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PRELIMINARY NOTE

ON

BOMBAY COTTONS

BY

F. FLETCHER, M. A. (Cantab), B. Sc. (Lond.), &c.
DEPUTY DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY.



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NOTE

ON THE

COTTONS OF THE BOMBAY PRESIDENCY AND THEIR IMPROVEMENT.

I.—INTRODUCTION.

A word of explanation seems necessary as a preliminary with regard to the term "improvement" in relation to cotton.

The quality of cotton-fibre in contradistinction to the plant depends on the following 6 factors in the fibres which compose it, *viz*:—

- | | | |
|-----------------|---|----------------------------|
| (a) length, | } | Constituting the "Staple." |
| (b) strength, | | |
| (c) fineness. | | |
| (d) uniformity, | | |
| (e) colour, | } | Determining the "Grade." |
| (f) cleanness. | | |

Other less clearly defined qualities are "bulkiness" and elasticity. The matter is however not so simple as it might first appear and the value of a sample of cotton does not vary directly with all the factors above-mentioned though it does with most of them. Thus if one of the factors—length, strength, uniformity—cleanness or increases while the remaining 5 factors remain the same, it may be said with certainty that the value of the sample increases also; if, however, the fineness increases while the other 5 factors remain constant, the sample does not necessarily increase in value. This is due to the fact that different qualities of cotton are used for different purposes; thus while Sea Island and Egyptian are used for the manufactures of an extremely fine and strong material, *e. g.*, muslins, laces, mercerized cotton goods, mailings, &c., and American, Broach, &c., for the manufacture of ordinary calicoes, the roughest types of cotton, *e. g.*, Bengals and Khândesh, though used to a certain extent for mixing with finer growths are also largely used for mixing with wool in the manufacture of worsted goods. Now for the manufacture of calicoes the finer and smoother cotton is the better, while for mixing with wool roughness is required. When we increase the fineness of such growths as Bengals, Khândesh, &c., which, as far as the purposes to which they are put go, may be considered to be on the border land between cotton and wool, we increase their value as cotton but decrease it as wool. The question then arises whether an improvement in these growths should be sought in the direction of fineness or of roughness. In the case

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of the superior growths, such as Egyptian, American and Broach, there can be no doubt that improvement should be attempted in the direction of a longer, stronger and finer fibre. As an example of a coarser and shorter cotton that is more valuable than a finer and longer one to which it is in other properties similar may be mentioned Comilla. This cotton may fetch a higher price by as much as 25 per cent. than ordinary Bengals and Khándesh owing partly to its being picked cleaner but partly also to its being rougher than the latter. As Kapás (seed cotton) its price compared with those mentioned is still greater owing to the higher percentage of lint to seed contained in it.

2. The 6 qualities that determine the value of manufacturer are as above stated. From the cultivator the value of a variety of cotton—the plant in contradiction to the fibre—depends on:—

- (g) yield per acre of seed-cotton,
- (h) price of seed-cotton,
- (i) hardiness of the plant,
- (j) method of ripening.

The yield per acre is of the very greatest importance, but for the purpose of deciding the question of the superiority of one or other of two competing varieties is indissolubly bound up with the question of the price of the produce. The point can be settled only by actual experiment in the field. As an example we may quote the fine-staple Bani of Hinganghát which has been largely replaced by the coarse Jari or Varádi, and here it would appear that the producer and consumer (or rather a particular class of consumer) may be anxious to proceed in opposite direction. Thus the Lancashire spinner would prefer that the finer Bani be grown since he cannot use the coarser Jari, while the cultivator may claim that Jari gives him a larger yield per acre and that the price obtained from the worsted-manufacturers of Saxony, though not so high per maund as that obtained for Bani, is such as to make the value per acre of Jari greater than that of Bani.

The price of seed-cotton again depends on

- (a) the value of the cotton,
- (b) the percentage of cotton to seed.

3. It is obvious that the ratio to one another of the prices which the cultivator receives for equal weights of seed-cotton of two different growths is not necessarily identical with the ratio between the price of equal weights of the cotton of the two growths. Seed-cotton of one variety may be even dearer than seed-cotton of another variety, while the cotton itself of the latter is the higher priced of the two.

Thus if seed-cotton of Bani is worth Rs. 7 and of Varádi Rs. 7 per Bengal maund the cotton in Bombay may be worth respectively

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Rs. 235 and Rs. 200 per candy. These figures are reconciled as follows:—The percentage of cotton in seed-cotton is in the case of Bani 25 and in the case of Varádi 33.3. From four maunds of seed-cotton of Bani therefore one maund of cotton is obtained, while the same quantity of cotton is obtained from three maunds in the case of Varádi. Now if we take Re. 1 per maund of cotton as ginning charges and another Re. 1 as the rail charges to Bombay and if we take the value of the seed-cotton as Rs. 2 per maund we have (neglecting profit and broker's comm.

		Value.		Value.	
		Rs.		Rs.	
Bani	Seed-cotton (4 maunds).	23	} Produces	Cotton (1 maund) ...	X
	+ Ginning ...	1		+ Seed (3 maunds) ...	6
	+ Freight on cotton ...	1		.....	...
		30			X+6

X = Rs. 24 per maund.
Price per candy = Rs. 235.

		Value.		Value.	
		Rs.		Rs.	
Varádi	Seed cotton (3 maunds)	22½	} Produces	Cotton (1 maund) ...	X
	+ Ginning ...	1		+ Seed (2 maunds) ...	4
	+ Freight on cotton ...	1		... ..	...
		24½			X+4

X = Rs. 20½ per maund.
Price per candy = Rs. 200.

The fact that seed-cotton of a finer variety does not necessarily fetch higher price than a coarser variety may have an influence prejudicial to the cultivation of the finer variety. It should be remarked that pure Bani seed-cotton fetches a slightly (10 to 20 per cent.) higher price than Varádi and that in the above hypothetical case the Bani is supposed to be impure.

The fact that the price of seed-cotton of two varieties is not proportional to that of the cotton, somewhat complicates the process of cotton breeding since valuations are made in terms of ginned cotton and these have to be translated into value per acre of seed-cotton.

4. With regard to the hardness of the plant little need be said as on an average of years it is included in the factor "yield per acre",

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and it is of course only on an average of years that an opinion as to hardiness can be formed; a new variety that in ordinary years proves much superior to the local variety may in a year of short rainfall suffer so much more than the latter as to prove worthless.

5. The method of ripening is perhaps of more importance in the case of cotton than of most other crops. To take an instance in the lower Tapti Valley the inferior Varádi (or Jari) of Khándesh is grown in places, where the superior Broach will grow excellently; the reason given by cultivators is that owing to the fact that with the Khándesh variety picking extends only over a couple of weeks, while the ripening period of Broach is 5 weeks, and theft is much more difficult to prevent in the latter variety. Further the Khándesh variety ripens in November, while Broach comes to maturity in February-March; the former crop can therefore be turned into cash at an earlier date than the latter, and this with the cultivator often outweighs the considerable final monetary loss incurred in the cultivation of the earlier and coarser variety.

6. From the point of view of the breeder of cotton the method of ripening involves another factor, viz:—The method in which the bolls open. This affects the cleanness of the cotton when picked; for example the variety "Wágad" of North Gujarát does not open completely and the cotton from this variety is invariably less clean than that of the more widely opening Broach, the dirt (technically "leaf") consisting of small particles of the bracteoles or leaves surrounding the boll. This factor has received special attention in America where many of the varieties open so widely that in picking the cotton, the picker need not touch the boll-leaves.

II.—COTTON-GROWING TRACTS.

7. Having thus briefly noted a few of the points to be constantly kept in view in attempts to produce a more valuable variety of cotton—more valuable to the cultivator, that is,—for growth under any particular set of conditions as to soil and climate—we may now consider what are the various *sets of conditions* met with in this Presidency.

The greater part of the cotton-growing area of this Presidency may be defined as an elevated belt of country varying in width up to about 120 miles extending from the Madras borders in the south to the Sátপুরas in the north—a distance of 500 miles—with its western limit running parallel to and 20 to 50 miles east of, the summit of the western Gháts, while to the east it merges imperceptibly into the immense cotton-growing tract that embraces Central India, the Central Provinces and Berar, Hyderabad and the western portion of Madras. In the region where the Sátপুরas interrupt at once this belt and the line of the Gháts, the former passes over the now depressed summit of the latter and appears again at sea level on the plains of Gujarát and Káthiáwár surrounding the Gulf of Cambay, and still further north of those of the Indus Valley.



**COTTON-GROWING TRACTS
OF THE
BOMBAY PRESIDENCY.**

Scale of Miles.



- A. *Surtee-Broach* [Color swatch]
 - B. *Karnatak* [Color swatch]
 - C. *Kaira-Ahmedabad* [Color swatch]
 - D. *Deccan* [Color swatch]
 - E. *Sind* [Color swatch]
 - F. *Surtee Broach & Kaira-Ahmedabad* [Color swatch]
 - G. *Deccan and Karnatak* [Color swatch]
- Isolyets shown thus: [Line swatch] 40"

Cotton.

(F. Fletcher.)

8. The above-Ghát portion of this belt comprises by far the greater portion of its area. The belt between its western limit and the summit of the Gháts receives a rainfall varying from as much as 400 inches (nearly) in the rugged, jungle covered, rice-growing western half (known variously as the Dangas, Mávals, Dongri, Mallád in various regions) to 30 inches or less in the less rugged eastern half which grows Bájri (*Pennisetum*) or Jowár (*Sorghum*). This eastern strip passes gradually eastwards into the cotton-growing plain generally known as the "desh" with a rainfall of between 20 and 30 inches. In the northern portion of the belt (Khándesh) and its below-Ghát counterpart (Gujarát), the rice tract is less pronounced and the transition to the cotton tract is more rapid, no distinct Jowár-Bájri zone intervening; while still further north the rainfall is insufficient to create a rice belt at all.

9. The general appearance of this tract—the "Desh"—is that of an almost treeless plain (1,500 to 2,000 feet above sea-level) the monotony of which is relieved only by infrequent shallow depressions generally well-wooded in which the upper reaches of the Tapti, Godavary, Bhima, Krishna rise and their (generally intermittent) tributaries flow and by bare flat-topped hills which rise abruptly either singly or in chains to a considerable height above the general level. The soil is in general of the black-cotton type but is much shallower than in the Surtee-Broach (Gujarát) tract often constituting a covering often only a few inches thick to the underlying basalt from which it is formed. Owing to this fact and the smaller amount of precipitation the growing season is not long enough to allow the Surtee-Broach type of cotton to mature except in the Karnátak tract where the rainfall though smaller is better distributed than in the Surtee-Broach tract.

