BELGAUM.

CHAPTER I.

DESCRIPTION.

Belgaum, lying between 15° 23′ and 16° 58′ north latitude and 74° 5′ and 75° 28′ east longitude, has an area of about 4600 square miles, a population of about 864,000 or 185·57 to the square mile, and a realizable revenue of £124,100 (Rs. 12,41,000).[1]

Boundaries.

The district is separated from the west coast by a belt of land twenty-five to seventy-five miles broad. It is bounded on the north by the Miraj and Jath states; on the north-east by Bijápur; on the east by the states of Jamkhandi and Mudhol; on the south-east by the state of Rámdurg and the Navalgund sub-division of Dhárwár; on the south by the Dhárwár sub-division of Dhárwár and the Supa sub-division of North Kánara; on the south-west by Goa; on the west by Sávantvádi and Kolhápur; and on the north-west by Kolhápur and Miraj. The lands of the district are greatly interlaced with those of the neighbouring native states. Within the limits of the district are large tracts of native territory, and many Belgaum villages are surrounded by native states. Of the tracts of native territory that lie within the limits of the district the chief are, in the north of Athni, two patches of Jath and Jamkhandi containing five villages; between Chikodi and Athni, Ráybág, a Kolhápur sub-division with thirty-seven villages; in the west of Chikodi, Lát, a portion of Kolhápur with eleven villages; and in the Belgaum sub-division two tracts of Sángli and Kurundvád. Of the Belgaum villages which are surrounded by the lands of native states, there are some patches in Ráybág, within the limit of the district, and others in Jamkhandi, Miraj, and Kolhápur outside of the district.

Sub-Divisions.

For administrative purposes the area included in Belgaum is distributed over seven sub-divisions Athni in the north, Gokák in the east and centre, Parasgad Sampgaon and Khanápur in the south, and Belgaum and Chikodi in the west. These sub-divisions have on an average an area of 665 square miles, 162 villages, and about 123,400 people:

[1] The population and revenue details are for 1881-82.

[2] As these native states are unsurveyed no area details are available. The number of villages has been roughly calculated from the district maps.

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Sub-Divisions.

Belgaum Administrative Details, 1882.

Sub-Division.	Area.	Villages. Government. Villages. Inhabited.	Villages. Government. Villages. Uninhabited.	Villages. Government. Hamlets. Inhabited.	Villages. Government. Hamlets. Uninhabited.	Villages. Alienated. Villages. Inhabited.	Villages. Alienated. Villages. Uninhabited.	Villages. Alienated. Hamlets. Inhabited.	Villages. Total. Government.	Villages. Total. Alienated.	Villages. Total. Total.	Population, 1881.	To the square mile.	Land Revenue, 1881-82.
														£
Athni ...	786	64	1	16	4	17	...	11	65	17	82	105,961	134	15,862
Chikodi ...	840	157	1	50	40	56	1	16	158	57	215	245,614	292	26,144
Gokák ...	670	80	5	33	11	34	1	8	85	35	120	93,029	138	13,144
Parasgad ...	640	103	7	16	12	23	...	1	110	23	133	91,826	143	18,744
Sampgaon...	424	120	19	10	6	1	...	4	139	1	140	119,843	282	23,913
Belgaum ...	663	120	2	55	28	80	1	53	122	81	203	128,477	193	15,041
Khánápur ...	633	190	25	83	5	24	1	15	215	25	240	79,264	125	11,308
Total ...	4656	834	60	263	106	235	4	108	894	239	1133	864,014	185	124,156

Aspect.

Belgaum,[1] running parallel to the Sahyádri hills, with a very irregular outline, measures about a hundred miles from north to south and fifty to eighty miles from east to west. Kolhápur on the north-west and North Kánara on the south-west separate it in a great degree from the Sahyádri hills. But between these two districts a strip about twenty miles broad passes west to the crest of the Sahyádris. This western tract, and in a less degree the rest of the western fringe of the district, are rugged with forest or bush covered hills, and have a comparatively damp and cool climate. A line drawn through Nipáni, Sankeshvar, Páchápur, Ankalgi, Marihalli and Yellurgad includes the fringe of the district which in character and climate belongs to the hill rather than to the plain country. Within these limits the rainfall is heavierand the vegetation more abundant, and the houses have pent roofs and wide eaves to carry the water clear of the mud walls. The rest of the district, sloping gently to the east, is broken by many ranges of low rolling hills, and by bold single peaks and granite rocks. It is divided from west to east into three belts of varied plain and upland by the courses of three rivers, the Krishna in the north, the Ghatprabha in the centre, and the Malprabha in the south. Most of the plain is of rich black soil, but towards the east it is stony and red and in the north there are in places long stretches of bare rock. In the north-east and centre the country is monotonous and uninteresting, low rolling downs and shallow valleys. In the richer parts are large stretches of black soil, and the higher grounds are almost bare of trees. In spite of numerous well grown trees in the valleys the country is deplorably bare. In the centre where later flows of trap form low flat-headed hills that crown the water-sheds of the larger streams, the country grows less monotonous, and little further west are high bold hills, the remains of still later flows of trap. The west and south are fairly wooded, the plains with mangoes, tamarinds, and jacks; the hills with brushwood, scrub timber, and prickly-pear. The west is watered by the south-west monsoon. Further inland

[1] Chiefly from materials supplied by Messrs. G. McCorkell, C.S., W. H. Horsley, C.S., and J. L. Laird, District Forest Officer.

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the south-west rains are light and uncertain. In the north and east want of rain often causes serious loss, and the east and south depend for their supply chiefly on the north-east monsoon.

For descriptive purposes the district may be divided into four parts: the western fringe and the tract of land that runs west to the Sahyádris, and the three belts of the eastern plain that, running east and west, are drained by the Malprabha in the south, by the Ghatprabha in the centre, and by the Krishna in the north. Of the tract that stretches west to the crest of the Sahyádris, the extreme west is a succession of valleys running between spurs that stretch east at right angles to the main range of the Sahyádris. In the hilly west and in other parts of the western fringe the rugged hills, the running streams, and the abundance of trees and brushwood make the country interesting and beautiful. The upper slopes and scarps which are of trap are much like the slopes and scarps near the Bor and Tal passes in Thána. But the scenery changes in the lower slopes where the older quartzites of the Kaládgi series are reached.[1] The tops and upper slopes of the hills are almost bare; the lower slopes and valleys are fairly wooded. The villages are far apart and small with five to fifty huts and a dozen to 200 people chiefly Maráthás, with some Telves and a sprinkling of Lingáyats. Besides the villages there are some Dhangar hamlets of grass-thatched huts, the floors slightly raised and cowdunged, the walls two or three feet high of wattled *kárvi* or Strobilanthus sticks, coated with a wash of mud and cowdung. On the higher ground *rági* Eleusine corocana and *sáva* Panicum miliare are grown sometimes by ploughing and sometimes by coppice-burning. Every village has a little watered rice land on which every year two crops of red rice are grown. Of garden produce there are only plantains and limes. In the hot weather there is no water except low down in the valleys of the chief streamlets. In February when the trees are bare and the grass is bleached or burnt, a few *ráis* or sacred groves alone relieve the general bleakness and barrenness. The fresh leaves of May brighten the hills, but the blackened ground is not hidden till at the beginning of June the rains cover it with grass. Further east the valleys are flatter, broader, and more suited for tillage. Large swelling hills rise on all sides, but they are neither so high nor so steep as in the extreme west. Near Belgaum the smaller hills are rounded, and the larger more distant masses, which are capped by iron-clay, have true table-tops. The land is well watered by deep cut streamlets, which draining into larger streams find their way north to the Ghatprabha. There is a plentiful rainfall from the south-west monsoon, and from the abundance of its evergreen brushwood the country at all times looks fresh and cool. The general features of the western fringe of the rest of the district resemble this tract rather than the open plain to the centre and east. The people grow rice instead of millet, wear coarse woollens instead of cotton, and, instead of in walled flat-roofed villages, live in villages of tiled houses surrounded by deep prickly-pear and *bábhul* fences.

[1] Memoir Geological Survey of India, XII. Part I. 172.

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Southern Belt.

Of the three belts into which the Malprabha in the south, the Ghatprabha in the centre, and the Krishna in the north divide the centre and east of the district, the valley of the Malprabha in the west is covered with hills and forests, some of the hills, especially to the north of Khánápur, being high, rugged, and of striking outline. On either side, as it draws near the Malprabha, the land is more open, and there is much level and arable ground, broken by gentle downs, and sometimes by sudden masses of granite. The banks of the river are fringed with trees and bushes, the south-west rainfall is abundant, and the chief crops are early rice, Indian millet, and sugarcane. There is not much garden tillage. There are many rich well-peopled villages of tiled houses surrounded by huge prickly-pear and *bábhul* tree hedges. Further east, in the extreme south the country is broken by ranges of low hills that run north and south and towards the east become gradually lower and less wooded. Here the early crops yield in importance to the cold weather crops and the north-east monsoon is perhaps the more important. Close to the Malprabha the country along both banks merges into a black or cotton soil plain with few trees, and, except during the south-west rains, with little vegetation or beauty, the barren sandy soil of the quartzites bearing but a scanty growth of forest trees. Only here and there the dullness of the view is broken by ridges of sandstone with sharp broken outlines. The prettiest spots in the country are where the rivers cut through the low ranges of hills. On the Malprabha Rámdurg, Torgal, Basargi, and a few miles to the south the bold rock of Parasgad repay a visit. The deep gorge known as Navil Tirth or the Peacock's Pool has much beauty; the bold wall-like quartz cliffs of Sogal, about ten miles west of Manoli, are adorned with lovely waterfalls and well-grown trees, and, if clothed with timber, the curious Kathárigad valley, about six miles north-west of Sogal, would be higly picturesque. In this part of the country the early and late crops are of about equal importance, but rice is not grown. The chief crops are Indian millet, cajan pea, wheat, gram, cotton, tobacco, and *kusumba* Carthamus tinctorius. There is not much garden land. The villages, which lie close together and at regular intervals, are generally walled and moderately large and rich with many *ráis* or groves of mango, jack, and tamarind.

Beyond the ridges which cross the black soil plain north-east and south-west, especially on the left bank of the Malprabha, is a low rolling plateau of sandstone hills very stony and barren. North of this, between Torgal and Karikol, is a rocky wilderness of poor sandy soil deep cut by streams and covered with scrubby brush-wood.

Central Belt.

To the north the drainage area of the Malprabha is separated from the Ghatprabha valley by the Belgaum hills on the west and farther east by a succession of low rather bare sandstone ranges. North of this the Ghatprabha valley, beginning in the west among rugged forest-clad hills, changes eastwards near Dadi and Páchápur into a waving plain, broken by lines of low hills whose sides have a scanty covering of stunted teak. Further east the river passes

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through a flat black-soil plain, which, towards the north, is suddenly broken by a tableland 300 to 400 feet above the neighbouring valley. Near Gokák, about the centre of the district, on both banks of the Ghatprabha, whose eastern course is tame and uninteresting, the plain is broken by ranges of low rather bare sandstone hills, through one of which the river forces its way in the famous Gokák falls. Close to the falls is the Márkándeya gorge also a spot of great beauty. East of Gokák on both sides of the river stretches a wide plain of rich black soil mixed in places with large patches of poor red. The rivers are fringed with *bábhul*, and along their banks are many garden plots and well-shaded villages. Away from the rivers the country except in the rains is bare and desolate.[1] The fields are treeless, the garden plots few, and the village sites miles apart and poorly shaded. Most of the villages are walled and fortified, and a few are fenced. The main harvest is early, chiefly early grown Indian millet; but especially in the east there is always a large area of late crop. The late crops are millet, Indian millet, cajan pea, gram, barley, and *kulthi*. A peculiarity of the Gokák trap hills, which are flat-topped and terraced, is that the sides are covered with trees and only the tops are tilled. Towards the west in Chikodi the soil is poor, but the south-west rain is more certain than in Gokák where much of the rain is from the north-east.

