood in the town of Bhurtpur. Here they have adopted a regular system of breaking the branches of the trees in order that they may become available as dry wood, to the great injury of the forest. This Ghunna is in charge of a Foujdar, who has a guard of 100 sepoy to watch it. Two hundred maunds of fire-wood are daily brought in for the consumption of the different departments and workshops of the Raj, besides timber of Babool and Neem, as may be required. The Ghunnas in the districts of this State are generally in charge of the respective tahsildars, and are principally used to furnish the needful grass for the Raj cattle, horses and elephants. The following is a list of the preserves in the Bhurtpur State, as communicated to me by Bunsee Shur,—the Vakeel in attendance upon the Political Agent of Bhurtpur:—

- 1.—Bhurtpur Ghunna, area about 40 square miles.
- 2.—Hailah (Pergunnah Bhurtpur), about 16 square miles.
- 3.—Gurrhee and Pahartal (Pergunnah Deeg), about 5 square miles.
- 4.—Khoh (Pergunnah Deeg), about 5 square miles.
- 5.—Roopbass, about 16 square miles.

In some Ghunnas cattle are permitted to graze under certain restrictions.

14. The preserves in the Kishengurh State were of extreme value to the people during the recent famine. The Rajah gave special permission to lop the branches of the *Prosopis spicigera* and other trees for their cattle, by which means many were preserved from starvation.

On the hills south-east of the Betuchee Nala, the shifting cultivation by cutting and burning the jungle, locally called Balree or Valree, is permitted to members of certain Bheel tribes; but the forest is there extensive and comparatively dense, and re-produces rapidly.

15. As regards the working of these preserves, I did not, as a matter of course, expect to find any regular system of cutting and re-production. As a rule, wood or timber is cut promiscuously where it happens to be most convenient; and in one locality only, in the coppice woods of the Raogyee of Humeergurh on the Bunass river, did I notice a pleasing exception. They are principally composed of the small-leaved species of *Conocarpus* already adverted to, which coppices freely; and here I saw a regular gradation of coppice, from that just cut, through the various stages of growth, to wood fit for cutting.

16. In the British districts of Ajmere and Mhairwarra, the Government gave up at the settlement all rights of occupancy in the waste as well as in the cultivated lands. The waste lands of each village are entered as "Shamlat," or common property. The revenue derived from them is considered to belong to the proprietors paying the Government demand; the village expenses are defrayed from this income, and the surplus is distributed to the Khewatdars. Finally, these Shamlat lands may be divided at the pleasure of the people in proportion to their shares, either by themselves, or through an Ameen. These were the arrangements made at the settlement in 1852 (see pages 86 and 179 of the settlement report of Ajmere and Mhairwarra, Agra, 1853). It seems doubtful whether, under these arrangements, these lands have not more the character of private than of public property. So much however, is certain, that Government has reserved to itself very limited rights, if any, in these lands.

17. The practical result of this policy, which was doubtless dictated by the highest motives, has not been satisfactory. While in some of the neighbouring Native States, where the Chiefs have wisely reserved their rights to the uncultivated lands, there are extensive and useful wood and grass reserves, the waste lands of Ajmere and Mhairwarra are for the most part utterly barren, producing little besides *Euphorbia*, and a few scanty shrubs of wild indigo.

18. Under these circumstances, I see no chance of realizing any forest revenue in Ajmere and Mhairwarra sufficient to maintain a forest officer for these districts. Doubtless it would be most desirable to do something for the preservation and improvement of the scrub-jungle still existing on these nominally communal lands. In some places a richer vegetation would prevent the spread of the shifting sands, and in others, it would aid to husband and to regulate the water-supply of the tanks which must always form the main source of prosperity to the agricultural population of these districts.

19. This appears to me to be particularly important in the district of Mhairwarra. Here I noticed in most cases that the hills in the vicinity of the tanks are more completely denuded of every kind of vegetation than those further distant. This is natural, as the villages are generally located near tanks, and their cattle graze over the nearest hills, and wood and grass for domestic use are ordinarily cut in the nearest jungles. I examined several out-of-the-way and thinly-populated jungles in Mhairwarra, and found hills and valleys covered with what, considering the dryness of the climate, must be called a surprisingly luxuriant forest vegetation, frequently reaching a height of from 20 to 30 feet, with a good proportion of *Acacia Catechu* and other valuable kinds.

20. The hills of Mhairwarra are capable of supporting a fair amount of forest vegetation, but in most places it has been checked or destroyed by the constant demands made upon it, and by the absence of all protection. Besides the wants of the agricultural population, the requirements of the Cantonment of Nusseerabad have been a heavy drain upon the resources of this district. Thus the eastern face of the hills stretching from Todgurh to Bednore, as far as they are in British territory, presents a perfectly desert aspect, having been denuded of every stick of hard wood, principally *Acacia Catechu*, by the charcoal-burners of Nusseerabad. Here and there an isolated tree of *Boswellia* remains to shew the height which the original forest attained. As soon, however, as I entered the adjacent territory of the Thakur of Bednore, I found the country fairly well-wooded, not a tree having been felled. On enquiry I learned that the Thakur had prohibited the cutting of any wood by outsiders, in order, as one of his family explained to me, that a plentiful water-supply might be ensured to the tanks on his property.

21. It has been said, with reference to these districts, that the demarcation and protection of selected portions of waste lands to be gradually converted into productive coppice or forest, would be a measure of great importance which would be beneficial to the country, and by way of example, might be expected to do good in the surrounding Native States.

22. We will hope that eventually some means may be devised to make available the needful waste lands for carrying out this plan. But, under existing circumstances, the Native Chiefs of Rajputana have certainly nothing to learn by way of example from the manner in which the waste lands of Ajmere and Mhairwarra have hitherto been treated. It will be a matter for the most serious consideration of the revenue authorities, how far Government is bound in perpetuity by the arrangements made at the settlement in regard to the waste lands in these districts. If it were possible to vindicate their character as public property, the State, as the guardian of all public interests, might assume their management, retaining a sufficient share of the revenue to defray the expenses of management and supervision. The waste lands would still remain the property of the villages, but they would be managed by Government on their behalf.

23. In Mhairwarra especially, I would urge the consideration of some such measure for all hills whose drainage fills the tanks. The scanty rain-fall on those hills does not come down continuously throughout the year, but in a small number of heavy showers, which, not being retained by any vegetable cover, rush down the barren hill-sides in torrents, silting up the tanks and breaking bunds, instead of filling the tanks gradually and steadily. It is evident that, if by any means these hills could be covered with trees and brushwood, the surface drainage would be regulated, and the water-supply to the tanks would be improved. These are the questions which should, in my opinion, be carefully considered by the revenue authorities.