10. The cotton belt as above outlined can be divided into 5 distinct tracts defined by the character of soil and season and consequently also by the types of cotton grown in them though they naturally grade off into one another.

These tracts are in the list below placed in the order of the quality of the cotton produced in them, the best being placed first:—

	Texture of Soil.	Annual rainfall.
		Inches.
A. The Surtee-Broach or South Gujarát Tract ...	Black clay ...	33-45
B. The Karnátak Tract ...	Do. do. ...	28-34
C. The Ahmedabad-Kaira or North Gujarát Tract ...	Sandy ...	28-37
D. The Deccan Tract ...	Black clay ...	20-30
E. The Sind Tract ...	Loam ...	7-0

Cotton.

The conditions of soil and climate in each of the tracts differ from those in the others, and the tracts are more or less rigidly defined by the combined character of these two factors. Further since the whole Presidency is with regard to temperature well within the cotton zone, the only item that need be considered with regard to climate is the rainfall. The effects of temperature are complex and will not be dealt with in this note; they are important chiefly, in India, in the case of the northern continental portions.

The variety of cotton grown in any one of the tracts above mentioned is special to that tract and is in general the best of existing types that can be cultivated in it and, though, as will be shown, this type can often be improved, it can seldom be supplanted.

11. There are then two factors, *viz.*, soil and rainfall, which in this Presidency define the type of cotton that can be grown in any particular tract. It may be here stated that soil and rainfall are complementary to one another in so far that a light soil under a heavy rainfall is often equivalent to heavier soil under a lighter rainfall.

With regard to rainfall it should be always kept in mind that the best cottons of the world, *viz.*, those of Egypt and United States of America grow under a rainfall (or in Egypt its equivalent in irrigation) of four or five inches in each of the 8 or 9 months which constitutes the growing period of the varieties grown in those countries. The total annual rainfall is then no criterion as to the kind of cotton that can be grown unless, *as is in general the case in India*, the amount though varying from 7 to 400 inches all falls with the same period—for India June to October. In India therefore the different cotton-growing tracts are bounded generally by isohyets (lines of equal annual rainfall) the quality of cotton varying directly with the rainfall up to the upper limit of monthly precipitation under which the cotton plant can grow at all. For instance, the isohyet of 45 (that is a rainfall of 45 inches per annum) limits the growth in a southern direction of Surtee-Broach cotton. If however the region to the south of the limit instead of receiving its larger rainfall in the same period as the region to the north, had it spread over a longer period it would not only grow cotton but a cotton of a finer variety than the Surtee-Broach growth (see paragraph 53) which is our best indigenous variety.

12. Corresponding then to the graduation of fibre as we pass down the above list we get a diminution in the effective rainfall (or its equivalent in irrigation). By this term is meant the rainfall that can be utilized by a crop owing either to its being so distributed in time as not to run off the surface of the soil instead of sinking in or to the soil being of a retentive nature and capable therefore of storing up the heavy short-period rainfall for use by the crop after the monsoon is over. Thus the Surtee-Broach Tract (A) has a rainfall of 33 to 45 inches and a very retentive soil, while the Karnátak Tract (B) has a

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(E. Fletcher.)

B.—The Karnátak Tract.

19. This tract together with the Deccan tract (*D*) makes up the above-Ghát portion of the cotton-growing area of this Presidency. It comprises the part of this Presidency lying east of the line drawn from Bársi to Kolhápúr and thence on to Harihar on the Mysore border. It is largely contained within the Dhárwár and Bijápúr Districts, but embraces also parts of the Kolhápúr Agency and the districts of Sátára (south-east corner), Belgaum (eastern two-thirds); in the Sholápur District it merges with the Deccan Tract (*D*).

20. In this tract there are two types of soil; in the eastern belt a stiff loam of the black-cotton-soil type, while in a narrow western belt a lightish soil of a reddish colour containing scattered bands of black soil; this light soil belt is confined to the southern part of the tract being contained principally in the Dhárwár District. The surface of the country is undulating and interspersed here and there with the low hills often rounded and covered with scrub forest. These become more frequent as we proceed west from the black soil belt across that of red soil and west of a line between Sátára and Dhárwár pass into the wooded and rugged rice tract (Mallád), which announces an approach to the edge of the Gháts whence a rapid descent of some two thousand feet takes us to the coast region (Konkan), where the heavy rainfall makes rice the only crop possible. The rainfall in the tract decreases as we proceed east from the Mallád. The character of the monsoon differs materially in the distribution through the year of the annual precipitation, from that of the Surat-Broach Tract (*A*) as will be obvious from the following table (to be compared with Table I):—

TABLE II.

Rainfall in the Karnátak tract.

Di-strict.	Dhárwár.				Bel-gaum.	Sátára.	Bijá-púr.	Sholápur.		Madras Presi-dency.
	Dhár-wár.	Ron.	Golag.	Hudli.	Athul.	Tés-gaum.	Bárgaváli.	Bársi.	Sángola.	
<i>Months of</i>										
May ...	3.60	2.01	2.51	2.57	2.93	2.26	1.71	6.20	1.24	1.8
June ...	5.88	3.87	3.22	4.65	2.86	3.61	3.25	4.33	3.79	1.8
July ...	6.00	1.81	2.60	4.76	2.22	3.34	2.33	4.51	1.80	1.3
August ...	3.94	3.45	3.45	3.53	2.09	2.77	2.70	1.64	2.85	2.3
September ...	4.67	5.32	5.26	5.0	5.10	5.22	7.51	5.52	7.35	3.7
October ...	5.28	2.02	5.77	5.62	1.63	4.13	3.75	2.43	3.44	3.9
November to April ...	4.71	2.91	3.68	3.53	2.97	3.32	3.20	2.34	3.68	2.8
	34.11	22.39	25.93	27.03	23.62	25.75	24.57	24.01	23.15	17.6
Area in thousands of acres under cotton in the districts named.		627			225	19	551		46	

Cotton

We are here in the region receiving the two monsoons, and rain is received both earlier and later in the year than in Tract A. This better distribution in time of the annual rainfall makes up for the smaller total amount and lower temperature as compared with that tract and produces in the best parts of the tract a staple, longer and stronger than any other cotton in India not even excepting Broach; this is also the reason why here alone of all the many regions tried, American cotton has survived as a field crop among cultivators.

21. Corresponding to the two types of soil found in this tract are grown two types of cotton known to commerce as "saw ginned Dhárwar" and "Kumpta" respectively. The former—the "Viláyti hattí" of cultivators—is the acclimatized American species, *Gossypium hirsutum*, and is the produce of seed introduced in 1830. It is grown almost exclusively on the red and medium and shallow black soil areas of the Dhárwár District. It need hardly be said that it retains only a small semblance to its ancestor since no selection of seed has taken place, though in attempts at acclimatizing any crops this fact is of the very first importance. The saw ginned of Hubli fetches Rs. 5 to 10 more than that of Gadag owing probably to the better rainfall at the former place.

The cotton known commercially as Kumpta and to the cultivator as "Jowári hattí" (country cotton) is a variety of the herbaceum species that is hardly distinguishable from the Surtee-Broach plant (of which it is probably the direct descendant), except by the character of the produce which gives a lower ginning outturn of a slightly longer fibre, the cotton being very thin on the seed. The outturn at the gin is much less than in the case of the acclimatized American, and it is this factor probably more than any other that has enabled the exotic to compete with the indigenous, since the yield of the former in seed-cotton is no greater if as great while the value of the cotton itself is less (see Table X).

22. The areas under these two varieties of cotton are not returned separately but it may be stated that as a pure crop the American is confined almost entirely to the Dhárwár District and to the Bársi Táluka of Sholápur though sown mixed with Kumpta in other parts of the tract. It probably occupies about 200,000 acres.

Kumpta covers a very large proportion (about 85 per cent.) of the area given at the base of Table II and occupies about 1,200,000 acres.

The areas under cotton in the chief cotton-growing tálukas of the Dhárwár District are given below with a rough estimate of the percentages of the two kinds of cotton and the red and black variety in the soil that bears them :—

Cotton.

(F. Fletcher.)

Table III.

Taluka.	Acreage under Cotton in thousands.	Percentage of			
		Soil.		Cotton.	
		Red.	Black.	American.	Kumpta.
Dhárwár	25	5	95	5	95
Hubli	58	5	95	5	95
Bankápur	39	10	90	15	55
Hángaí	8	<i>Nil</i>	100	<i>Nil</i>	100
Kod	19	90	10	90	10
Ránebenur	39	30	70	60	40
Karajgi	123	40	60	50	50
Navalgund	114	<i>Nil</i>	100	<i>Nil</i>	100
Ron	86	<i>Nil</i>	100	40	60
Gadag	120	30	70	40	60
Total ...	627				

The yield varies very greatly but averages about 150 lbs. of seed cotton per acre.

23. In the south of the tract, *e.g.*, Dhárwár, sowing of both the varieties takes place in August-September, the north-east monsoon being there dominant. As we proceed north the influence of the north-east monsoon diminishes and in Bijápur and Sholápur and northwards sowing generally takes place in June-July.

The rotation is either a two-year one with Jowár or a three-year one with Jowár and wheat.

24. The effect of being sown for generations in August-September appears to have had the effect of causing a difference not only in the *produce* of Kumpta as compared with its parent Broach but also of changing the *constitution* of the plant. Kumpta at Dhárwár in consequence not only produces seed-cotton with a lower ginning outturn and a slightly longer fibre than Broach but behaves differently from the latter variety when both are sown together at the time (June-July) at which Broach is generally sown. For instance on the Dhárwár Farm on its inception in 1904-1905, it was decided to re-introduce Broach into the district and see if fresh blood would not increase the ginning outturn without causing deterioration in the staple. Accordingly two plots were sown with Kumpta and Broach separately at the end of June. Kumpta lost its leaves in September and ripened in November-December yielding 690 lbs. of seed-cotton per acre, 26 per cent. of which was cotton. Broach, on the other hand, continued to grow well and in February-March yielded 1,066 lbs. of seed-cotton, 32 per cent. of which was cotton. The Kumpta was valued at Rs. 210 per candy (784 lbs.) and the Broach at Rs. 208.