Northern Belt.

The water-parting between the Ghatprabha and the Krishna is marked in the west by some plateaus of poor soil 300 to 400 feet higher than the plain; further east it is marked by low rolling bare hills. For two or three miles on either side of the Krishna an open well-tilled black soil plain, dotted with many rich villages of flat-roofed houses and garden plots, stretches eastwards, gradually broadening as the western ranges break into single peaks. The banks of the Krishna are thickly clothed with *bábhul* trees. In this tract tillage is almost confined to the valleys of the different streams which run into the Krishna. There is little irrigation and in the west is an immense area of unarable stony ground. In the west the chief rain is from the south-west; further east the fall is less certain and depends more on the north-east monsoon.

North of the Krishna is a belt of deep rich soil with many small villages of thatched houses. Beyond this rich belt the country gradually rises in waving downs. The north-west is, except near villages, badly off for trees. The soil is poor and irrigation is confined to the valleys. In the west, where the soil is rich and the south-west rainfall fairly certain, there is much irrigation, and the barrenness of the plain is relieved by green patches of garden surrounding wells or fringing streams. The villages, which are fairly

[1] In 1791, when during the third Maisur war (1790-92), Captain Little's detachment passed through the district on its way to and from Scringapatam, between Páchápur about twelve miles south of Gokák and Nesargi about fifteen miles south-east of Páchápur, the country was covered by a thick forest called Manoli Bári, the road through which was rugged and stony. The forest lost itself in the south-west of Murgod. In some parts where the rivers took too great a sweep the forest was the boundary between the Marátha and Maisur territories. Moor's Narrative, 15.

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numerous, are fenced by hedges and are well shaded by trees. Further east a range of low flat-topped hills coming from the north-west disappears near the Krishna. East of these hills the country stretches flatter and poorer, a waving treeless flat, with long stretches of sheet rock. The upper valley of the Don is very fertile and grows unwatered wheat; in other places there is little tillage except in low-lying plots at the sides of brooks and in occasional patches of black soil. Here and there the dull bare plain is broken by steep solitary peaks and granite rocks. Every five or six miles, marked by a few *nim* and tamarind trees and brightened by garden patches, are the sites of villages of flat mud-roofed houses surrounded by more or less ruinous walls. The south-west rain is uncertain and scanty and the people trust mainly to the north-east supply. Most of the crops belong to the late harvest, white *jvári*, millet, cajan pea, linseed, and wheat.

Hills.

Except some parts of Athni in the north and of Sampgaon in the south, the district is thickly covered with ranges of hills, some of them topped with strongly built forts, some of them covered with wild brushwood and prickly-pear, and some with their sides carefully tilled almost to the tops.

North Ghatprabha Spur.

Two great spurs cross Belgaum from west to east, and form the water-partings that divide the drainage area of the Ghatprabha from that of the Krishna on the north and of the Malprabha on the south. The water-parting between the Ghatprabha and the Krishna, which may be called the North Ghatprabha Spur, rises in the Sávantvádi state close above the famous hill-fort of Manohargad about forty miles north-west of Belgaum. After running north-east for more than thirty miles it turns nearly east till it reaches Chikodi. Among the sandstone hills, which in this part of the district go to form the North Ghatprabha Spur, the chief are the table-topped and ironclay-capped hills of Vallabhagad or Hargápur (560 feet high) about fifteen miles south-west, and Hunur or Pavitra or Páijargudd (270) about seventeen miles south, of Chikodi; the flat-topped hills of Mallayan or Ádigudd (630) about twelve miles west, and of Julapengudd (730) and Nágarhál (850) about five miles north, of Chikodi; of Nágarpachmi (390), Jogigudd (875), and Nirvánepan (710) within a mile of Chikodi; and of Shendur or Rásubái (670) with a pointed top, about five miles west of Nipáni. Of these Pavitragudd is alone difficult to climb. All are covered during the rainy months with grass and have no other vegetation; all are infested with jackals and wolves. Except Nágarpachmi, Jogigudd, and Nirvánepan all have their tops or sides tilled with wheat, millet, and rice, by Maráthás, Lingáyats, Jains, Mhárs, and Musalmáns. From Chikodi the main spur passes east right across Belgaum and beyond the Belgaum boundary till it is cut by the valley of the Ghatprabha close to its meeting with the Krishna. It reappears in Kaládgi as a low ridge east of the Ghatprabha and continues eastward for about twelve miles along the southern bank of the Krishna.

North Malprabha Spur.

The second great spur may be called the North Malprabha Spur. Starting from the north side of the Tolkat pass, about twenty-four

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North Malprabha Spur.

miles west of Belgaum, it rises into the high ridge known as the Kásar Sudda. Of the hills which form the North Malprabha Spur the two most noticeable are Párgad about thirty-six miles, and Kálánandigad about twenty miles west of Belgaum. The peaked hill of Párgad is so steep that it has to be climbed by rock-cut steps. The sides are wooded except where patches have been cleared for wood-ash tillage. It has a ruined fort and several reservoirs. The highest point of the range is the perfectly table-topped hill-fort of Kálánandigad on the Rám pass road between 800 and 900 feet above the plain. Its base is more rugged and its upper slopes are steeper than those of the neighbouring hills. The ascent from the north side is by about one and a half miles of steep footpath. Unlike the neighbouring hills Párgad seems to consist throughout of a very heavy red clayey iron-stone and the capping is sharply scarped all round the edge. The other hills forming the spur are generally neither very high nor very steep. They yield little but grass and a scanty sprinkling of brushwood, and their slopes fall gently almost into the plain leaving near the base large spaces fit for tillage. Though towards the west of Chándgad about twenty-two miles north-west of Belgaum the timber-covered hills are high and abrupt, the main spur sinks to the north of Chándgad, but again rises in the high ridge of Gandharvagad two or three miles further. The Gandharvagad hill with a ruined fort has rather bare sides. The ascent is about a quarter of a mile, steep on one side and easy on the other. At Rájgoli, a little to the east of Gandharvagad, the main spur is crossed by the narrow valley of the Támraparni. In the next ten miles it is broken by the channels of the Islámpur, Márkándeya, Belgaum, Kelvi, Iranhatti, and Nandi, all flowing north-east to join the Ghatprabha. In this part of the district, especially to the north of Belgaum, are long sandstone ridges with grass and brushwood covered sides, and nearly level tops, none of them more than 300 feet high and none of them too steep to be used as grazing grounds. Beyond Nandi, for fifty miles in an unbroken line, the main spur continues to separate the Ghatprabha from the Malprabha. It ends in the Ámingad hills, about ten miles west of Hungund in Kaládgi and 130 miles east of the Sahyádris.

Minor Spurs.

Besides these main ranges three important but minor spurs, the Mahipálgad ridge about ten miles north-west of Belgaum, the Bailur ridge about fourteen miles south-west of Belgaum, and the Jámboti ridge about six miles south of Bailur, stretch east from the Sahyádris. The hills forming the Mahipálgad and Bailur ridges are lofty, their bases large, and their outlines bold and striking. The Mahipálgad hill-fort is perfectly table-topped and is capped with iron-clay. It is the highest point of the range and its sides fairly clothed with wood. The ascent is about 3000 feet long by an easy path. Bailur, which is a table-topped mass, is capped with iron-clay, the capping being sharply scarped all round the edge. It is one of the Trigonometrical Survey Stations, and is the highest point in the district, being 3491 feet above the sea level. After a length of about five miles, the Bailur ridge disappears in

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the valley of a streamlet which runs into the Malprabha. Beyond the valley it again rises in the high and very noticeable hill of Yellurgad. This, which has the ruins of a fine old fort, is one of the Trigonometrical Survey Stations, 3365 feet above the sea level and 797 above the sill of the chief gate of the Belgaum fort. Beyond Yellurgad, the ridge stretches fourteen miles north-east by east when it touches the southward extension of the great North Malprabha Spur. Here the most noticeable hill is the bold and high Kardigudi, a Trigonometrical Station about twelve miles east of Belgaum. After touching the North Malprabha Spur the ridge runs for three or four miles further and sinks into the somewhat raised plain which forms the water-shed between the Ghatprabha and the Malprabha. The Jámboti ridge which is about six miles south of the Bailur hills, has the special interest of being the most southerly mountain mass within the Deccan trap area. The hills which form this ridge are high, more or less wooded to their summits, and press closely on each other. The chief is Kirvalegudd or Goraknáth eight miles west of Khánápur. It is about 2100 feet high and is flat-topped. It has a sloping ascent and the sides are covered with brushwood giving shelter to tigers and spotted deer.

Detached Hills.

Among the isolated hills, unconnected with the Sahyádri spurs, some lie to the north of the Krishna, some to the north of the Ghatprabha, and some both north and south of the Malprabha. Of the hills to the north of the Krishna, the most noticeable are those round the town of Athni and those in the north-west of the Athni sub-division. The hills round Athni town are rolling flat-topped sandstone ranges, 200 to 300 feet above the plain, bare of vegetation except prickly-pear. Those on the north-west of the sub-division belong to a spur that runs south-east from Sátára. Within Athni limits the bare flat-topped hills rise from the plain in clear cut terraces, whose outlines, unbroken by trees or bushes, stand out with marked clearness when caught by the rays of the sun. Of this range the chief hill within Belgaum limits is Junápnála or Belvankigudd, a rugged fortified peak, about fifteen miles north-west of Athni. It rises about 1000 feet above the plain and is covered with short thorny scrub and grass. On its flat top Lingáyat and Marátha husbandmen raise crops of wheat and gram. Of the hills to the north of the Ghatprabha there are the sandstone ranges in Gokák, 200 to 300 feet high, which run north and south and are covered with prickly-pear. About two miles north of Gokák the bold rugged slopes and table-topped mass of Bágedgudd or Bastigudd reaches a height of 2667 feet, and stands 700 to 800 feet above the plain. It is a great mass of trap in which the lines of eight leading flows may be clearly traced. About seven miles east of Gokák is the Manikeri ridge of reddish drab quartzite beds capped with trap. Manikeri, the highest point, is a Trigonometrical Station about 2458 feet above the sea. The top commands a wide view in which the objects of most interest are the Gokák falls and the Gokák scarp. At Hulkund, four miles south-east of Manikeri, the ridge is crossed by a river bed, but it rises again to the east and forms two conspicuous rocky hills. Of the hills to the