Cotton.

It would appear from the following table of temperatures that the Kumpta variety is accustomed when three months old to be checked by the colder weather of November-December (see mean minimum temperatures in the table) and when, owing to earlier sowing, it attained this age in September, was forced to earlier maturity by the warmer weather of that period. Broach on the other hand being accustomed to a still higher temperature continues to grow normally with the result that an extremely good yield was obtained :—

Table IV—Temperatures.

		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Dhārwar	... { Mean maximum	83	87	88	92	91	86	81	83	86	85	82	80
	... { Do. minimum	66	69	72	74	74	70	70	70	71	71	68	64
Surat	... { Do. maximum	87	91	91	101	98	95	93	88	90	96	94	90
	... { Do. minimum	57	59	68	75	79	81	79	77	76	72	65	61

It is hoped that by introducing fresh blood of the original stock into the Karnatak much good will result. This is being done both by introducing Broach as a field crop and also by hybridizing the Kumpta with Broach.

25. The fact that in the Sholapur District only 2·4 per cent. of the unirrigated cropped area is put under cotton, while in Bijapur nearly 20 per cent. is under this crop is due in a great part to the lighter nature of the soil in the former district, while under the same rainfall the black soil of Bijapur cannot except in good seasons mature this crop. The monsoon is also more uncertain in the former district which seldom enjoys a good season more than once in 4 years. This effect of character of soil is well shown in Sholapur District itself, the talukas of Bārsi and Sāngola in which the area under cotton is respectively largest and smallest in the district, having respectively 6 per cent. and 1 per cent. of their unirrigated cropped area under cotton. This great divergence is due not so much to rainfall as to the fact that the soil in Bārsi is of a heavy black type while in Sāngola it is light and stony. Again in the Bārsi taluka of Sholapur the rainfall is greater and better distributed in time than in other talukas of the district. This is owing to the nearness of the Bālāghāt hills and the cotton grown in this region is better than that of other talukas of Sholapur, *e.g.*, Sāngola, which enjoys a worse rainfall (see Table II).

This tract as was stated above merges into the Deccan tract in the north and east. In those parts therefore we find a mixture of varieties, for example in the Bārsi Taluka of Sholapur and the Indapur Taluka of Poona there are grown the three varieties of Kumpta, American

Cotton.

(J. Fletcher.)

and the Deccan growth, in some cases as more or less pure crops, in others as a mixture containing 2 or all the kinds.

26. The names under which the cotton of this tract comes into the market are given in Table IX below. *Westerns* is the produce of the same species of plant as *Kumpta*, the difference between the two being that the latter is grown under better conditions of rainfall than the former and is therefore of better quality. Thus *Westerns* come from the Sholápur (except Bársi), Bijápur and Belgaum Districts and from Bellary (Madras) and are valued at about Rs. 30 per candy below *Kumpta*. A reference to Table II will show that the rainfall in these places is as much in the case of Bellary as about 10 inches below that of Hubli in the Dhárwár District which is typical of the *Kumpta* growing areas. Further, much of the cotton from Sholápur and neighbouring places is still hand-ginned which will account for 10 of the 30 rupees by which the price falls short of that of the best *Kumpta*.

Cotton from Miraj though classed commercially as *Westerns* (see Table IX) is grown under the same conditions as good *Kumpta* and generally fetches the same price as that growth. Again cotton from Athni (Belgaum) though grown under the same rainfall as that from Bijápur District is of better quality than the latter owing to the more retentive nature of the soil which is of the good black cotton soil type.

(C).—*The Ahmedabad-Kaira or Northern Gujarát Tract.*

27. This tract comprising the two districts named, together with the northern part of the Broach District is somewhat remarkable in that it grows within a narrow area a number of types in a more or less unmixed condition. This is due partly to the black soil occurring in patches in the prevalent *gorádu* soil of the district, partly to the use of well-irrigation and partly to the cultivator's individual taste.

Except in the "Bhál" or black soil area comprising the southern half of the Dholka and the eastern half of the Dhandhuka talukas the Broach variety (here known as *Lália*) will only mature if the rainfall is supplemented by three or four waterings after the close of the monsoon; this black soil area is in reality a part of the Surtee Broach Tract but is separated off from it by the Gulf of Cambay and can thus for geographical reasons be conveniently treated of here.

The tract is a part of the *gorádu* plain mentioned above that commences in the north of the Broach District and extends to the Indus Valley. The soil is in general light, both in colour and texture, and is specially suited for cultivation under wells, which are very numerous. The general appearance of the plain in those parts that enjoy a rainfall of over 20 inches is that commonly described as "park like" fields being well wooded and separated by high cactus hedges at frequent intervals in which occur mango and other trees.

Cotton.

28. The average rainfall in the tract is about 30 inches, its distribution during the monsoon being illustrated by the following table:—

TABLE V.

Rainfall in inches.

Month.	Ahmedabad.	Nadiad.	Kaira.	Dhandhuka.
June	4.56	5.81	4.28	4.20
July	10.84	12.08	11.71	10.54
August	8.58	11.60	9.42	6.06
September	6.31	6.78	6.21	5.06
October to May	1.19	1.28	1.11	2.02
Total	31.39	37.55	32.72	27.92

Passing from the cotton-growing tract we are considering the rainfall on the great *gorādu* plain gradually diminishes until it practically vanishes in the almost rainless Indus Valley.

29. The four chief types of cotton grown in this tract are known to cultivators as *Wāgad*, *Lālia*, *Goghāri* (or * *Kānvi*) and *Rozi* (or *Jeria*). Commercially they are grouped under the common name "Dhollera", a term which is almost synonymous with that of "Broach (Gujarāt cotton)." This growth is largely consumed locally in the mills of Ahmedabad.

30. *Wāgad* is a variety of the herbaceum species which differs from Broach outwardly only in the size and imperfect dehiscence of the bolls. The cotton is not picked from the bolls, while, as in other growths, they remain on the trees, but the dehiscing boll is plucked bodily from the plant and the seed-cotton extracted at leisure in the houses of the cultivators. This "boll-cotton" is known as "Kalas" and contains about 69 per cent. of seed-cotton which again contains 35 per cent. of cotton. The cotton is of fair quality, coarser than *Lālia*, but owing to the method of harvesting contains much dirt in the form of parts of the bracteoles and boll coverings.

Lālia is identical with the Broach variety and yields under irrigation a similar cotton; on light soil it is almost always grown in plots of a couple of acres round wells from which after the close of monsoon it receives three or four waterings. In one tāluka (Dhandhuka) it is grown unirrigated on black soil often mixed with the last named variety. The rainfall however (30 inches) is insufficient to allow the bolls to open completely and they are often plucked whole from the

* The slight differences between these two varieties is possibly due only to difference in the conditions under which they are grown.

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tree like the Wágad with which it is mixed. The mixture fetches a better price than Wágad alone but it is doubtful whether the pure crop would not pay better.

Ghogári is grown unirrigated under the same conditions as unirrigated *Lália*. It produces a coarser fibre but yields better under a short rainfall.

Rozi.—This is the *G. Wightianum* of Todaró and is assigned by Professor Gammie to *G. Obtusifolium*. It approaches the species *herbaceum* in general characteristics and appearance but is a perennial and once sown is left on the land for three or four years. It is not sown as the sole crop in a field but as a mixture (a plant at wide intervals in every sixth row or so) with *Báji* and other crops. The ginning outturn is poor (25 per cent.) as is also the quality of the cotton.

31. Outside this Presidency the tract is continued into Baroda, *Rájipla*, *Pálanpur* States, *Rájputána* and *Káthiáwár*. The last named province has a large area under cotton on a variety of soils, including, especially towards the west, patches of the black soil of the *Surtee-Broach Tract (A)* in the general *gorádu* surface. Corresponding with the variety of soils is a variety of cottons which while possibly fairly pure in the fields are mixed at the presses with the result that the reputation of the whole tract is not high. In the black soil portions good cotton of the *Broach* type was formerly grown, but latterly seed of *Khándesh* cotton taken across the gulf from Bombay as cattle food has been sown under the name "*Mathia*." The admixture of this short-stapled variety has accelerated the process of degeneration of *Káthiáwár's* reputed cotton.

32. The crop is sown at the commencement of the monsoon (June) in rotation with *Báji*.

33. The area under cotton in the *Ahmedabad* District is 3 lákhs of acres and in *Kaira* six thousand acres. The per acre yield varies from 200 lbs. of seed-cotton when unirrigated to as much as 1,200 lbs. when irrigated.

D.—The Deccan Tract.

34. This includes in this Presidency the districts of *Khándesh* (the whole), *Násik* (eastern one-third), *Ahmednagar* (eastern one-third) and *Poona* (south-eastern corner) and in *Sholápur* and *Bijápur* gradually merges into that of the *Karnátak*. In *Khándesh* the rainfall is derived almost entirely from the south-west monsoon, but to the south partly also from the northern current; the annual precipitation varies only between 20 and 25 inches—and exceptionally to 30 inches in East *Khándesh*—in the different portions as shown in the following table:—

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TABLE VI.

Average rainfall (inches) in the Deccan Tract.

District.	Klándesh.		Násik.	Ahmednagar.		Poona.
	East.	West.				
Station.	Jalgaon.	Dhulia.	Má'egaon.	Shevgaon.	Nevasa.	Indápur.
<i>Month of.</i>						
May	0.26	0.06	0.73	0.71	0.78	1.40
June	4.38	3.90	4.06	6.36	4.78	2.89
July	8.62	5.77	4.37	5.11	3.97	2.06
August	6.83	3.97	3.15	3.22	2.13	1.72
September	6.38	6.28	6.44	6.84	7.23	6.93
October	1.20	1.19	1.41	2.21	1.52	2.86
November to April	1.15	1.23	0.70	1.93	1.75	2.35
Total rainfall	28.82	23.10	20.86	26.38	22.16	20.21
Area under cotton in thousands of acres by districts	893	395	71	14	4	11

It is interesting to note that the rainfall in East Klándesh is heavier than in the western portion of the district, contrary to the general rule for the "desh" as a whole, and that the cotton is in consequence better in quality and greater in quantity than in the west; for instance the cotton of Jalgaon is better than that of Dhulia (see table above) though produced by the same variety of plants.

35. The area under cotton in the districts of the Deccan Tract as given for the year 1903-1904 at the base of Table VI the total area being 15 lakhs of acres or 24 per cent. of the whole area under cotton in this Presidency (including Native States.) The per acre yield varies from 100 to 700 lbs. of seed cotton.

36. Before treating of the variety of cotton grown in this tract it may be here mentioned that the same variety is grown under similar conditions, in practically the whole of Central India, Rájputána and the Central Provinces (including the Berars), the Nizam's Dominions and also on the lighter alluvial soils often under irrigation of the United Provinces, Punjab and Sind. The total area in India under this variety is probably therefore as given in the following table:—

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(F. Fletcher.)

TABLE VII.

Presidency.	Lákh of acres.
Bombay	13.70
Central Provinces	13.05
Beñar	28.51
United Provinces	12.38
Central India	7.71
Nizam's Dominion	26.40
Rájputána	3.94
Punjab and North-Western Provinces ...	12.94
Sind	2.07
Other Native States	5.03
	125.73 lákhs or 12½ million acres.

This is about 70 per cent. of the total area under cotton in India (17½ millions).

37. The rainfall at a few places in these extra-presidential regions is given in the table following:—

TABLE VIII.

Average rainfall at several inland stations of Peninsular India.

Month of.	Jálma.	Akola.	Amraoti.	Saugor.	Keemuch.	Indore.	Jhan-i.	Sikan-darabad.	Nágpur.	Rájpore.
May	0.8	0.2	0.6	0.6	0.5	0.6	0.3	1.4	0.8	.9
June	7.2	5.2	6.9	6.3	3.9	6.8	4.0	3.7	8.8	1.4
July	4.8	7.3	8.8	16.3	11.2	10.4	13.6	6.0	13.3	1.3
August	5.3	6.7	7.0	11.2	19.4	7.6	10.5	5.7	8.9	1.1
September	7.5	5.8	5.3	7.3	5.5	8.1	5.2	5.2	7.8	.7
October	3.4	2.2	1.6	1.3	1.0	1.2	0.8	3.3	2.3	2.2
November 10										
April	2.5	2.3	2.0	2.0	0.7	1.2	1.4	3.0	3.0	.9
	33.5	30.2	32.2	46.1	33.2	36.1	35.8	28.3	41.9	51.0

From this table it might appear that the rainfall of Nágpur, approximating to that of Navsári in character, should ensure a better quality of cotton than that now coming from the former district. Here however the question of temperature comes in and though the mean maximum is about the same as at Dhárwár, the mean minimum at Nágpur for December and January is 54 and 55 which is much below that of

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the Surtee-Broach Tract and still more below that of the Karnátak Tract where as we have seen Broach cotton grows well.

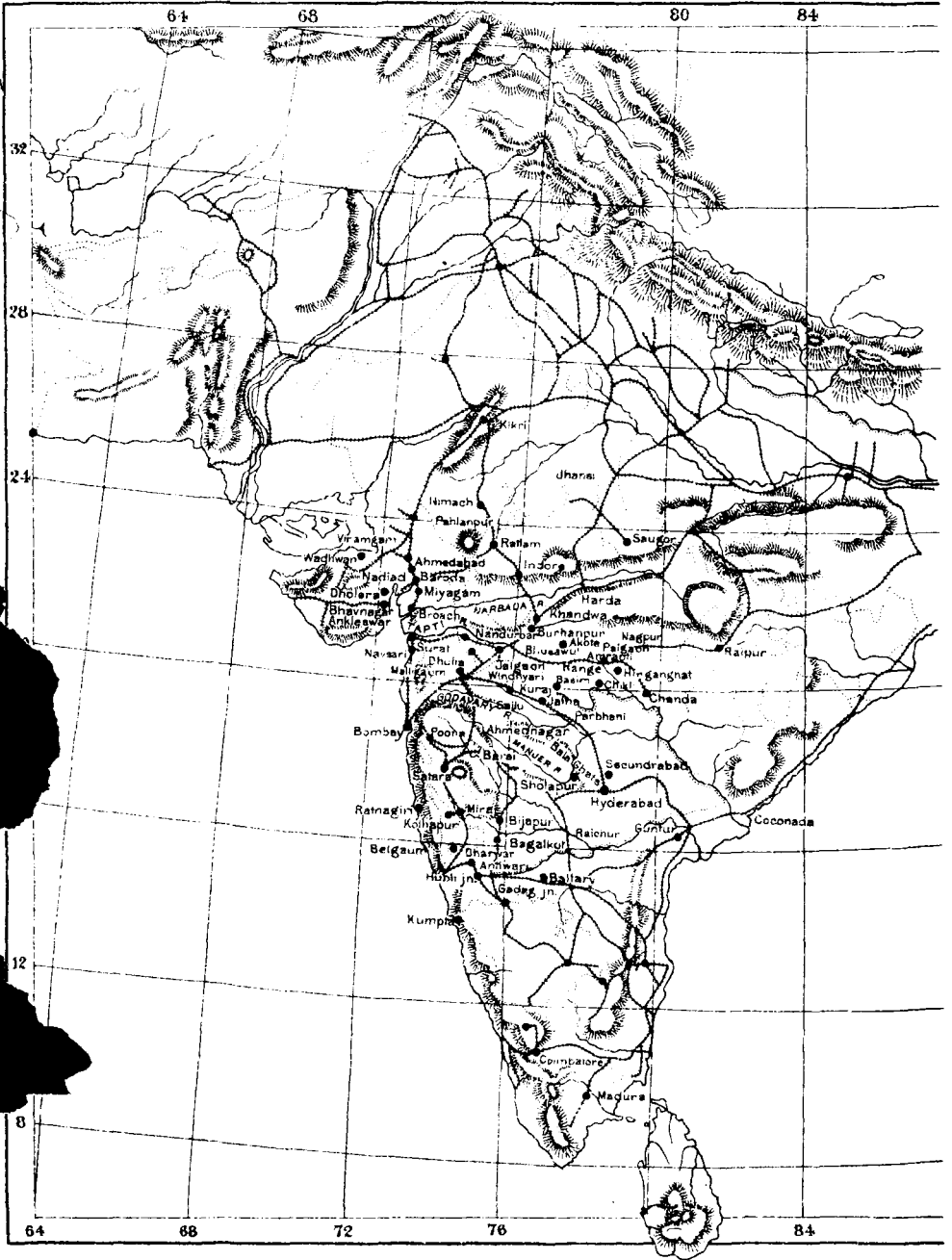
The importance of the particular growth of cotton produced in the tract under record it is hardly possible, in view of the large area over which it is grown, to exaggerate and a thorough investigation of it is of the very greatest urgency. Owing to the enormous area annually put under this variety a very slight increase in its per acre value would mean, in the aggregate, a very large increase in the total value of the growth. The lines on which this investigation should proceed are indicated below.

38. It is necessary however to sketch briefly the nomenclature under which cotton, and the cotton of this tract in particular, comes into the market. In general it receives the name of the district in which it is grown and if more detailed classification is required the name of the station at which it is put on to the rail for transport to the cotton markets of Bombay, Calcutta, Madras and Karáchi. We thus get the following names applied to different qualities of cotton :—

TABLE IX.

Commercial classification of Cotton.

Tract in which grown.	General name of the growth.	Sub-divisions of the growth according to		Remarks.
		Province or District.	Station or Town.	
A	Broach or Surtee-Broach.	{ Broach ...	MIagam and to the south about 7 others.	
		{ Surat ...	{ Surat, Navsári and 19 others.	
B.	{ Kumpta	{ Dhárwár, Gadag, Hubli, Gadag, Hubli.	In the Bombay Karnátak. In Nizam's Dominions. In Madras.
	{ Saw-ginned Dhárwár.	.....	{
	{ Westerns	Annigeri, Bágalkot, Sholápur, Belgaum, Bijápur, Miraj and about 30 others.	
		Raichore and 5 others. Bellary and 12 others.	



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TABLE IX—continued.

Tract in which grown.	General name of the growth.	Sub-divisions of the growth according to		Remarks.	
		Province or District.	Station or Town.		
C.	Dhollera ...	Cutch ...	About 10 towns.	From many of these places a variety known as "Mathia" is also obtained which is distinguished thus:—"Bhavnagar (Mathia)."	
		Northern Gujarať.	About 20 towns.		
		Káthiáwár ...	Wadhván, Bhavnagar, Junágad, Dhollera and about 40 others.		
D.	Umras (or Umrawatti).	Beláti. {	Berar ...	Amrávati and 10 others.	} Short stapled.
			Central Provinces.	Nágpur, Pulgaon and 10 others.	
		Khándesh. {	Khándesh ...	Jalgaon, Dhulia and about 20 others.	} Medium length.
			Central India	Indore and about 6 others.	
		Central Provinces. {	Berar ...	{ Burhánpur. Harda. Khandwa.	} This is Umras proper and fairly long in staple.
			Berar ...	Akola and 20 others.	
		Hinganghát ...	Hinganghát ...	Hinganghát and about 2 others.	} Long staple.
			Bársi ...	Bársi and 10 others.	
		Nagar ...	Nagar ...	Ahmednagar and 10 others.	} Improving in quality.
			Rájputána ...	Kekvi and 20 others.	
Tract not treated of in this article.	Bengals ...	Central India ...	... ..	} This is Bengal proper.
		Bengal ...	Comilla ...		
E.	Sind, Punjáb ...	United Provinces.	Cawnpore and about 20 others.	} In Madras.	
		.....	Over 30 stations in Sind and Punjáb.	
Tract not treated of in this article.	Coconada	Coconada and Gantur.	} Do.	
		Tinnevelly		Coimbatour and about 12 others.

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39. From the table given it will be seen that a variety of cotton grown in a particular tract may be known under several names commercially though it has all been produced by one botanical variety (or one mixture of varieties) of plants; for example, Umras and Bengals (part), Sind, Punjab are all produced by a mixture in different proportions of the same botanical varieties of cotton. Further in the case of Berar the cotton coming from the southern part is known as Berar (proper) while the growth from the northern part of that province and from the southern part of the Central Provinces is known as Beláti and that from the northern part of the Central Provinces is classed as Khándesh.