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north of the Malprabha, the Kathárigad hill, about twelve miles north-west of Saundatti, is 2844 feet above the sea and about 1200 feet above the plain. It is covered with prickly-pear and brushwood sheltering wild hogs and panthers. It has a remarkable flat dome with steep deep-fissured sides. The hill is formed of granite gneiss capped by a mass of quartzite. To the geologist the view from the top is of great interest. South of the Malprabha river and four miles north of the Kel pass, in the extreme west, stands the flat-topped hill-fort of Bhimgad, rugged, steep, and surrounded by a double line of broken hills, rising 1800 feet from the plain. From the north side of the great Mahádáyi ravine looking over the scarp formed by the edge of the trap area, the fort, with the neighbouring limestone peak and several huge masses which have slipped into the valley, forms a view of rock and forest of rare wildness and beauty. The way up is by rock-cut steps, through bush-covered slopes which shelter bears, tigers, wolves, and bison. Neither the top nor the sides are tilled. At the foot of the hill is a village inhabited chiefly by Maráthás. About ten miles south-east of Bhimgad is the flat-topped hill of Dongargávgudd. It is about 2400 feet above the plain and is covered with scattered trees sheltering tigers, leopards, and wolves. There is no tillage and there are no hamlets. About twelve miles north-east of Dongargávgudd the flat-topped Samshergudd rises about 1800 feet from the plain. Its gentle slopes are covered with rocks and a few trees which shelter hyænas, wild dogs, and hares. About three miles south of Shamshergudd the flat-topped hill of Máchigad or Bijganigudd rises about 1500 feet above the plain. It is covered with trees and its top and sides are tilled. About eight miles south of Máchigad the flat-topped sloping hill of Kumbhárdegudd rises about 1800 feet from the plain. It is covered with trees which shelter tigers, leopards, and wolves. Sampgaon has three hills, Deshnur about ten miles north, Ganimardi about ten miles south, and Hitalmardi about eighteen miles south-west of Sampgaon. The flat-topped Deshnur hill, about 1320 feet above the plain, is covered with grass and brushwood. Bedars, Lingáyats, and Maráthás till its top with gram, millet, and *rági*. The other two hills, which are also flat-topped, have their sides covered with grass and brushwood. The top of Hitalmardi is tilled and millet and rice are grown on it. The Parasgad hills are flat-topped and are covered with brushwood and prickly-pear sheltering panthers and wild hog. Of these hills Yellamma about 425 feet above the plain is three miles, and Huli about 300 feet above the plain is six miles, north-east of Saundatti; Hirekummi, a Trigonometrical Survey Station, 2572 feet above the sea and 500 to 600 feet above the plain, is about eight miles south-east of Saundatti; Someshvargudd about 350 feet above the plain is about thirteen miles north-west of Saundatti; and the Parasgad hill is about a mile south of Saundatti. The Parasgad hill is about 600 feet above the plain and 2572 feet above the sea and has steep rocky sides difficult to climb.

Rivers.

The district drains eastward along the three lines of the Krishna in the north, the Ghatprabha in the centre, and the Malprabha in the south. None of these rivers is navigable, and between February

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and May the volume of the Krishna is much reduced, and the Ghatprabha and Malprabha shrink into small streams. All three have worn deep courses through the surface black soil and laterite, and most of their banks are covered with *bábhul* trees.

The Krishna.

The source of the KRISHNA is near the hill-station of Mahábaleshvar in Sátára, at a height of 4000 feet above the sea. After a south-easterly course of about 175 miles, through Sátára and parts of Sángli Miraj and Kolhápur, it enters Belgaum at the village of Ganeshpur about twenty miles north of Chikodi, and, after flowing about six miles to the south-west, receives from the west the waters of the Panchganga. Below this meeting the united streams turn nearly at right angles to the south-east, cross a narrow strip of Kolhápur, and enter Chikodi, forming for about five miles the boundary between Chikodi and Athni, until at the village of Sháhápur, the river turns nearly west for three miles when it again changes to the south-east. At this point it receives from the west the waters of the Dudhganga, which, with its tributary the Vedganga, drain the north and west of Chikodi. Below the meeting the river runs five miles to the south-east when it again turns north-east for about eight miles. Next it passes through Ráybág of Kolhápur, where, near Chinchi, it is joined by a streamlet called Halhaula in Kanarese, but by Musalmáns called Dudh Nalla or Milk-river from its white water.[1] After a few miles it suddenly turns north and enters Athni, where it winds to the south-east and then to the north-east, receiving the Agrani from the north about eight miles south-west of Athni. Beyond this it flows south-east, and forming the south boundary of Athni, turns north-east till it enters Kaládgi near a village called Janvád. Close to the Krishna are many plots of garden land and the banks are covered with trees. The river sides are steep and scarped from twenty to fifty feet high, generally of black soil or laterite. In the rocky bed are many *bábhul* shaded islands.[2] The monsoon freshes fill the river bed from bank to bank, and, as a rule, from June to December the volume of water is very large. During the dry months the stream greatly dwindles, and between March and June there is but a scanty flow.[3] There are eight ferries at Ainápur, Hálihál, Satti, Mahisvádgi, Savadi, Shirhati, Chikk Padsalgi, and Hire Padsalgi. The ferry boats are round wicker baskets covered with leather, twelve to fifteen feet in diameter, and able to carry thirty to forty passengers.

The Ghatprabha.

From its source in Sundargad to the north of the Rám pass till it joins the Krishna at Kudli-Sangam about thirty miles north-east of Kaládgi the GHATPRABHA has a total length of 100 miles.

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[1] Moor's Narrative, 268.

[2] On one of these islands about a mile east of Kudchi, Lieutenant Moor of Captain Little's detachment found (1791) a beautiful mango grove overshadowing two Musalman tombs. One was of a Musalman saint named Shaikh Muhammud Suraj-ul-Din and the other of a princess of Balkh. Both had travelled so far to make converts to the true faith. They settled on the island and remained for many years doing acts of charity and benevolence. Narrative, 269.

[3] In the middle of May 1791 Lieutenant Moor found the Krishna near Ainápur about 500 yards from bank to bank. There was much water, the deepest part on the north bank being five feet. Narrative, 269, 300.

After flowing about thirty miles north-east through Kolhápur the GHATPRABHA enters the district north of the village of Shedihál at the junction of the Belgaum and Chikodi sub-divisions. From Shedihál, near which it receives the Támraparni from the south, the Ghatprabha flows about twenty miles north-east across the Chikodi sub-division, where it is joined from the west by the Harankáshi. It then enters Gokák between the villages of Sultánpur on the west and Shivápur on the east. From this it takes a sharp turn to the north, running along the boundary of the sub-division. It again turns suddenly to the south-east and flows in an almost straight course to Gokák. Three miles to the west of Gokák rushing through a rugged and picturesque gorge between two ranges of sandstone hills and dashing over a cliff about 175 feet high, the river forms the falls of Gokák, whose thundering roar is heard for about five miles round. Except in the rains, little water is seen in the rocky bed of the river above the fall. It runs in narrow channels deep cut into the rock, till, as it reaches the brink of the cliff, it spreads across the bed of the river. For some distance above the fall the force of the current has worn many large holes which are a favourite bathing-place for Bráhmans and others who come to visit the local deity Mahálingeshvar. The grandeur of the falls varies greatly at different seasons, but from June to December they are almost always worth a visit. A little above the fall the river is about 250 yards across but narrows to eighty as it reaches the brink of the chasm. This narrowing greatly increases the depth and the speed of the mass of water, which, at the rate of ten feet a second, hurries ten feet deep down the shelving tables of rock. The denseness of the body of water, and its dull muddy colour make the fall seem slow and sullen.[1] But the feeling of massive weight is relieved by light and airy clouds of white and amber spray, which, rising from the depth of the gorge in curling wreaths, veil the foot of the fall, except when a fitful gust sweeping up the glen scatters the spray. Above the crest of the gorge the spray vanishes as it rises; but it again gathers, and at a little distance falls in gentle showers. Spray-bows, of varying brightness, clearness, and size, lend their tints to the ever rising vapour.[2]

About two miles below the falls, and half a mile above the town of Gokák, the Ghatprabha receives the Márkándeya, after a course of about forty miles from the hills to the west of Belgaum. From Gokák the Ghatprabha again runs north-east and passes out of Belgaum into the Mudhol state. Except among hills the banks are low and gently sloping, and, in places, owing to the hardness of the rock, the bed is very shallow. Like the Krishna it is unfit for navigation. In 1835 the water rose so high as to cover three of the flight of steps which leads to the largest of the temples on the right

[1] A tumbler of water deposited about one-fiftieth of a fine reddish clay. Captain Newbold in Geological Papers on Western India, 354.

[2] Spray-bows like rainbows are formed only on the surface of the cloud facing the sun. The brightness of their tints depends on the size and closeness of the particles of vapour. They are brightest where the particles are of middle size and closeness and grow dull as the particles are smaller and denser. The largest spray-bows are to be seen in the evening. They form an arch right across the river, and, as the sun sets, rise, withdraw, and vanish. Memoir Geological Survey, XII. Part I. 89.

Chapter I. Description. Rivers.

bank of the river at Gokák. The chief ferries are at Hádkal, Ghodgiri, Modga Dodali, Hansihal, Gokák, Tigdi, and Dhavleshvar. Like those on the Krishna the boats are round coracles, wicker-work covered with leather.

The Malprabha or Malapahári.

Unlike the Krishna and the Ghatprabha, which rise beyond the limit of the district, the MALPRABHA has its source among the eastern Sahyádri spurs about eight miles west of Jámboti in Khánápur.

Of the origin of the river this story is told: In the village of Kankumbi, on the eastern brow of the Sahyádris, lived a man who was happy in being the husband of a beautiful and virtuous woman. In spite of his wife's goodness jealousy seized his soul, and he gave his wife neither rest nor peace. At length, driven to despair, she sacrificed to the gods and putting up a prayer to Basava, the patron of Lingáyats, threw herself into a mountain tarn. No sooner did the pool receive this sacrifice than its waters began to rise, and, flowing over their banks, formed a river which was called Malprabha or Malapahári, the Cleanser from Sin.

From its source in Khánápur the Malprabha runs east for about thirteen miles, when it turns south-east for about eight miles, and then north-east past the towns of Khánápur and Lokodi. In this part of its course, though it is shallow in the fair season, it continues to flow throughout the year. Through Sampgaon, across which it next flows in an almost easterly direction, it is a sluggish stream, running in a deep bed between high steep banks.[1] Crossing Parasgad in a north-easterly direction it passes into the Torgal state near the village of Basargi. About four miles north of Saundatti the Malprabha rushes violently through a gorge in the Manoli hills. Before the river wore this gorge through the hills the plain to the west was probably an inland lake, whose surplus waters fell, as at Gokák, over the north face of the cliff. By degrees the fall wore the rock and gradually cut a passage backwards till the lake was reached and its waters drained. On either bank of the gorge is a rock naturally formed into a rough figure. These rocks are the subject of the following story: In former days the river, instead of passing through the hills, crept humbly and slowly round their base. One day a peacock, who sat flaunting his gorgeous tail on the top of the rocks, reproached the river for its humility in creeping round the base of the hill and keeping to the level ground. Enraged at the peacock's taunts the river suddenly changed its course and rushed to the spot on which the peacock was sunning himself. Before the bird had time to take to flight he was changed to stone, and the water bursting the barrier of rocks broke the image of the peacock one-half of it on either bank. From this, it is said, the place took the name of Navil Tirth or the Peacock's Pool.[2] The gorge which

[1] At Sangoli, about five miles south-east of Sampgaon, Lieutenant Moor, of Captain Little's detachment, found (May 1791-92) the Malprabha about two hundred yards across with two feet of water and a good bottom. Narrative, 45, 259.