All this cotton is produced by the same mixture of varieties, and as will be shown later the difference in quality is due to the difference in the proportions in which the varieties are grown to form the mixture.

40. The mixture of varieties that produces the cotton over some 12½ million acres of the Deccan cotton growing tract will now be examined in detail and the proportion in which the constituents are mixed will be given for the few cases investigated.

This mixture consists principally of 5 varieties which Professor Gammie has named as below:—

Four of the varieties belonging to Todaro's species neglectum and one to the same author's species indicum. The varieties are:—

				Cultivator's name.
(1)	Gossypium	neglectum	rosea	...
(2)	Do.	do.	Cutchica	...
(3)	Do.	do.	vera	...
(4)	Do.	do.	Malvensis	...
(5)	Do.	Indicum		...

} Varádi.
} Jari.
} Bani.

Broadly speaking the fibre produced by these varieties increases in value as we go down the list, *Gossypium neglectum rosea* producing the shortest stapled and the lowest priced cotton on the market, while the last species in the list (*G. indicum*) produces the cotton known as Bani or Hinganghát, which when pure is equal to the best Broach in value and is therefore little inferior to middling American.

41. For the purpose of analysing botanically some of the commercial growths of cotton specially those of the Deccan tract I obtained, through the courtesy of the Bombay Chamber of Commerce and Messrs. Ralli Brothers, seeds (without cotton) of the growths given in the table below. The name of the variety is that of the growth from which the seeds were obtained and not that to which the seeds when sown by me gave rise. The growth had therefore been classed before the seeds were sown.

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Owing to the inability of the fieldman to distinguish between the 4th and 5th of the varieties mentioned above, these varieties were counted as one; it may be said that the proportion of plants of the 5th variety (Bani) was in all cases small. In future work however all the 5 varieties will be counted separately:—

TABLE X.

Field number of the sample.	Name under which the seed was received.	Percentage Analysis of plants produced from the samples of seed.							Comparative price in rupees per candy of 784 lbs. in Bombay.*
		Varādi.		Jari.		Ameri- can.	Broach and Kumpta.	Red- flowered.	
		Neglec- tum rosea.	Neglec- tum rosea Cutchica.	Neg- lectum- vera.	Neglectum vera Malvensis	Hirsu- tum.	Herba- ceum.	Arbore- um.	
1	2	3	4	5	6	7	8	9	10
341	Nāgpur ... ..	...	...	34.2	65.8	...	...	...	200
342	Umāvatī	43.7	19.5	23.0	11.5	2.3	...	...	185
343	Central India	51.0	27.4	7.3	10.9	5.5	...	...	180
344	Berār	59.6	20.7	3.5	17.3	8.0	...	...	185
345	Bārsī	4.8	6.5	9.7	64.5	14.5	...	...	} 200
370	Bārsī (mixed staple).	4.2	...	11.5	60.0	24.2	...	...
371	Bārsī (good staple).	1.0	...	11.1	64.8	23.1	...	...
346	North-West Pro- vinces.	42.2	23.1	21.9	12.5	
347	Bhāvnagari ... ..	...	9.1	...	7.3	...	83.6	...	?
318	Belāti	64.0	14.9	6.1	13.8	...	...	...	185
349	Rājputāna	39.4	11.5	7.7	41.4	...	...	...	?
350	Central Provinces...	1.1	1.1	82.5	35.3	...	...	...	} Probabl y almost as for Nāg- pur. ?
351	Western Bengal	83.5	2.5	11.4	2.5	...	...	...
352	Punjab	43.9	24.7	...	28.8	...	...	2.7	180
353	Khāndwa (fair staple.)	11.4	20.3	11.4	53.1	3.8	...	...	200
354	Harda (good sta- ple).	3.8	0.9	33.0	62.3	...	...	...	200
355	Harda (fair to good staple).	5.4	9.5	20.7	55.4	...	...	...	200
356	Dhāmangaon	55.0	27.5	11.3	5.0	1.2	...	...	190
357	Pulgaon	92.5	6.6	...	0.9	...	...	...	190
358	Kumpta (Hubli) ... ..	...	...	...	...	...	100	...	225

* The price as given in this column is meant only to indicate the relative values of the growths as ordinarily received; the actual prices of course vary and the ratio between any two stations may be reversed in the case of particular samples. Where two samples are from the same station the price in the table is that of the better one.

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TABLE X—continued.

Field number of the sample.	Name under which the seed was received.	Percentage Analysis of plants produced from the samples of seed.							Comparative price in rupees per candy of 724 lbs. in Bombay.*			
		Varādi.		Jari.		Ameri- can.	Broach and Kunta.	Red- flowered.				
		Neglectum rosea.	Neglectum rosea Cutchicea	Neglectum vera.	Neglectum vera Malvensis.	Hirsu- tum.	Herba- ceum.	Arbore- um.				
1	2	3	4	5	6	7	8	9	10			
359	Akola (good staple).	3.6	2	10.8	81.9	1.2	}	199		
360	Akola (ordinary staple).	59.8	18.5	2.2	18.5	...	...	...	
361	Khamgaon (ordinary).	14.5	14.5	10.5	57.9	2.6			}	190
362	Khamgaon (good)...	2.1	8.7	6.5	79.4	3.3	...	...		
363	Karanja (ordinary staple).	64.4	18.4	2.3	14.9	}	190		
364	Karanja (good staple.)	19.7	8.6	8.6	60.5	3.6	...	...		
365	Junagar (Malthia)...	...	86.3	1.1	10.5	...	2.1	...			}	175
366	Junagar (Dholka good staple).	3.3	3.3	2.2	6.7	...	84.5	...	}	?		
367	Parbhani (good staple).	1.0	3.0	19.0	55.0	23.0	...	...					}	200
368	Sailu (good staple).	5.7	0.9	9.4	80.2	3.8	...	...		
369	Sailu (well up good staple).	34.4	...	12.5	37.5	15.6	}	200		
370	Hinganghat (ordinary staple).	56.1	12.2	0.1	23.5	2.0			}	230
373	Hinganghat (good staple).	2.1	...	13.5	84.4	...	...	...	
374	Sind	1.2	3.4	41.2	51.2	}	190		
	†Pimpalner	42.5	31.8	4.6	21.1			}	?
	†Nandurbār	22.5	36.7	8.2	32.6	...	...	...	
	†Taloda	2.3	35.7	16.7	45.3	}	?		
	†Shahāda	39.7	52.9	...	7.4	...	...	...	
	†Dhulia	40.0	41.2	2.6	13.2			}	185
	†Chopda	76.9	23.0	...	...	...	...	...
	†Jalgaon	73.0	16.2	8.1	2.7	}	?		
	†Broach	100	...			}	215
	†Surat ... ..	...	...	...	...	...	100	...
	†Navsari	100	...	}	230		
	†Saw-ginned Dhār-wār.	100			}	215

* The price as given in this column is meant only to indicate the relative values of the growths as ordinarily received; the actual prices of course vary and the ratio between any two stations may be reversed in the case of particular samples. Where two samples are from the same station the price in the table is that of the better one.

† Seed from these places was obtained from another source.

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42. A detailed examination of the table is instructive. A few points only can however be now pointed out. The analysis should be compared with the figures in the last column which represent the comparative prices of the cotton usually arriving in Bombay of the growths named in the second column.

It will be found that the price varies directly in almost every case with the percentage of the plants producing the better staple. This is very marked in the cases in which seeds from the same place were obtained from crops showing a difference in staple; such instances are Bársi, Harda, Akola, Khámgaon, Karanj, Sailu, Hinganghát. In all these cases the seeds from the better growth contained a larger percentage of Jari (columns 5 and 6) than of Varádi (columns 3 and 4). This is I think of the utmost importance for it shows that differences of quality in many cases are due not to differences in soil, climate or methods of cultivation but to differences in the actual seeds sown, and that therefore seed distribution can do much good. It may be urged that the ryot would grow the better staple if it paid him better. This is however to ignore the lack of knowledge under which the ryot labours especially in the case of cotton. It has hitherto been found impossible to distinguish between samples of Bani, Jari and Varádi seed after ginning, and the cultivator himself certainly cannot distinguish. The case of cotton is therefore entirely different from that of cereals where the appearance of the seed tells the cultivator what quality of a harvest he is likely to obtain. It should be noted that the quality of the Bhávnagri sample must have been above that ordinarily received in Bombay which is Mathia, while the sample (347) in the table is almost pure Broach cotton.

Again the purity of the Kumpta (358), sawginned Dhárwár- (American), Broach, Surat and Navsári is all that can be desired.

With regard to Hinganghát it may be said that the crop received under this name in Bombay used to consist of pure Bani (*Gossypium indicum*), while the sample (372 and 373) analysed included only a few plants of this variety. The pure Bani cannot be had now in Bombay being all appropriated by the mills of the Central Provinces. The price (Rs. 200) of the so-called Hinganghát in Bombay is witness to the impurity of the growth, for when pure the cotton from Bani is worth as much as best Broach (say Rs. 230).

43. The growth of cotton in the Deccan tract of India and not only of this Presidency may for the present purpose be divided into the three divisions of Varádi, Jari and Bani according as it is respectively of a very short and coarse, of a coarse but long or of a fine long staple. It should however be understood that all these and especially the two first are now grown mixed, and that the Varádi of Khándesh and Jari of Central Provinces are practically identical. The coarse Varádi has in fact replaced the original Jari in many localities, *e.g.*, in Akote (near Akola. see samples 359 and 360) while both have replaced

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Bani to a large extent. The area now sown with pure Bani—the centre of cultivation is in the Wardha Valley—in the Central Provinces and Berar—is not accurately known but except around its original home is negligible.

It would be both interesting and extremely useful to have on record a history of the decline of the cultivation of Bani, which when grown pure is an even more valuable fibre than Broach or Kumpta. It has been within recent years largely displaced by the coarser Varádi a name which rightly or wrongly indicates Berar as the point of origin. Doubtless there are many cotton merchants who could say whether a pure sample of Bani is now equal to what it was 15 years ago. This would be interesting in view of the suggestion that the deterioration in part at least is due to the degeneration in the plant itself and not entirely to intermixture of coarser growths; so far there is no evidence in favour of this suggestion. It is much more probable that the process of deterioration in the cotton of a district is due to the replacement, in part or bodily, of the original variety by a coarser and possibly more prolific one. It has generally been assumed that such replacement has been consciously and honestly brought about by cultivators in their own interests on finding that the per acre value of the coarser sort was greater than that of the finer. I venture to think that although this may have been the case it is by no means proved and there are two alternative methods in which the cultivator or the Bania (money-lender) respectively plays a less honest and an entirely unconscious part.