[2] According to another legend, a peacock, hard pressed by its pursuers, was unable to fly over the chain of hills which rises to the north of the great black plain. In its terror it cried piteously and the deity of the Malprabha, taking pity on the bird, clove a passage through the rocks by which it escaped. Finding the new passage convenient, the goddess adopted it as a channel for her stream, and has

Rivers.

The Malprabha.

is about 300 feet deep includes an upper or south-western half not more than fifty yards wide, and a lower half which is broader and with lower banks. The upper or south-western half is so narrow that, even in moderate floods, not an inch of margin is left between the water and the vertical walls on either side. During great floods the water rises thirty to forty feet in the gorge, and rushes with mighty force, forming pot-holes of great size and depth, which at every new-moon in the fair season, when the water is low, are largely resorted to by Hindu devotees. In its lower or northern half, the gorge widens considerably, and the sides decrease in height, till the quartzite beds die out in a level flat which stretches for some distance to the north-east.

At every village along the bank of the river, right down in the bed of the stream, is a small square temple containing a *ling*, and in front of the small low door is almost always an image of Basav in the form of the sacred bull. The banks vary much in character; in some parts they rise sharply from the water's edge, in others they have a gentle slope, and in a few places the river runs almost on a level with the country round. Near Manoli the Malprabha receives from the left the Benákatti, a stream which rising in the trap hills near Sategiri, has a southerly course of about twenty miles. Besides the Benákatti, though both from the north and the south many small streams fall into the Malprabha, it has no important feeders. At Sogal, ten miles west of the Manoli gorge, a stream which after a southerly course of about five miles falls into the Malprabha near Kungari, runs southward through a depression in the quartzite boundary ridge, and forms a very picturesque waterfall in a semicircle cut into the hard quartzite conglomerate. The fall is over a sheer rock fifty to sixty feet high. Above the principal fall are two minor falls, which, with an old temple and a group of trees, form a very pretty scene. The chief ferries on the Malprabha are at Jámboti, Khánápur, Mugutkhán-Hubli, Turmuri, Sangoli, Virápur, Yakundi, and Manoli.

Besides these three main rivers, where, in the south-west, the district stretches to the crest of the Sahyádris, the Mahádáyi, a feeder of the Goa river, and the Tilári, a small river near the Rám pass, drain westward through clefts in the crest of the Sahyádris.

Water.

Except the east of the plain country, which is generally badly off for water, the water-supply is plentiful. In Gokák, the plain from four to six miles wide, between the Ghatprabha and the chain of hills on which Mamdápur stands, is formed of rich black soil everywhere of good depth. The land is capable of yielding the richest crops if only there was water. But the rainfall is so uncertain that only once in three years is there a fair harvest. The east of Parasgad is subject to droughts followed in the hot months by a failure of drinking water. In other parts artificial ponds and reservoirs hold drinking water during most of the year.

Geology.

Geologically[1] the district forms three great belts. In the south

used it ever since. The river at this spot is supposed to have great cleansing power. Memoir Geological Survey, XII. Part I. 99.

[1] The geological sketch of the district has been compiled from Mr. R. B. Foote's Memoir on the Geological Features of the Southern Marátha Country and Adjacent Districts. Geological Survey of India, XII. Part I. of 1877.

Chapter I. Description. Geology.

is a narrow strip of gneissic rock; in the centre are quartzite and limestone partly overlaid by two great bands of trap; and in the north and west are trap and iron-clay. The earliest traceable event in the history of the Belgaum rocks is the making of the stratified schist. This process was probably continued at intervals through long periods. The schist beds were then forced up, broken, and their character changed by a volcanic eruption, of which certain old highly crystalline trap dykes are a record. After remaining as land through long ages the gneissic rocks sank, were worn by the sea, and as they sank still lower, sandstones and limestones were formed from their ruins and laid over them. Another volcanic eruption forced the sandstones and limestones above sea level, changed their character, and twisted and broke them. For long they continued as land, weathering into hills and valleys, the rivers widening in places into small lakes where cross ridges checked their flow. Next, from the north-west, lava flows rolled over this rugged country, filling valleys and leaving swelling downs and shallow hollows. Of these flows only a few reached the east of the district, but towards the west at least eight great flows came at intervals and lay one over the other. Since the flow of lava ceased the general lie of the country has not changed. The surface has been greatly worn, but the wearing forces have apparently entirely been air-forces, sun, rain, and wind. Though over large areas it has now disappeared the iron-clay capping of Bágedgudd near Gokák shows that the latest lava flow spread at least as far east as the centre of the district. The rivers have long forced their way east through the hardest hills. But rocks formed under fresh water and gravel and shingle beds on river banks, sixty to eighty feet above present flood levels, show that at some period after the latest outflow of lava the country was in places covered with lakes. Since their outflow air and water have changed the latest lava beds into an iron-clay rock that caps most of the higher hills, and in the plains the traps have weathered into red soil, and traps sandstones and gneiss mixed with vegetable matter have weathered into black soil. The rocks are almost entirely without organic remains. Almost the only signs of plant or of animal life are in recent alluvia, where, besides shells, the bones of a wild ox and of an extinct species of rhinoceros have been found.

Beginning from the surface the succession of the geological formations is:

Post Tertiary or Recent:
7. Sub-aërial Formations and Soils.
6. Alluvia.

Later Tertiary:
5. Bone-bearing Deposits.

Upper Secondary:
4. Deccan Trap and Associated Formations
(*b*) Iron-clay (laterite) Formations. (*a*) Intertrappean Lake Beds.
3. Infra-trappean Formations, Lameta Beds.
2. Kaládgi Series of Sandstones and Quartzites (Sub-metamorphic).

Azoic:
1. Gneissic (Metamorphic) Series with Associated Intrusive Rocks.

For descriptive purposes the different formations come most conveniently in their true geological or ascending order.

Within Belgaum limits the Gneissic Rocks form a belt that stretches across the south of the district varying in breadth from two to six miles. Besides in this belt gneissic rocks appear as inliers in some cases among sandstones and quartzites, in other cases among trap.[1] It has not been settled whether all the gneissic rocks belong to the same geological age. Full inquiry will probably show that they admit of subdivision and classification. The series includes a very considerable variety of rocks, schistose or granitoid, separated into great sharply-defined bands, which, in many cases, may be traced across the country from the southern boundary of the younger traps, across Dhárwár to the Tungbhadra and away into Bellári and North Maisur.

West of the Dhárwár-Belgaum road the gneiss is greatly obscured by lateritic or lithomargic surface deposits. Beyond these, near Khánápur, about fifteen miles south of Belgaum, is a broad belt of granitoid gneiss, the bedding of which is doubtful. Further west is a great development of very schistose chiefly micaceous gneiss with some very thick beds of crystalline limestone, the strike of which is difficult to indicate as the beds roll at low angles. These beds show much the same position in the several sections at Bhimgad and in the Tilári ravine. The rocks met with in the gneissic series are divided into two great groups, the granitoid, which are highly crystalline and massive, and the schistose, which are less crystalline and often highly foliated and distinctly bedded. The schistose areas differ from the granitoid areas by the much greater smoothness of their surface. Even when they form hills the hills are in most cases gently rounded, the scenery is commonplace and tame, and there is a want of vegetation. A band of granitoid gneiss crossing the Malprabha, and numerous dykes having a north-east to south-west course, appear in the Kathárigad valley, about sixteen miles west of Torgal. Another granitoid band forms some noticeable hills at Ganibáil, twelve miles south of Belgaum, and passes south through Khánápur to the Nandgad hills. Besides, at Saundatti, a very broad band of schistose rocks appears in the upper valley of the Malprabha at Báil Hongal, about ten miles west of the Kathárigad granitoid band, and stretches south-west within a few miles of Khánápur, where it joins the most westerly band of granitoid gneiss.

The commonest type of granitoid gneiss is a more or less porphyritic rock consisting of quartz, felspar, and hornblende in varying proportions. The felspar very frequently predominates. As a rule the granitoid varieties are not distinctly bedded. The transition from the highly crystalline massive form to distinctly bedded and even schistose rocks is often seen near the boundaries of granitoid areas. The granitoid gneiss in those cases shows a broadly banded structure, the bands being parallel to the true

[1] There are twelve chief inliers: the Kathárigad inlier thirty miles east of Belgaum; the Halki and Budnur inlier north of the Belgaum-Kaládgi road; west of these are the Vannur and Páchápur inliers; to the north of these are three other inliers at Kelvi, Mamdápur, and Gokák; further south are two inliers in the Belgaum valley; and west of Belgaum close to Patna two small inliers show through the Deccan trap.

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foliation of the less altered rocks, and being in fact the true layers of original deposition.

The two chief varieties of schist are micaceous and hæmatite. The micaceous schists, though uncommon in the east, are seen in vast thickness in the ravines of the Mahádáyi and Tilári and in the scarps south of the Párvár and Rám passes. Of hæmatite schists numerous beds are found in the upper valley of the Malprabha in the Báil Hongal schistose band where they form conspicuous ridges among the softer schistose rocks. Their silicious laminæ are generally very fine-grained, and are often as semi-vitreous in texture as true quartzites. Their colour varies from nearly white to bright red or even dull brown. The true foliation or bedding of the rock is almost always perfectly preserved. They are poor in iron, and rarely show much of the red staining, though they are frequently jaspideous in texture. The country is covered with their debris to a remarkable extent. Minute and small quantities of gold are found associated with hæmatite beds in some of the streamlets about Báil Hongal and Belovádi.

Associated with the schistose members of the gneissic series are beds of crystalline limestone. On one of the most conspicuous masses of this limestone stands Bhimgad fort, about twenty-five miles south-west of Belgaum. From the north side of the great Mahádáyi ravine, looking over the scarp formed by the edge of the trap area, Bhimgad, with neighbouring limestone peaks and several huge masses which have slipped into the valley, forms a wild and most beautiful scene. The dolomite beds extend southward from Bhimgad across the Kel or Talevádi pass and up the northern slope of Darshindongar the highest hill in this part of the Sahyádris. Here, as at Bhimgad, the limestone is a light gray sacharoid magnesian with numerous quartz laminæ.[1] Near the east gate of Bhimgad a large quantity of dark blackish brown powder is found on the surface of the dolomite from which it has evidently weathered. The face of the limestone which is here greatly hid by vegetation is darker than in the main mass of the mountain. There are three other chief instances of crystalline limestones. A gray crystalline limestone underlying the hæmatite-schist bed which forms the crest of the ridge south of Báil Hongal in the upper valley of the Malprabha; a small outcrop of very silicious gray limestone which forms two small inliers four miles east of Nesargi on the Belgaum-Kaládgi road; and to the east of Gudganhatti, six miles north-east of Nesargi, a very considerable bed of gray limestone associated with argillaceous and micaceous schists.

Of trap, granite, and quartz the three chief foreign dykes or reefs that cross the South-Marátha gneiss, the only reefs of any size within Belgaum limits, are trap dykes. A numerous set of dykes, with a north-east to south-west course, cross the gneiss inlier in the Kathárigad hills. The largest of this group is a very broad dyke which, rising from the black soil three miles north-west of Behvur,

[1] An analysis of the dolomite showed water and organic matter 4·0; carbonate of lime 56·4; carbonate of magnesia 34·8; oxide of iron with a little alumina and manganese 3·6; insoluble 2·2.

runs for about eight miles, till it joins another very large dyke. Beyond this dyke it does not reappear, or is again immediately lost under the alluvium of the Krishna at Mudukop. An intrusion of dioritic trap, surrounded by a vast unbroken spread of cotton soil, occurs at Asmatti, about twelve miles east of Parasgad, and forms a long low rocky hill. To the north and south the ridge dies away rapidly under the cotton soil, but groups of large masses stand out at intervals showing that it stretches north-west and south-east for about three miles with a width of two-thirds to three-quarters of a mile.

Gneissic Rocks.

Kaládgi Series.

A great series of quartzite, sandstone, and limestone rocks, in many respects closely resembling the Kadapah series,[1] forms a well marked basin, lying mainly between the banks of the Krishna and the Malprabha rivers. In geological sequence these rocks are next in age to the gneissic series on which they directly and unconformably rest. Their broken ridges of varied outline relieve the dullness of the central and eastern plain, but their barren sandy soil is unfavourable to vegetation. Within Belgaum limits the rocks that belong to the Kaládgi series are of two leading varieties, quartzites and limestones. The quartzites are found in a line that runs from Daddi in the west to Rámdurg in the east, about two-thirds from the north of the district. The limestones, which are of later formation than the quartzites, occur in an inner basin in the eastern centre of the district, a space about fifteen miles from north to south and about thirty miles from east to west. Beyond these limits, quartzite and limestone rocks appear in many parts of the district both as outliers resting on older rocks, and as inliers, exposed by denudation within the area of younger rocks. The chief of the inliers are to the west, the Mángaon inlier in the upper valley of the Harankáshi, the Shengaon and Assangaon inliers in the valleys of the Vedganga and Dudhganga in Kolhápur, and a group of large and small inliers on the south bank of the Ghatprabha near Yádvád about nine miles south-west of Mudhol. Of the outliers one of some importance caps the Parasgad hill and two small ones occur a little to the north-east.

The series, as a whole, where disturbed, is decidedly metamorphic. The disturbed parts lie within the Kaládgi basin, the undisturbed parts are, with few exceptions, the western outliers. As no trace of any organism has been detected the series may for the present be regarded as lifeless or azoic.

The whole series may be subdivided as follows in descending order:

	Feet.
B.—*Upper Kaládgi Series.*	
6. Shales Limestones and Hæmatite Schists ...	2000
5. Quartzites with local Conglomerates and Breccias ...	1200-1800
A.—*Lower Kaládgi Series.*	
4. Limestones Clays and Shales	5000-6000
3. Sandstones and Shales	3000-5000
2. Silicious Limestones and Hornstone or cherty Breccias	
1. Quartzites Conglomerates and Sandstones	

[1] This series takes its name from Kadapah a British district in the Madras Presidency between 13° 12′ and 16° 19′ north latitude and 77° 52′ and 79° 48′ east longitude.

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Geology.

Kaládgi Series.

The total thickness of the series is not clearly known. Near Kaládgi the depth is not less than 10,000 to 15,000 feet, and in the west, among the Sahyádris, where all the rocks apparently belong to the lower series, the thickness is not less than 1000 feet.

Rocks belonging to the upper series are found only over small areas in the east of the district. The chief places are to the west of Lokápur and to the west and east of Yádvád. Of the upper series of rocks the limestones of the higher portion are found only in the east. This limestone tract is on the eastern boundary about fifteen miles from north to south, from about five miles south of Mudhol to about ten miles north of Rámdurg. It stretches in a broken belt about thirty miles north-west into the trap country, narrowing till it ends near Beshati on the right bank of the Ghatprabha about twenty miles below Gokák. The remaining rocks of this series belong to the quartzites and shales, the lowest section of the Lower Kaládgi Series. These form an irregular winding belt, which, beginning about five miles on either side of Rámdurg in the east, stretches first north-west to Gokák, and then south-west to Daddi in a band ten to twenty miles broad.

The base of the Kaládgi series rests on the gneissic rocks whose surface was so uneven that in places the basement beds of the quartzites and sandstones may be seen lapping round prominences rising from the surface of the older rocks. The silicious rocks of the lowest Kaládgi sections are entirely of materials taken from worn gneiss. The two sections of the Lower Kaládgi series may be further divided as follows:

II. 4. Limestones Clays and Shales.
3. Sandstones and Shales.
I. 2. Silicious Limestones and Hornstone Breccias.
1. Quartzites Conglomerates and Sandstones.

Lower Kaládgi Series.

The three lowest subdivisions are so closely connected that they may be best taken together in the same section. The basement beds of the Lower Kaládgi Series consist of conglomerates, grits, sandstones, and quartzites of great aggregate thickness. There are occasional beds of shale or shaley flags, and in one place several beds of hæmatite schists. All the outliers belong to this section of the series. In the rocks of the series there is great local diversity of texture and colour. At the same time the relative characters of the more important subdivisions are to a great extent constant, and the gradual decrease in coarseness of texture from below upwards holds good almost everywhere. Resting upon the basement beds, in the east and south of the basin, are found beds of intensely silicious limestone, which in many places pass or seem to pass into very characteristic hornstone or cherty breccias. Resting upon these come in most parts of the basin the clays, shales, and limestones that are grouped together in sub-section 4. In the south and west of the basin an important group of sandstones and shales appears between the breccia beds and the base of sub-section 4. But the imperfect character of the local sections and the presence of a broad band of Deccan trap combine to make the relations of the beds obscure and doubtful. As a rule the rocks of this section lie somewhat upturned,

the outer boundary scarps forming a true basement edge. Within the basin, they are usually waving, but in some places are horizontal, and in others are much disturbed and crumpled. In the western outliers the conglomerates and sandstones are almost undisturbed and show a minimum of metamorphic action.

Lower Kaládgi Series.

The colour of the conglomerates and lower grits varies much more than the colour of the higher beds. Among the conglomerates the chief shades are purplish-gray and dark purple, pinkish-gray from the decomposed granite-gneiss, whitish-gray where there are many quartz pebbles, and much light reddish-brown. The shaley beds are usually drab or pale ashy-gray. Near the jaspery hæmatite schists of the gneiss the conglomerates are in many places almost entirely composed of rolled or angular fragments of the jaspery hæmatite of all colours peculiar to those beds.

The cherty breccia beds, which are peculiar features of the Kaládgi basin, by weathering into disconnected masses, obscure the relations between the underlying and the overlying rocks. The position and the relations to the great bands of very silicious limestone, which occur to the north and north-west of Manoli, seem to show that the breccias are altered silicious limestone. The change from limestone to breccia was probably caused by highly acidulated water soaking in and carrying away so much chalky matter that the cherty skeleton was broken by the weight of the overlying rocks. Subsequent infiltration of flinty chalky and iron-clay matter formed the crushed chert into a breccia with variable cement. The greater part of this change probably took place during the period of volcanic energy which produced the Deccan trap.

The following details of sections show the character of the Kaládgi quartzite hills in different parts of the district:

Lower Kaládgi Quartzites.

At Gokák, the great series of pebbly and gritty quartzites are remarkably uniform in colour and texture. Drab to reddish brown are the leading colours. The best section is in the gorge of the river just below the fall. Here the exposed thickness of quartzites and conglomerates cannot be much less than 400 feet, of which more than 300 are exposed in the cliff on the north side of the falls.[1] The curved lines showing the outcrops of the quartzite beds are very conspicuous on the face of the cliff. For some distance above the fall the water [2] runs at a great pace, and in consequence has worn in the very hard quartzite many fine specimens of pot-holes some beds of which both here and in many neighbouring sections are typical waxy quartzites showing beautifully preserved rippling.

[1] The cliffs flanking the right side of the river below were found by Captain Newbold rent by nearly vertical fissures from summit to base. Two of the largest, with a direction of east-south-east, were crossed nearly at right angles by minor cracks, which thus insulated portions of the rock. The bases of these tottering pinnacles were often undermined by the action of the water and the mass tumbled headlong into the stream. Geological Papers on Western India, 355.

[2] At Konur, about two miles and a half above the Gokák falls, a tumblerful of the turbid water deposited one-fiftieth of its bulk of a fine reddish clay, not calcareous. The pebbles brought down were chiefly quartz, granite, and hypogene schist, with a few calcedonies; the sand contained grains of magnetic iron. Geological Papers on Western India, 355.

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Lower Kaládgi Quartzites.

A large fissure[1] in the cliff which forms the south side of the gorge, is really composed of joint fissures much enlarged by the partial sliding forward of the rocky masses.

In spite of the hardness of the rock, the gorge is cut fully a mile back from the general scarp of the Gokák hills. This scarp must have had something of its present shape before the outpouring of the Deccan trap. And there can be little doubt that these quartzite rocks were more worn away before than they have been since the outpouring of the trap flows.

Two small but very marked outliers of the basement conglomerate beds cap isolated and almost conical schistose hills, one on either side of the Ghatprabha where it issues from the gorge below the falls. These conglomerate beds form sharply scarped table tops to two hills of hornblendic and micaceous schist. The larger hill, which rises more than 600 feet above Gokák, overlooks a great part of the quartzite plateau which stretches away far to the south-west.

Very beautiful quartzite cliffs, whose bright red contrasts splendidly with the encircling green brushwood, occur in the valley of the Márkándeya, two miles south-west of Gokák, and especially in a great ravine that opens into the valley from the Karabgatti plateau on the south. Round many parts of the Gokák scarp the edges of the conglomerate beds form wall-like cliffs, and occasionally from the more rapid weathering of the schistose beds in the underlying gneiss, fallen quartzite and conglomerate masses strew the sides and bases of the hills.

The Gokák scarp disappears northward under the Deccan trap at Arbhavi, four miles north of Gokák. To the south it forms two bold headlands jutting east. Further south it is lost, and the beds forming it dip southward, and then roll generally at low angles over a large area covered with small wooded hills on the banks of the Kelvi and its tributaries. It stretches south through Lakhmápur and Deshnur to Marihal, about ten miles east of Belgaum, east to Mamdápur and Nandi, and west to the Márkándeya river on the Páchápur-Ankalgi valley. Throughout this region the sandstones less frequently assume the character of quartzites, having been exposed to a decidedly smaller degree of metamorphism. The coarser beds, as conglomerates and grits, show little change, but

[1] The head of the fissure is elliptical in form, with mural sides of sandstone, which, in its lower portions, is interstratified with layers of shale of a purplish-brown and yellowish-brown colour, with minute spangles of mica disseminated and between the laminæ containing incrustations of common alum. The head appears to have been cut back about 100 yards by the wearing of the water. Large rocks with angular unworn surfaces evidently dislodged from the rocks on the spot are seen in the bed and on the sides of the river below the deep receptacle of the fallen waters and on its margin. At the bottom of the deep fissures in the sandstone cliffs there were heaps of fallen fragments of rocks intermingled with bones and dung of bats, rats, wild pigeons, sheep, and goats. The upper portions of the fissures, with their sides marked with shallow polished grooves, were also choked with rubbish and rocks. Captain Newbold made two holes through the floor of the chief fissure. After penetrating the surface layer of loose stones a fine red earth was found imbedding angular fragments of sandstone and a few rounded pebbles of sandstone and quartz. Geological Papers on Western India, 355, 356.

some of the fine grained beds, even where they lie horizontally or very nearly horizontally, are true quartzites. Where the beds have been disturbed the amount of metamorphism is in direct proportion to the amount of disturbance.