44. The whole question turns on the relative yields in both seed cotton and cotton of the finer and coarser varieties. The only evidence I have on this point is that furnished by the Government Experimental Farms at Nagpur, Cawnpore and Dhulia which is as follows:—

Name of Farm.	Period of Experiment.	Variety.	Average yield per acre in lbs.		Percentage of cotton in seed-cotton.
			Seed-cotton.	Cotton.	
Cawnpore ...	5 years—1895—99 ...	{ Bani ...	580	145	25
		{ Jari ...	769	246	32
Nágpur ...	{ 5 years—1892—96 and	{ Bani ...	216	54	25
	{ 98.	{ Jari ...	206	66	32
Dhulia ...	1 year 1905-06 ...	{ Bani ...	670	167	25
		{ Jari ...	693	209	30

At Cawnpore there can be no doubt that the coarser Jari pays better under the system of planting practised than Bani. Whether this system is equally fair to the two varieties is a question that can only be decided by experiments in which each variety is sown and cultivated in the method best suited to it.

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At Nágpur even if we take the price of Bani seed-cotton to be no higher than that of Jari, though it is not unusual for it to be 20 per cent higher, the cultivation of Bani is the more paying. The same remark almost applies to the one year's experiment at Dhulia.

We may then conclude that in certain districts of the Deccan tract the cultivation of Bani still pays the cultivator better than that of Jari.

45. The cultivator is not however a free agent with regard to the crops he shall sow which are often decided by the Bania and his point of view must therefore be considered.

Though the per acre yield of seed-cotton may be the same for both Bani and Jari and therefore even supposing that Bani seed-cotton sells only at the same rates as Jari seed-cotton the two are equally paying to the cultivator, the case is quite different when we consider the cotton alone and it is with this form of the crop that the Bania is chiefly concerned. Taking the figures for Nágpur above we find the per acre yield of cotton to be in favour of Jari which yields 20 per cent. more than Bani. This increase is only just sufficient to counterbalance the less price of Jari cotton (in contradistinction to seed-cotton) as compared with Bani. If however the Bania can sell his Jari cotton at the price of Bani he gains in dealing in the former commodity. This he can do to a certain extent by judiciously mixing a little Jari cotton with a large bulk of Bani. Having once tasted the sweets of illicit gain the descent to Varádi was not only easy but inevitable, and by dint of deluding himself he was deluding some one else; the cultivator (or his Sowkár) would progress in his unrighteousness and add more Varádi. It may be argued that when owing to the practice of admixture becoming generally known dealers would decline to be further defrauded and would give for Varádi only the price of Varádi whether it was called Bani or not, a return to the cultivation of Bani would ensue if this were more paying than the honest cultivation of Varádi. There are however difficulties in the way of this return. The first difficulty is that to obtain the intrinsic value of a sample of cotton, there must be sufficient cotton of the same class to make a market. Suppose for instance in a Varádi growing tract, an enterprising cultivator grows 5 acres of Bani and obtains 1,000 lbs. of seed-cotton (Kapás). This quantity would have to be ginned separately in the first place and when ginned would not be sufficient to form a bale. The cultivator would probably get less per maund for his finer Kapás than he would have got for the coarser local growth since it would be bought on the basis of Varádi cotton (in contradiction to seed-cotton) and the percentage of Bani in it would be less. Combination among cultivators would overcome the difficulty, but this is at present non-existent in India.

Another difficulty met with in an attempt to resuscitate the cultivation of the finer growth is that a district having once obtained an infamy cannot for some time receive a proper reward for its reform in its conduct, and its return to respectability can only be

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made at a price, *viz.*, the selling of a superior variety for some time at a price little if any above that of the ordinarily grown inferior variety.

46. If the cultivator and Bania's honesty is held to be above suspicion the following second alternative to the usually accepted view as to the method of displacements of Bani by Varádi is put forward here for the first time. There is evidence tending to prove that in some districts the cultivation of Bani is more paying than that of Varádi though the per acre yield of the latter is the greater. Supposing therefore that the cultivator (or a district) wishes to continue to cultivate Bani as a pure crop and supposing further for the sake of illustration that a plant of Varádi produces twice the number of seeds of a plant of Bani then through contamination of the seed at the gin if we have one plant of Varádi as a weed in a field of Bani and this is not removed the resulting seed when sown will give two plants of the Varádi to the acre of Bani and the following season four plants and so on. The percentage of impurity would thus if unchecked increase from year to year in geometrical progression up to the point of complete substitution of the weed for the original crop. A cultivator may thus unconsciously allow Varádi to displace Bani in his fields even though he knows that the latter would pay him better. If the cultivator had the knowledge and initiative required for the separation of the two varieties—not to the uninitiated very different from one another—there would of course be no possibility of his unconsciously decreasing his income in this way. Cultivators however as a rule know much less of the varieties of cotton than of such crops as Jowári, wheat, &c., the excellency or otherwise of the produce of which is more or less brought home to them very practically in their daily bread.

On the above supposition as to the relative number of seeds produced by single plants of the two varieties it is easy to show that it would take but 16 years to convert fields of Bani containing one Jari plant per acre into fields containing nothing but Jari.

The supposition however assumes a greater disproportion between the yields of Jari and Bani than is ordinarily found. The following is a closer approximation to actual facts. Taking the rates (80 lbs.) of seed-cotton to be Rs. 7 and Rs. $8\frac{1}{2}$ for Jari and Bani respectively we see that the two varieties are equally paying to the cultivator if when Bani yields 120 lbs. of seed-cotton per acre Jari yields 150 lbs. Of the 120 lbs. of Bani 75 per cent. *i. e.*, 90 lbs. is seed and of the Jari 68 per cent. *i. e.*, 102 lbs. That is the ratio of the number of seeds produced by a single plant of Bani and Jari would seem therefore be as 9 is to 10 and not as 1 to 2. The problem is however complicated by the fact that though single seeds are of equal weight in Bani a greater number of seeds of Bani should probably be sown than of Jari to secure the best results. This is a point which has been experimented on.

47. From the above remarks it will be apparent that a further experiment is necessary before it can be stated that ?

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Jari is invariably more paying than of Bani under the same set of conditions *when the produce in each case fetches its intrinsic value.* Experiment along these lines has been initiated on the Government Farm at Dhulia.

48. Other experiments there being carried out with a view to the improvement of the three agricultural varieties of Varádi, Jari and Bani include attempts to increase the per acre yield and the ginning outturn of Bani by hybridization and selection and to improve the staple of Varádi by the same means.

49. The cotton of this tract is sown in June and matures in November-December. The rotation is a 2-year one, Bájri on light soils or Jowári on heavier ones, alternating with cotton.

E.—The Sind Tract.

50. The 5th cotton growing tract of the Presidency remains to be dealt with very briefly. It is not here possible to go thoroughly into the possibilities of this tract as they are dominated by the question of irrigation. Briefly the canals of Sind may be divided into two classes, *viz.*, inundation and perennial; of the latter there is properly speaking only one, the Jamrao, which commands an area of $7\frac{1}{2}$ lákhs of acres, of which one lákhs is annually placed under cotton. On canals of this kind providing water all the year round it has been proved that Egyptian cotton of a quality only slightly inferior to that of Egypt itself can be grown and will yield as much seed-cotton as the local variety and is worth twice as much. It must be sown in March or April so as to mature before frost occurs in January.

51. On the inundation canals on the other hand water is available only during the period of inundation of the Indus. This is about $3\frac{1}{2}$ months (June to October) that is about the same as the period during which rain falls in the Presidency Proper. The local variety of cotton all over Sind, except in the Upper Sind Frontier, is identical with that described above under the name Varádi or Jari which here however under the influence of irrigation yields 5 to 10 times as much per acre. It might be argued that even under the inundation canals since the quantity of water available is at least equal to that falling as rain in the Surtee-Broach tract, the superior cotton of the latter tract might be grown in place of the inferior Varádi. Here, however, the question of temperature comes in and where the cotton cannot be sown before June it is necessary to grow an early ripening variety because frost generally occurs in January; Jari ripens in 5 months and Broach in 8, and it is therefore uncertain whether Broach would mature on inundation canals in Sind. The per acre yield is high averaging about 600 lbs. of seed cotton and even reaching 1,600 lbs.

52. What is required therefore for a radical improvement of the cotton in Sind is an improvement in the irrigation, and this is now

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under consideration by the Irrigation Department in the form of a large perennial canal taking off at Rohri and running as far as Hyderabad.

Summary.

53. The quality of cotton is in general directly proportional to the length of the period of growth of the plant producing it. Thus Egyptian matures in 9 months, American in 8, Broach in 8, Jari in 5½. The length of this growing period depends on

- (1) The amount of annual rainfall;
- (2) The distribution of annual rainfall;
- (3) The retentivity of the soil.

Excepting the Karnátak tract the rainfall in this Presidency all falls between the middle of June and the end of September, a period of 3½ months. If the soil is deep retentive black cotton soil the growing period of the plant extends for as much as 5 months after rain has ceased (Surtee-Broach tract); if less retentive (Deccan tract) for only three months. The Deccan tract therefore cannot in general produce as long a staple as the Surtee-Broach tract even if the rainfall were equal in both.

The five cotton growing tracts of this Presidency are:—

A. The Surtee-Broach Tract—With a deep black retentive soil, which, under a rainfall of 34 to 45 inches, falling in 3½ months, can support our best indigenous cotton, though this requires 8 months for maturation.

B. The Karnátak Tract—Also with a black retentive soil, which, under a smaller rainfall of 23 to 34 inches, distributed over 5 months, can support an indigenous cotton almost if not quite equal in quality to Broach and which at the expense of its ginning outturn takes a month less to mature; on the lighter soils American cotton also grows well under the better distributed rainfall.

C. The Ahmedabad-Kaira Tract—With a light soil and a rainfall of 28 to 37 inches falling in three and a half months; owing to a given quantity of rain being less effective on light than on heavy soil unless well distributed throughout the growing period, this tract cannot produce an annual cotton equal in quality to the two former tracts.