The same characteristics are found in the rocks that stretch west across the Márkándeya river to the Kákti and Kankumbi scarps near Belgaum and along the upper valley of the Ghatprabha past Konur, Ghodgiri, Majti, Vatmuri, Sutgatti, and Daddi to the extreme west of the Kaládgi basin at Vatangi. The two gneiss inliers of Iranhatti and Yellápur seem to be high points of the old gneissic surface, round which the true basement beds of the quartzite series are not exposed.

The lower Kaládgi quartzites and sandstones at Vatangi in the extreme west are covered on three sides by Deccan trap flows. Beyond the ridge of trap, which covers the quartzites west and north of Vatangi, the quartzites reappear in the valley of the Harankáshi, occupying a considerable area near the village of Mángaon. The rocks that form this inlier present no peculiar features. They are quartzites and grits which mostly dip northward or north-west at low angles. They are best exposed in the row of hills which runs south-east from Salgaon on the bank of the Harankáshi and joins the trap ridge. The quartzites and grits are mostly pale coloured and fine-grained, and form a series of beds several hundred feet thick. Of the same character of rock are the beds that form smaller inliers in the valley of the Vedganga, eight miles north-west of Mángaon. These lie in the centre of the valley between Yengol and Shengaon and are four in number, the southmost, close to the village of Yengol, forming a small outstanding hill 200 to 300 feet high. Here all the beds dip north-west 5° to 10°. The other inliers are simply exposures on the flanks of the great ridges.

Passing to the south-west limit of the quartzite series, at Kákti, about five miles north of Belgaum, the rock forms a scarp whose base is hidden by a thick talus, or slope of fragments, abutting on a broad alluvial flat, which has gathered in the valley of the Márkándeya above the gorge by which that river flows through the congeries of hills and small quartzite plateaus that lie between Kákti and the Ankalgi valley. This scarp is merely the north-west continuation of the scarp that forms the boundary of the quartzite plateau to the north of the Belgaum valley, and along the entire base of which the underlying metamorphic rocks are to be seen. From the relative position of the trap flows that form the base of the great flat-topped One Tree Hill to the north-east of Belgaum, it is clear that the Kákti scarp was formed before the outpouring of those particular trap flows, and not improbably before the very earliest trap flows. It is not unlikely that this scarp extends far to the north-west under the overlying trap. The form of the ground at Rájgoli on the Támraparni, and at Yengol in the valley of the Vedganga, suggests the idea that the scarps there seen are really the great boundary scarp of the westward extension of the Kaládgi basin, although the base of the scarp is not sufficiently uncovered to show the underlying metamorphics.

Chapter I. Description. Geology. *Lower Kaládgi Quartzites.*

Both above Kákti and along the south scarp above Kankumbi a succession of conglomerate and grit beds, with some compact quartzites intercalated between them, are seen to dip north or north-east at low angles. Farther north other gritty and pebbly beds are met overlying the beds which form the scarp. These scarp beds pass across the slightly inclined plateau to the gorge of the Márkándeya near Nandi, north of which come other quartzites which stretch to the valley of the Ghatprabha near Sutgatti and Vantmuri about half-way between Daddi and Páchápur. The very gritty and conglomerate character of the beds in the Kákti plateau changes gradually eastward, so that near Hoskatti and Hanbarkatti quartzite beds predominate. How very greatly this part of the Kaládgi basin was worn before the trap was poured out is shown by the quartzite beds that cap the Budnur hill, a gneissic inlier among the trap. A fine section of the quartzites, which there form the basement of the Kaládgi Series, occurs in the valley north of Siddápur, where the Budnur stream enters the Kaládgi basin by a picturesque gorge. The beds dip 12° north-east. At the next gorge eastward from Siddápur the edge of the basin is more than usually uptilted and the quartzite beds have a dip of 30° to 35° north-east.

At Murgod, in the west of Parasgad, a set of quartzite beds forms the actual base of the series, and is overlaid by a set of conglomerates with sandstone forming the surface of great part of the plateau east of the village. The surface of this plateau has been greatly broken by weathering, but has reformed into a breccia pavement made of an iron cement apparently of sub-aërial origin. The pebbles included in the conglomerates are mostly of an older quartzite, probably of gneissic age. The beds which form the plateau east of the village rise eastward to the apex of the flat dome of Kathárigad. The arch of the dome is seamed by deep fissures, which, cutting through the mass of quartzites, show the underlying granite gneiss. East of Kathárigad the quartzites sink rapidly into the valley of the Benákatti, a tributary of the Malprabha. To the south of Kathárigad, the rocks at the Sogal waterfalls are hard quartzite conglomerate, pale, reddish-brown, or purplish, and numerous bright red jasper pebbles form the hæmatitic beds of the Malprabha valley. The southern boundary of the Kathárigad erosion valley is formed by a considerable fault which runs west 29° north, and has caused an upthrow of the beds on its southern side. The fault stretches along the south of the ravine north-west of Karlhatti.

The rocks that form the beautiful gorge of the Peacock's Pool, or Navil Tirth, nine miles east-south-east of Sogal, are hard quartzites extremely polished within water reach. The polished surface is in most places covered with a thin film of dark grayish-black, a striking contrast to the delicate pale-red and pink of the other quartzite rocks. In the gorge, bed after bed may be traced upward or downward without a sign of doubling. The dip varies from 10° to 15° and averages about 12°. The leading colours are pale light red and pink and drab, with a few beds of light bluish-gray. Near the base some of the quartzite beds are of bright red salmon colour, or even of a pale peach blossom. Many minor beds among the quartzites are very pebbly,

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in fact are perfect conglomerates. Among the included pebbles and fragments are many of red and gray jasper from the hæmatite beds in the gneiss. Pebbles of quartz and other quartzites, also of hornblendic schist and of pistacite, are common among the inclusions. The quartzite beds often contain isolated pebbles, which, especially when of red jasper, contrast strongly with the generally uniform texture of the matrix. Taking the length of the section at one and a quarter miles directly across the ridge the total thickness of quartzite and conglomerates cannot be estimated at less than 1200 to 1300 feet, the average dip of 12° being perfectly steady throughout the greatest part of the section. Most of the faces of the cliffs exposed in the Peacock's Gorge correspond with some of the principal lines of jointing by which the whole quartzite series is permeated.

To the north the quartzites dip under a thick series of clay schists which stretch across the flat immediately north of the gorge to a low quartzite ridge, formed by a reappearance of the upper basement series in a sharply flexed anticlinal which abuts on the left bank of the river close to Manoli. Beyond Manoli the quartzite again disappears under schists. To the west this anticlinal sinks very low, and then rises and joins the south-east extension of the Kathárigad plateau south of Madlur. The large village of Manoli stands on the clay schists and is chiefly built of a flaggy variety exposed during the dry season in the bed of the Malprabha immediately opposite the village east of the Peacock's Pool. The Kaládgi basin is bounded by a line of bluff quartzite hills, showing here and there precipitous scarps, whose bases are everywhere hidden by fragments of rock. The underlying gneiss is seldom seen. The chief outlier of the quartzite beds to the south is the Parasgad hill, about eight miles south of Manoli. The quartzites of this hill along their northern boundary are faulted against the gneiss and form a great inclined plain with an average dip of 7° north. In many parts the surface shows vast sheets of bare rock. In a cave about 200 feet below the edge of the scarp is a very interesting spring, whose water must drain through joints in the rock from the brow of the hill.

Lower Kaládgi Limestone.

The clay schists that overlie the basement quartzites at Manoli stretch from some distance north-west of Yargatti, south-east to the Malprabha at Manoli, and across the Malprabha into the spurs of the hills that run north-east parallel with the river, and pass into quartzite or sandstones among the hills south-west of Rámdurg. To the north of the clay schists comes in sometimes a 'dirty' hornstone breccia, sometimes a set of highly silicious (cherty) limestones, whose extension is in great measure masked by the great accumulations of cherty debris derived from the weathering of the cherty beds, together with great spreads of cotton soil and also of sand formed by the decay of the silicious beds on the higher grounds. These silicious limestones appear to be distinct from the great limestone formation that occupies the Ghatprabha valley near Kaládgi. They stretch from Ujenkop south-east to Jakkabal on the Malprabha north-east of Manoli, and are connected with a patch of similar character that occurs at Goraganur further down the river. To the west of Yargatti, on the Belgaum-Kaládgi road about

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ten miles north of Manoli, the limestone beds roll in low reefs forming a rocky wilderness six to eight miles square. Over this area to the west of Yargatti the 'dirty' breccia is not seen. To the north-east of Yargatti are some beds of pink and pinkish gray limestone of less silicious character. In the hilly ground to the south-west and north of Torgal a thick series of sandstones with a few conglomerate and quartzite beds overlies the silicious limestones and dirty breccia, and forms a low rolling plateau very stony and barren. To the north, between Torgal and Karikol, the land is mostly a rocky wilderness of sandy soil, deep cut by streams and covered with scrubby brushwood. Further north the sandstones are represented by the drab shaley series and the overlying quartzites. The only remaining section of the quartzite basement series is a narrow strip to the north of the long spur of Deccan trap that forms the watershed between the Malprabha and the Ghatprabha. The most westerly part of this strip forms a high rocky ridge culminating in the Manikeri hill about twenty miles east of Gokák. Its red and drab quartzite beds have a north-east dip of 30° to 40°. At Hulkund the ridge is crossed by a stream, but rises again to the east and forms two conspicuous rocky hills, the southmost of which dies down in an anticlinal ellipse. To the west the anticlinal character of the ridge is obscured by the trap which surrounds the hill to a great height. Rather more than half a mile east of the elliptical end of the anticlinal other sandstone and quartzite beds are exposed. These probably belong to a rather higher horizon in the series.

The lower Kaládgi limestones and associated shales are found chiefly on the north-east part of the Kaládgi basin. A considerable extent of them occurs between Lokápur north-west to the Ghatprabha. These rocks lie partly within Belgaum limits to the east south and west of Yádvád, and partly in the Mudhol and Jamkhandi villages in the east of Belgaum. These limestones occupy a basin within the Kaládgi basin, and with boundaries in many parts fairly parallel to those of the great basin. The western boundary is formed almost entirely of the overlying traps, and there are a small number of limestone inliers beyond the north-west corner of the limestone basin. The limestone basin includes within its area a number of minor basins and outliers of rocks, quartzites, limestones, and shales that lie conformably on it and form the upper division of the Kaládgi series. From their low position, and from the great amount of contortion to which they have been subjected, it is difficult to fix the precise relations of this section of the Kaládgi Series.

At and round Yádvád is one of the largest shows of limestone in the whole region. The prevalent beds, mostly seen in the bed and banks of the Yádvád stream, are gray in various shades, but other colours as white-banded gray and white, greenish gray with pink, and white bands and grayish green are also found. The great plain south of Yádvád is covered by an almost unbroken sheet of typical cotton soil or regur through which rocks show only in a few widely scattered places. A little to the north-east of Monami banded green and white limestone, with some white and pink bands, occurs in

Lower Kaládgi Limestone.

small sections. The broken outliers from them in a limestone basin west of Yádvád stretch about twelve miles north-west to Beshati near the Ghatprabha. Large shows occur between Hal Yergudri and Uradi, six to eight miles north-west of Yádvád; between Bisankot and Beshati from ten to twelve miles north-west; at Kulgur about ten miles west; and between Has Yergudri and Temápur, between four and six miles west. In the long valley that stretches south from Temápur the limestones are red, pink, and banded with gray, green, and brown. The beds are mostly much crumpled and the true dip is often doubtful. At Alimati, about eight miles north-west of Yádvád, are handsome brecciated beds of drab limestone cemented by a purple matrix. At Manápur, about one and a half miles south of Alimati, beds of dull red earthy limestones are associated with red chert, lumps of which are scattered on the surface.