D. The Deccan Tract—With soil varying from light to a thin black clay which, under a rainfall of 20 to 30 inches all falling within 3½ months, can produce either a coarse cotton (Jari) or a fine one (Bani); here again a finer variety matures in the same time as a coarser one (or at most a fortnight later) but only at the expense of the ginning outturn.

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E. The Sind Tract.—This tract is dependent on irrigation, and where this is of a good type, that is, perennial, and it is possible to sow early, can grow Egyptian cotton after Sea Island (only grown over a small area in America) the finest cotton known to commerce. Where however irrigation is only possible during the period in which the Indus is in flood (June to October), the quality of cotton that can be grown will probably, even when improved to the utmost, not be superior to that of the Surtee-Broach tract and is actually now equal only to that of the Deccan tract.

III.—IMPROVEMENT OF COTTON.

54. A review of what has been and is now being done in this respect in this Presidency is given below. The possible methods by which the cotton of any tract may be improved are:—

- (a) Hybridization between two varieties and subsequent selection.
- (b) Selection (plant to plant) of the local growth.
- (c) Exchange of the variety in one tract for that grown in another.
- (d) Introduction of varieties foreign to India.
- (e) Improvement in the methods of cultivation.

Hybridization.

55. Hybridization is often referred to in the public press as if when this is once done, the whole question of improvement of cotton is at an end. That this is not the case will be obvious when it is stated that of the progeny of a cross between any two varieties of cotton, some may be better, some equal to and some worse than either or both the parents. Hybridization not followed by extremely careful selection will lead to nothing, while selection alone without hybridization can often bring about a considerable improvement as will be shown later.

In 1901 Mr. Mollison caused crosses to be made at Poona, between large number of the Indian varieties of cotton. These were carefully examined by me in 1903, and transported as far as farms were available to the districts to which they appeared severally to be most suited. It need hardly be said that it is impossible to rear at Poona a variety of cotton intended as an improvement on that of the Surtee-Broach variety or at Surat on that of the Khándesh variety; for when transferred to their final home all kinds of changes may occur. It is necessary therefore to experiment in the tract in which the cotton is intended to be grown. Corresponding to the 5 tracts into which the cotton-growing area of the Presidency is divided above, we have now experimental farms at Surat, Dhárwár, Nadiád, Dhulia and Mirpurkhás situated respectively in tracts *A*, *B*, *C*, *D* and *E*. These farms were established in the following years respectively, *viz*:—1897, 1904, 1903, 1905, 1904. It will be apparent therefore that the Surat Farm alone has been established long enough to allow of even approximately definite results being arrived at, and on that farm unfortunately the

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past two seasons have enjoyed less than half the average annual rainfall. The hybrids have therefore been growing under unfavourable climatic conditions and it is further impossible to see how they will behave under a normal monsoon. As however the ordinary growths with which they have been compared in value have grown under the same unfavourable conditions, it is thought that indications of the real relative values of the hybrids and the local growths have been obtained.

56. Further it is to be noted that it takes about 5 seasons before a hybrid will come "true to seed" that is a hybrid seed produced in 1901 and sown in 1902 will not until 1906 produce plants, the seed of which will all give rise to plants similar to one another. We are therefore not yet in possession of such hybrids but those produced in 1901 will give rise this season (1906-1907) to a new variety.

57. Moreover hybrids grown on the Surat Farm which for 3 seasons have given promise of giving rise to improved varieties have deteriorated considerably during the past season, and of the many that have been bred and carefully selected only one (No. 1027 A) is now promising. Whether this deterioration is permanent or due merely to being grown for two seasons under less than half the normal rainfall, further experience alone can prove.

58. It would serve no useful purpose to give a history of all the crosses produced, many of which have already been abandoned. This history of three is however given as showing the method adopted and the uncertainty of results:—

TABLE XI.

No. of hybrid.	Name of parents.		Year.	Percentage of fibre in seed-cotton.	Approximate percentage value above fine Broach.	Remarks.		
	Female	Male						
1016	Broach ...	Kampta...	1901	...	...	Cross made at Poona. Grown at Poona.
			1902	...	...	
			1903	27.77	-1.8	Do. and selected. Grown at Surat and divided up into 3 sub-divisions according to quality of fibre, &c. and habit of growth. Grown at Surat.		
			1904	33.3	21.9			
			1905	28.7	-9.4			
						33.2	?	All these divisions show marked deterioration.
						32.1	-11.3	

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TABLE XI—continued.

No of hybrid.	Name of parents.		Year.	Percentage of fibre in seed-cotton	Approximate percentage value above fine Broach.	Remarks.	
	Female.	Male.					
1027	Ghogári ...	Kumpta ...	1901	...	...	Cross made at Poona. Sown at Poona.
			1902	...	...
			1903	36.9	...	Sown near Ahmedabad.	
			1904	39.2	7.3	Sown at Surat and sub-divided into 4 classes.	
			1905	37.3 37.2 35.6 38.8	-11.3 p p -15.1	Grown at Surat. All four classes have deteriorated.	
1027 A	Do. ...	Do. ...	1904	35.5	14.6		A single plant of the hybrid, 1027 was selected in 1903-1904 as giving a superior fibre.
			1905	34.0	18.9		The seed of this was sown separately in 1904 under the No. 1027A and again in 1905.

It will be seen then that extremely careful selection is the only means of obtaining any results at all. Had the hybrid (1027) not been very carefully examined, the hybrid (1027 A), which has been valued at a rate as high as 20 per cent. above fine Broach, would not have been obtained. It should be added that another valuation denotes only 8 per cent. improvement; owing to the small amount of cotton so far produced, a true and reliable valuation is impossible until next year. With regard to this hybrid 1027A it can only be said that if it does not deteriorate it will be worth many times more than the whole expenditure on the Surat Farm since its establishment. It is however hoped that so far from deterioration occurring a further improvement will be obtained by continued careful treatment.

59. Since hybrids on other farms, *viz*:—Dhárwár, Nadiád, Dhulia and Mirpurkhás have not been in existence long enough to become fixed in type, it is unnecessary to give details of them here. It can however be stated that there is no reason why an improvement should not be obtained at least equal to that obtained at Surat.

Selection.

60. The selection of particular plants among the local growth has not in India received the attention it deserves. As stated previously

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the cultivator has not the knowledge necessary to enable him to differentiate between two cotton plants when the difference between them is only that one is slightly more prolific or produces a slightly better fibre than the other, this difference not being patent as it is in the case of Jowár, Bájri, wheat, &c. That however much can be done in this way will be obvious from a reference to Table X which shows that a crop of Jari consists of a mixture of varieties and that the produce depends on the proportion in which these varieties occur in the mixture.

The method can however be utilized in the cases of pure crops such as Broach. As an instance of this it may be mentioned that while showing a casual visitor round the Surat Farm and wishing to illustrate the difference in staple between Broach and another variety of cotton, I picked a sample of Broach haphazard from the nearest plant in the field and was surprised to find that it would not serve the purpose intended as it was much better than the average of the crop. The seed from the tree thus accidentally discovered was picked and sown separately with the result that it produced in the season just past a fibre valued at 5 per cent. above cotton of the same variety grown on the same ground from ordinary seed.

This process of selection is now being carried out on all the farms of this Presidency, and especially at Dhárwár seems likely to lead to permanent results with the acclimatized American variety since in this variety there is much variation from plant to plant. Owing however to the total failure of the monsoon in the tract during the last year no definite results have been obtained in the short period (two seasons) during which the farm has been working.

Exchange of varieties.

61. The limits are narrow within which an exchange of variety from one cotton growing tract to another can take place. The growing of the Surtee-Broach variety in the Karnátak tract appears however likely to lead to good results but further experiment is needed. During the last two seasons it has been grown on the Dhárwár Farm side by side with the local indigenous variety Kumpta with the following results :—

TABLE XII.

Variety.	Yield in seed-cotton per acre.		Percentage of fibre.		Rainfall in inches.	
	1904-05.	1905-06.	1904-05.	1905-06.	1904-05.	1905-06.
Kumpta ...	690	356	26	25	} 26-93	12-57
Broach ...	1,066	346	32	30		

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It will be apparent that even if the Broach variety does not give a larger yield of seed-cotton per acre than Kump'a yet owing to the higher ginning outturn of the former its per acre value is at least 20 per cent. greater.

It is interesting to note that the percentage of fibre in the seed-cotton of both varieties is lower in the year of less rainfall, and that Broach variety when grown in Dhárwár has a less outturn than when grown in its own tract where it is ordinarily about 33. Further details will be given later as to the effect of moisture on the ginning outturn. It is immaterial whether the Broach variety deteriorates or not by continuous growth in the Karnátak so long as it gives a larger yield; since it would be no difficult matter to organize a biennial or triennial distribution of seed brought from Surat in country boats to Marmagoa.

62. Another instance of an exchange that is being tried is that of Bani which at Dhulia is being grown side by side with the local variety of Jari. These are however varieties from different parts of the same tract. As the faru has been worked for only one season, and that a poor one, nothing definite can be said as to whether this is likely to succeed or not. The result in the past season was that Bani yielded 670 lbs. of seed-cotton per acre while Jari gave 698 lbs.

Introduction of foreign varieties.

63. The foreign varieties that have been introduced with some success in the past may be divided into two classes, *viz.*:—perennial (or tree cotton) and annual.

Taking *the annual varieties* first we find that in 1830 American Upland seed was introduced and sown in large quantities in the Dhárwár district and it survives to-day in that district but in a greatly degenerated form. It has also been tried in the Surtee-Broach and Deccan tracts, but it is only in the Karnátak tract that it remains as a field crop among cultivators. The cause of this was given above when treating of that tract. Nothing further need here be said except that it is thought that if new seed be now introduced and *carefully selected* plant by plant, acclimatization may be accomplished at a smaller cost in deterioration of the staple. This process is now being carried out on the Dhárwár Farm.

64. Recently in the year 1904 I grew Egyptian cotton at Dhoro-náro in Sind with the following results:—

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Table XIII.

Variety.	Time of sowing.	Interval between waterings in days.	Yield in lbs. per acre of seed-cotton.
Yannovitch	April	20	872
	Do.	15	1,174
	May	30	805
	Do.	30	1,046
	June	20	704
	Do.	30	684
Abassi	April	15	1,018
	Do.	20	907
	June	15	940
	Do.	20	519
Mitaffifi	April	15	1,483
	Do.	20	1,257
	June	15	1,126
	Do.	20	744
	Do.	15	815
	Do.	15	364
Ashmoni	April	15	1,227
	Do.	20	972
	June	15	899
	Do.	15	900

The produce was valued in Liverpool at a little less than Egyptian grown cotton of the same varieties. In the year just past about 1,500 acres were sown partly with the Mitaffifi and partly with the Abassi varieties. The yield over large areas on good soil free from alkali was about 1,000 lbs. of seed per acre and would have been greater except that owing to being sown late, the crop was damaged by frost.

During the spring of the present year seed of the Abassi variety for about 6,000 acres was distributed to Zamindars, and there can be no doubt that it will pay the cultivator much better than the local Varādi variety when grown under the same conditions being valued at about twice the price of the latter, and the yield being rather more than less. The growth of Egyptian cotton or any other with a long period of growth is restricted to the parts of Sind where perennial irrigation is possible, since if it can only be sown when the river rises in June it cannot mature before the frost of December-January.

Many attempts have in the past been made to grow Egyptian cotton in Sind and elsewhere and it is probable that in Sind it was frost that caused uniform failure to result. This was certainly the case with a

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having been sown in July was totally ruined by frost in December and yielded no produce at all.

65. Further experiments in the coastal region of Sind where the air is always damp Sea Island cotton could be grown if perennial irrigation were available. An experiment on the Karáchi Sewage Farm kindly made at my suggestion by the Chairman of the Karáchi Gardens gave the following results:—

TABLE XIV.

Yield per acre in lbs.

			Cotton.
Abassi	...	...	377
Sea Island	...	...	427

The valuation of the produce has not yet been received, but the Sea Island cotton must be worth about 30 per cent. above even that of Abassi.

66. With regard to *tree cottons* little can as yet be said though experiments on two different species give promise of success. These species are in all probability *G. peruvianum* and *G. barbadense* (of some authors); the nomenclature however of the whole genus is complex. The former species yields the fibre known as "rough Peruvian", while the latter is apparently not cultivated as a field crop in any part of the world; it may be identical with the plant known as "Bourbon"; it yields a smooth cotton of long staple somewhat similar in style to Egyptian but not so long, while rough Peruvian is as its name indicates a rough cotton but is also very long. Exact valuation of large quantities of these two cottons have not been as yet obtained from England, but small samples have been valued at more than 20 per cent. above fine Broach.

It remains now to ascertain by experiment the yield per acre that these two varieties will give. This is now being done with the species *Barbadense* in the Ahmedabad-Kaira Tract and with the "rough Peruvian" in the Karnátak Tract, the varieties appearing from experiment to be suited to these tracts respectively. It is possible that the former variety may require irrigation in its first year, but with a normal monsoon it may be able afterwards to pass through the hot season without this. It appears to be extremely prolific as grown on the Nadiád farm and on a large private plantation started a year ago in the Pálanpur State. The area on the Nadiád Farm is not large enough to allow of the yield being calculated but is being increased during the present season; the first crop is now being picked in the case of the other experiment with this species.

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With regard to rough Peruvian which seems especially suited to the Karnatak Tract experiments are now being conducted on the Dhárwár Farm. It appears to thrive well on poor stony land which cannot be put under ordinary crops, and even under the deficient monsoon of the past season (12½ inches instead of 34) has survived and produced a fair amount of an excellent quality of cotton. The area is being increased to a size that will allow of the per acre yield being calculated.

The best method of cultivating these tree cottons is also being investigated; probably a wide spacing—say 5 feet every way—will prove the best, the intermediate area being cultivated, at least while the plants are small, with low growing crops, such as some of the pulses. Further there are indications that these tree cottons will respond to certain manures more readily than the annual varieties and experiments on this point will be commenced as soon as the plantations are well established.

Improvement in method of cultivation.

67. It is often stated that the poor quality of Indian cotton is due in part at least to the primitive method of cultivation employed. While this may be true to a certain extent in the case of districts that are backward agriculturally, it has been shown above that this inferiority is due on the whole to first, the character and amount of the rainfall and secondly to the fact that plant to plant selection has never been known.

Further it is often assured that the liberal application of manure will improve the quality. That this is far from true the figures below will show. In the past season (1905-06) cotton was grown on the Surat Farm on plots which two seasons before had received a liberal dressing of manure. It will be noticed that not only the quality but also the quantity from the manured plots is much lower than from the unmanured.

TABLE XV.

Variety of Cotton.	Yield in lbs. per acre of seed-cotton.			Valuation of Cotton in rupees per candy (784 lbs.)		
	Manured heavily.	Manured less heavily.	Un-manured.	Manured heavily.	Manured less heavily.	Un-manured.
Ghogári ...	68	38	149	185	210	215
Broach ...	83	28	162	215	260	265

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Manure applied two years previously is somewhat deficient when the short rainfall (20 inches instead of 42) is taken into account.

After it has been applied to the soil really forms part of the soil and it was stated above that soil and rainfall are in a great part complementary. Had the monsoon not failed it is probable that the above results would at least not have been so marked and possible that they might have been reversed.

68. The effect of water on the soil is the exact opposite of that above given for manure; here again however the abnormal season has exaggerated the effect. The results were obtained in the past season on the black cotton soil of Surat Farm on adjacent plots, one of which received two waterings after the monsoon, while the other received none. The quality and yield are indicated in the table following:—

TABLE XVI.

Variety of cotton.	Yield per acre in lbs. of seed cotton.		Valuation of Cotton in rupees per candy of (784 lbs)	
	Irrigated.	Unirrigated.	Irrigated.	Unirrigated.
Broach	420	123	258	230

The effect of watering on the percentage of cotton in seed-cotton is indicated by the following results obtained on the light soil of the Ahmedabad District:—

TABLE XVII.

Variety of cotton.	Percentage of Cotton in Seed cotton.	
	Irrigated.	Unirrigated.
Wágad	35	32
Lália	40	35

69. The conclusion to be drawn from these data is that the quantity of manure applied must be regulated by the quantity of water

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that the crop receives in the form of rainfall or irrigation combined. It may further be stated that of the two—water and the one of which the want is by far the greater in most parts is water. Were water available in the hot weather it would be possible by the growth of leguminous crops to make up for the general loss of manure by burning.

The water that falls as rain on the soil in the cotton-growing tracts of this Presidency, the cultivator husbands to the greatest possible extent by frequently stirring the surface soil between the growing plants.

Experiments have not yet been conducted to see whether the common practice of applying to black soil about 10 tons of farm yard manure per acre every 5 or 7 years can be improved on or whether this quantity of manure is indeed the correct amount and that corresponding to the rainfall received. A series of plots has now initiated on the Surat and Dhárwár Farms that will determine this point.

70. Artificial manures have not hitherto received a thorough trial, though experiments with them commenced two years ago on the farms of this Presidency. So far there is little indication that they can be advantageously applied to cotton or any of the common field crops but here again the shortage of rain may have produced an effect exactly opposite to what would result in a season of normal rainfall. Experiments in the effect of deeper tillage have also just been started, but it is as yet too early to make any statement as to results except that it seems possible that some improvement may be brought about by this means.

71. With regard then to improvement in the method of cultivation it can be said with certainty that in the best cotton growing areas of the several tracts, it is only exceptionally that such is possible and that the methods in use *are as far as we yet know*, those that under the rainfall received give the best results. One other item in the method of cultivation besides manure and irrigation is receiving special attention, and that is the time of sowing. This is fixed in all tracts except the Karnátak by the first fall of rain. In the Karnátak however though the monsoon commences in May sowing of cotton does not generally take place until August-September, and on the Dhárwár Farm experiments are being conducted in which sowing takes place in June-July. In the year 1904-1905, when the monsoon was normal except that the late rains were scanty, the early-sown crop of both Kumpta and American gave not only an increased yield but also a better quality of fibre. The results are given below:—

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TABLE XIX.

Time of sowing.	Variety.	Yield in lbs. per acre.		Valuation of Cotton (Rs. per candy of 784 lbs.).
		Seed-cotton.	Cotton.	
June-July	American	969	310	205
	Kumpta	690	179	210
August-September	American	371	118	*190
	Kumpta	551	143	203

* On the black soil of the farm the quality of American is Rs. 5 or 6 less than on light soil.

It will thus be seen that early sowing resulted in an increase of Rs. 11 and Rs. 53 of the per acre value of the Kumpta and American varieties respectively.

Summary.

72. From the statements above made it will be seen that progress has been made in the introduction of the foreign varieties especially of Egyptian cotton into Sind, while in the case of indigenous varieties at least one extremely promising hybrid has been reared on the Surat Farm and will be distributed so soon as sufficient seed has been grown. With regard to this improvement of indigenous varieties it must not be expected that progress will be made *per saltus* either in selection or in this process aided and accelerated by cross fertilization. Under the best circumstances and with an unlimited amount of the most highly trained assistance, it is impossible to obtain a fixed type from a cross within 4 seasons of the date of the creation of the cross and in field experiments on a large scale and with a very limited amount of assistance it takes at least 5 seasons. This period must therefore elapse before the value of a hybrid can in many cases be accurately judged.

The great desideratum in carrying out the work of selection is a sufficiency of trained men. An attempt is being made to train men who shall become capable by accumulated individual experience of performing the routine work of selection of hybridization in a reliable manner. Knowledge in all agricultural matters is so largely a matter of individual experience that the special work of any one man cannot be taken up by another who, while possibly more highly trained generally, must accumulate his special experience before he can be of any value. It is only by a division of labour and specialisation of this kind that any efficiency can be attained. An ounce of practice in culture is worth several pounds of theory, and the value of experience, which is here synonymous with practice, cannot be transferred on paper though results actually obtained by means of it may.

Cotton.

The above facts will indicate that it is yet early to look for results from hybridization on such newly established farms as those at Dhárwár, Dhulia and Mirpurkhás.

In the matter of methods of cultivation and transfer of seed from one locality to another much light has been thrown by the survey of the conditions obtaining in the different cotton-growing tracts and by experiments especially on the Surat and Dhárwár Farms.

73. Taken as a whole the work of the Department with regard to cotton during the past three seasons must be looked up as merely preliminary, but it is thought that the chief lines along which work is to be done in the various cotton-growing tracts have been discovered and these have been briefly sketched above for each tract.