The limestone on the two outliers south of the limestone basin near Sidanhal, eight miles north-west of Torgal, shows flaggy purple beds, sometimes rather earthy. They roll a good deal at low angles, and to the south are underlaid by beds of cream-coloured and whitish limestone which occur in the Tolagati stream a little to the south of Sidanhal. Returning to the main limestone basin by the Belgaum-Kaládgi road, gray and whitish limestones, some of them very cherty, are crossed on the north-east of the Panchgaon travellers' bungalow about eight miles north-east of Sidanhal. To the north-west of these is a large show of earthy sub-crystalline beds of red and pink which dip under the Lokápur synclinal. Further east, at Varatsgal in Mudhol, about two miles south of Lokápur, are numerous beds of gray limestone. To the east and west of Lokápur gray and bluish-banded limestones are largely exposed, and make the largest show in the whole limestone basin. The Belgaum limestones are almost entirely free from quartz reefs and veins. A few veins are found to the south-east and north-west of Hoskati, about a mile to the west of Lokápur.

Upper Kaládgi Series.

Rocks of the Upper Kaládgi Series, quartzites below and limestones and shales above, are found in bands resting conformably on the lower series, and occupying a number of small basins which form elliptical synclinal valleys. They lie on the whole east and west. The series nowhere passes beyond the limestone basin, and the area it occupies is extremely small. The chief are to the west of Lokápur, to the north-east of Yádvád, and some smaller outcrops on the Deccan trap area, near Alimati, about eight miles to the north-west of Yádvád. The quartzites of this upper series are very uniform, pale, and frequently conglomeratic, with local patches of brecciation. It is worthy of note that all the ridges of this series are cut by streams on their way to the Ghatprabha through weak spots caused by excessive jointing. A section in the gorge through which the Lokápur stream enters the basin from the south shows in descending order

3. Breccia of Quartzite.
2. Calcareous Shales with Limestones.
1. Quartzites with Pebbly Beds.
Fragments hiding Calcareous Shales.

The calcareous series that rests on the upper quartzites consists

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Upper Kaládgi Series.

almost entirely of calcareous shales purplish or gray and overlaid by purple and gray argillaceous shales; limestones show only occasionally and generally in thin bands. In some parts the purple shales are highly ferruginous, being richly charged with earthy red hæmatite. As a rule the surface of this series is thick covered by cotton soil or by thick, red, ferruginous, gravelly soil formed by the decay of the hæmatitic shales. Limestones of this series occur at Murgar in Mudhol about four miles east of Yádvád, at Jembigi about four miles further east, at Yenkatpur a little to the north of Lokápur and at Varatsgal about two miles to the south of Lokápur.

Intrusive Rocks.

The only Intrusive Rocks in the Kaládgi basin are trap dykes, which are sparingly distributed and occur only in the upper part of the series. There are three trap dykes near Lokápur, all of compact green diorite weathering in concentric ellipsoidal masses unlike any of the older diorites seen in the gneissic area. Their course is north-west by west to south-east by east, and they show only in the centre of the valleys among the shales. In the absence of organic remains and from its isolated position it is impossible to correlate the Kaládgi series closely with other series rich in quartzites. Still, the character of its rocks is much like the character of the rocks of the Kadapa Series and of the Gwalior or Bijávar Series of Central India.

Infra-Trappean Rocks.

Underlying the great Deccan trap, and resting sometimes on the gneissic and sometimes on the Kaládgi series, are certain deposits of sedimentary origin of small thickness and extent. They are interesting, as some of them may represent the pre-trappean deposits of Central India which are known as Lameta beds from the Lameta pass near Jabalpur. Unlike the hard rocks of the Kaládgi Series these deposits are in a soft unconsolidated or half-consolidated state. They are formed of the ruins of various older rocks with a considerable mixture of the red earthy clay called bole in isolated lumps, or in strings, or generally spread through the mass. The most common form of these deposits is gritty marly clay or clayey grit, as at Malanhatti three miles north-east of Gokák, and at Kulgur twelve miles north-east of Malanhatti. Coarse shingle, mainly gneiss and quartz pebbles, seen largely at Nágarhál east of Yellurgad near Belgaum, is the remains of former pre-trappean deposits. The most extensive exposure of these infra-trappean beds is near Sigihalli, about ten miles south-east of Belgaum. The sandstones here are seen in very thin courses in soft sandy marl resting on hornblendic schistose gneiss. These infra-trappean beds are eight to ten feet thick. As far as is known they contain no fossils. The presence of bole in so many of the pre-trappean deposits appears to be due to the heating action of the trap flows poured on to beds of fine clay. The quantity of the bole is always largest close to the trap, where it occasionally occurs pure and much broken by minute cracks. The pure bole is rarely many inches thick. In some cases it is very markedly affected by a system of prismatic jointing on a small scale; but the mass is so friable that it is impossible to collect any of the very pretty little prisms; they crumble even with the most delicate handling. From the circumstances under which they occur, from

their limited extent, and from their strong resemblance to the fresh water deposits among the lower trap flows the infra-trappean beds may be set down as of limestone origin.

The north half of the district and two great spurs, one that runs from near Gokák south-east to near Rámdurg and the other that runs from Belgaum about twenty-five miles north-east, that is about three-fourths of the district, are trap. The depth of trap grows gradually greater from the east to the west. In the east where only a few flows have spread are low rolling downs with shallow valleys between; further west later flows rise in flat-topped ridges between the water-sheds of the larger rivers; and still further west the latest flows are piled into high and massive hills.

The chief varieties of trap are basalt, amygdaloid trap, vesicular trap, and clayey trap. These, with some few intertrappean sedimentary beds and numerous highly iron-charged clayey beds make up the mass of the trap flows. By far the commonest rock is basalt. This includes, besides compact and vesicular basalt, the highly weathered earthy trap so common throughout the Deccan. In form basalt is either massively shapeless, rudely tabular, or rudely columnar, the two last forms being the most common. The lower flows are mostly basaltic, the middle flows alternately basaltic and amygdaloid, and the upper chiefly basaltic, capped by beds of laterite and clay. The lower trap flows were poured over an exceedingly rough surface. The upper flows often overlap the lower and rest on the higher parts of the older rocks. In the west, when studied from some commanding point, the flows are seen to dip at a low angle to the north-east. About twenty-five or thirty miles from the Sahyádris the dip becomes more easterly, and so gradual as to be hardly perceptible. The absence of centres of eruption and the rarity of beds of volcanic ash seem to show that the volcanic centres through which the trap was poured were north of the Belgaum district. That the trap flows were poured out in the air and not under water is now generally accepted as proved. Of the age of the trap nothing has yet been determined. The intertrappean beds occur near the local base of the traps. These beds are of small extent, and are found only along or near to the south-east edge of the trap area.

The grandest sections of trap are to be seen in the great western scarp of the Sahyádri hills. Their great thickness, some of them forming cliffs several hundred feet high, makes the flows very difficult to study. But they can be well examined in the cuttings on the roads over the Phonda and Ámboli passes. To the east the best sections are the bare hills round Chikodí, Bágedgudd north of Gokák, and Yellurgad south of Belgaum.

The series of trap flows seen in the bare hills round Chikodi consists of six basaltic flows. The three lowest are separated from each other by thin beds of amygdaloid trap and red bole. The highest flow is separated from the rest by thin boliferous beds, part of which may be volcanic ashes. The two middle flows, though distinct, show no intercalated matter. The whole makes up a thickness of 600 to 700 feet, of which the three lower basaltic flows occupy fully two-thirds.

Chapter I. Description. Geology. *Deccan Trap.*

The bare slopes of Bágedgudd, about two miles north of Gokák, give a very good section. This is the most easterly point at which the uppermost trap flows occur. From the south eight chief flows may be seen over the water-shed ridge that divides the valleys of the Ghatprabha and the Krishna. They are best seen from a distance, as close at hand the ruggedness of the slopes masks the terrace structure. Beginning from the highest the succession is (1) iron clay (laterite); (2) amygdaloid; (3) basalt; (4) basalt; (5) amygdaloid, red and brown; (6) basalt; (7) amygdaloid, purplish and soft; and (8) basalt. The lower beds stretch far on all sides, and may be traced for many miles in the spurs that branch from the great central mass. Its lower flows connect Bágedgudd with the Chikodi hills about twenty-five miles to the north-west, with the Manoli hills about the same distance to the south-east, and with the lower basaltic plateau that stretches along the north frontier of Mudhol about the same distance to the north-east. To the north of Gokák the lower Bágedgudd flows form several rocky ridges which stretch into the Krishna valley. The hills near Athni and Gateh may be said to be extensions of the Bágedgudd series. The dolerite and basalt flows that form the group of hills at Gosbal and Kauljalgi about fifteen miles east of Gokák represent the three lower members of the Bágedgudd sections.

The iron-clay bed which caps Bágedgudd is the youngest known, the most constant, and the most safely determinable member of the local Deccan trap series. As it caps all the highest ridges and peaks in Kolhápur and Belgaum it may be called the summit bed. Of all the mountains those which it caps are the most perfectly table-topped, and in most cases the capping is sharply scarped all round the edge. As these scarped plateaus crown all the highest hills and were easily made very strong, many of them were chosen by native chiefs as sites for their strongholds. Such are Gandharvgad about twenty and Mahipálgad about twelve miles north-west of Belgaum, Kálánandigad about sixteen miles west of Belgaum, and Yellurgad about eight miles south of Belgaum. Further north the same rock forms the hill-forts of Samángad and Bhudargad, about twenty-five and forty miles north of Belgaum in South Kolhápur, and of Vallabhgad and Páijargudd in Chikodi. Underlying the great iron-clay bed is a bed of clayey trap often purple and much softer than the overlying bed. The more rapid weathering of this clayey trap bed is the reason why the scarp so constantly and sharply defines the iron-clay summit bed. This clayey trap generally passes into ordinary purple or reddish brown amygdaloid, below which are basaltic and other amygdaloid flows. The clayey trap is largely developed on Kálánandigad about sixteen miles west of Belgaum, and on Bailur fourteen miles south-west of Belgaum, the highest hill in the district 3491 feet above the sea. Further north the clayey trap is well seen on Vallabhgad and Páijargudd in Chikodi.

A somewhat striking feature of one of the basaltic flows, which, at many parts of the southern boundary, forms the basement bed is the weathering into great rude blocks, some of which might almost be reckoned small tors. These blocks frequently rest directly on the underlying gneiss. At Bastvád about eight miles south-west of

Belgaum, at Nágarhál about two miles east of Yellurgad, and to the north-west of Murgod in Parasgad, a few big blocks remain isolated on the gneiss at small distances from the boundary of the basalt flow. At Bavihal two miles north of Sampgaon, an unusual variety of trap occurs below the blocky basalt flow which generally forms the base in that quarter. This exceptional variety differs from any other Deccan trap in being much more crystalline in texture and resembling far more a highly hornblendic diorite of gneissic age. The upper part of the intermediate bed consists of pure bright-red bole, two to three inches thick, which shows very distinct prismatic columnar cleavage.

Typical basalt which occurs in innumerable places, is largely quarried on the slopes of One Tree Hill north of Belgaum. It is a fine close-grained brownish black stone with a few small vesicular cavities. A variety which is porphyritic from enclosing rather large crystals of green glassy-looking olivine, was observed on the high hill which forms the north-eastern extremity of the Yellurgad ridge.

Volcanic ash-beds are not numerous. They are found in the flanks of Vallabhgad about fourteen miles south-west of Chikodi, and in the north Ghatprabha range between Chikodi and Valur in south Kolhápur. The beds may at first sight be easily taken to be amygdaloid flows, but examination shows that they are chiefly of fragments, lapilli, or volcanic ashes and dusty particles of vesicular trap cemented by the deposition of calcite and zeolitic matter in strings and films between the fragments as well as in the vesicular cavities. The lapilli are mostly reddish or purplish, and much red bole is spread through the mass, which, by contrast with the whitish calcite and zeolite, makes the whole reddish or pinkish gray.

Columnar cleavage of basalt is occasionally seen in the west, but is generally rude and unworthy of note. The best case is probably the cutting at the top of the Phonda pass. In the Konkan, west of the Rám pass, Mr. Wilkinson noted fallen masses of perfectly columnar trap.

The mineral substances enclosed in the trap flows are not very numerous. Zeolites, chiefly scolecite and stilbite are very abundant in small or large vesicular cavities in many trap flows. An uncommon crystalline form of heulandite was found in a purple amygdaloid at Dandápur, nine and a half miles north of Gokák. The crystals occurred lining irregular clefts in the rocks.

Small agates are found in large numbers on the weathered surfaces on the ridge north of Chinchni three miles west of Chikodi, at Kurgaon eight miles south east of Chikodi, and near Hamámságar twenty-miles south-east of Gokák.

Some curious fungoid concretions of chalcedony and rock crystal are found in a soft clayey amygdaloid flow south-east of Dehmangi, about four miles south-east of the Belgaum fort. Similar concretions also occur on Kálánandigad sixteen miles west of Belgaum. Calcspar occurs frequently both in basaltic and in amygdaloid traps. Magnetic iron is spread in considerable quantities through the mass of the basaltic and doleritic trap. Arragonite occasionally occurs in doleritic

Chapter I. Description.

Geology.

Deccan Trap.

trap flows. Red bole frequently occurs in amygdaloid beds and in some volcanic ash-beds as in the slopes of Vallabhgad in Chikodi. Olivine is not very often seen. The best specimens occur in the first high basaltic hill south-west of Nesargi on the Belgaum-Kaládgi road.

Inter-trappean Beds.

Between the flows of lava that make up the Deccan trap, sedimentary rocks, chiefly sandy deposits, conglomerates, grits, and clay beds sometimes occur. In a few of these fossils have been found, whose organic contents show them to be of fresh water origin. The similarity of their mineral character leaves little doubt that all these rocks were formed in fresh water lakes. Though their mineral character differs, the fossils, Physa prinsepii, Lymnea, and Unio deccanensis, prove that the traps of the Southern Marátha Country and of Central India belong to the same period.

The Southern Marátha intertrappean beds lie near the base of the trap series. In one important case a fresh water marl was found resting on the gneiss rocks, and thus underlying what locally appears to be the lowest trap-flow. This may have been caused either by the flow overlapping some older flow or by its representing the deposits in a fresh water lake older than the first outpouring of the Deccan traps. In two intertrappean beds within Belgaum limits, at Mamdápur, six and a half miles north-east of Gokák, and at Uparhati, a mile north of Mamdápur, organic remains have been found.

The intertrappean beds near Mamdápur in Gokák seem to have been formed on the shore of a lake. They have a considerable show of bright red sandy marl, the red being due to the somewhat abundant presence of bole. Under the red sandy marl with lime nodules and many gneiss and quartzite pebbles is a bed of pale-drab sandstone with lumps of quartzite and Unio shells. This sandstone rests on red marl, and the red marl on a greenish-yellow marly-looking bed of decomposed vesicular trap that passes into dark greenish-black vesicular trap, with many small and a few large agate amygdaloids. The whole thickness of marls and sandstones ranges from fifteen to twenty feet.

A little more than a mile from the Mamdápur section, separated from it by an exposure of gneissic rock, rises a low flat-topped ridge, on the west side of which, close to the village of Uparhatti, the intertrappean rocks again show. The exposed beds are quartzite and gneiss shingle of uncertain age; weathered basaltic trap; red sandy marl with three or four sandstone partings containing *Unio*[1] shells and decomposing whitish amygdaloid trap.[2]

Patches of shingle, chiefly of quartzite, appear from their position to be the relics of some intertrappean formation that has been worn

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[1] The *Unio* beds are about twenty feet thick, and were formerly continuous with those of Mamdápur. The fossil *Unios* in both sections are well preserved, even the beautiful lining or nacre being kept in some instances.

[2] This section represents the beds north of the village in order to introduce the quartzite and gneiss shingle. The *Unios* were found a few dozen yards south of the village.

away or masked by surface fragments. Of the latter class are the patches of quartzite gravel at Kolik and Chiguli, on the south side of the Tilári ravine, eighteen miles south-west of Belgaum. A similar gravel patch occurs at Volmani, a mile east of Jámboti, about fifteen miles south-west of Belgaum, and at much the same level relative to the trap-flows. Near the western end of the great trap spur north-west of Párgad, about four miles west of the Rám pass, there is another gravel patch in which quartz pebbles predominate. To the class of gravels that represent worn intertrappean beds most likely belongs a large spread of quartzite shingle that lies on the surface of the trap on rather high ground three or four miles north of Yádvád. The curious bed of quartzite shingle that caps the Uparhati hill near Mamdápur may also belong to this class of relics.

The position of some of the lateritoid or iron-clay rocks intercalated between trap-flows in the high western ridges suggests that they may be of intertrappean sedimentary origin. This is the case with some iron-clay beds on the south side of the Jámboti ridge seen on the path leading from Chikhli to Ámti. Other iron-clay deposits occur here and there over the trap area, which, though very likely the results of sub-aërial atmospheric action might, from their position, be regarded as intertrappean relics similar to the quartzite gravels.

The only instances of intertrappean limestone are two small exposures of flaggy light-brown oolitic limestones that occupy depressions in the surface of the trap and are obscured by the surrounding cotton soil. One of these is in the hollow at the foot of a hill south-west of Nesargi on the Belgaum-Kaládgi high road. The other is at Ghone, a village six miles east of Nesargi. Neither bed seems to have any signs of organic remains.

Iron-Clay.

The traps in many parts of the district are overlaid by an iron-clay rock. This rock is of two kinds somewhat hard to distinguish, and both of them formed of decomposed trap. The first are much changed from their original state by weathering; the second are collections of ruins of rocks of the first class. The rocks of this second class are probably partly made of altered sedimentary rocks, but they are chiefly altered lava flows. It is convenient to call the altered lava flows iron-clay rocks, and the altered sedimentary rocks laterite, the name originally given to the fringe of ferruginous deposits that surrounds the southern part of the Indian peninsula, and almost certainly appears in the South Konkan or Ratnágiri laterite. When the Southern Marátha iron-clay was formed the country had probably acquired nearly its present features. The weathering of trappean rocks into iron-clay rocks is well seen in the cutting on the Phonda and Ámboli pass roads. The basaltic rocks graduate into a moderately hard brown earthy mass, which encloses many nuclei of the original rock. The infiltration of surface water charged with iron has solidified the decomposed mass. The summit bed, which has already been noticed as capping many of the highest hills, seems to have been formed of a trap rock entirely without silicious segregations.

The underlying trap into which the summit bed is seen to graduate at the principal sections, as Vallabhgad and others, is a very clay-like rock without any enclosed minerals. In colour and fineness of

Chapter I. Description. Geology. *Iron-Clay.*

texture it resembles many of the purple, brown, reddish amygdaloid beds that occur so largely elsewhere, but differ in the total absence of vesicular cavities whether empty or full. Besides the highest ridges and peaks in the Belgaum section of the Sahyádris, which have their summits capped with iron-clay, there are many others on which an iron-clay capping forms a very marked feature. Some of the most important of these cappings form outliers[1] on the older rocks where the latter are of great elevation and stand above the general mass of the trap flows, but are overlapped by the ferruginous beds. Owing to the superior hardness of the highly ferruginous summit bed, and the more rapid weathering of the underlying beds, the surface of the underlying beds is generally covered by ruins or by great fallen masses of the upper beds. In other sections a quasi-stalactitic ferruginous rain-wash often affects the appearance of the surface of inaccessible cliffs. And the presence of numerous delicate gray, orange, pale-pink, and flesh-coloured lichens in many cases so greatly changes the colour of the scarp faces that they can be made out only on close inspection.

Within Belgaum limits the three best sections of the Deccan trap iron-clay are at Kálánandigad sixteen miles west of Belgaum, and at Vallabhgad and Páijargudd in Chikodi. The iron-clay rocks of Kálánandigad are best seen on the path up to the north gate of the fort. The hundred feet at the top of the hill consist of mottled purplish and white or purplish clayey rock, which, without any sudden change, passes into a compact lateritoid mass.[2] The hill-sides become scarped as soon as the level of the summit bed is reached.

At Vallabhgad the clayey under-rock shows a good deal of quasi-vesicular structure in the arrangement of colours. Numerous thin films of white are seen like other vesicles enclosing darker portions of the general mass. The ruling colours are purple and reddish-brown, much flecked with white vesicle sections. The iron-clay summit bed, instead of showing horizontal or approximately horizontal vesicular cavities in the mass, is permeated by vertical tubuli running nearly through it. The upper beds of these tubuli, which vary in

[1] The chief outliers of the summit bed, counting from the southern extremity of the trap area northward, are: (1) The Jámboti ridge; (2) Bailur with a peak 3491 feet high; (3) the Kárle and Báknur hills south-west of Belgaum; (4) Kálánandigad and Mátungi and the high spur connecting them with (5) the Mahipálgad ridge; (6) the Gandharvgad ridge; (7) the Vágbud and Kásarsudda plateau west and south-west of Chándgad; (8) the high ridge between the Ghatprabha and Harankáshi south of Ámboli, and also from a little north of the Belgaum and Vengurla road north-east to the Khánápur Trigonometrical Station hill near Ajra; (9) the high ridge dividing the valleys of the Ved and Dudhganga rivers, including the well marked plateau north of Pyáh; (10) the Vallabhgad outlier; (11) the two Bágedgudd outliers, on the eastern of which is a Trigonometrical Station; (12) the group of outliers west and south-west of Gokák, two of which overlap the Kaládgi quartzites; (13) the Páijargudd group of four small outliers, with a fifth forming the summit of Huligarkit hill three miles to the east; (14) the Arlehatti outlier four miles west of Páchápur resting directly on the quartzites; and (15) the Yellurgad outlier eight miles south of Belgaum, the last of the summit bed outliers. Several other outlying patches of similar iron-charged clayey rocks occur in the more eastern parts of the trap area, but they are too distant to be safely correlated with the summit bed.

[2] Captain Newbold supposed that the beautiful lilac colour of the lithomargic earth underlying the iron-clay of the Bidar plateaus was due to the presence of manganese. This supposition is probably correct. Memoir Geological Survey of India, XII. 206.

diameter from a quarter to three-quarters of an inch, but which are generally less than half an inch across, are empty for a little distance, giving the surface a pitted appearance. But the tubes are generally filled with lithomargic clay and have their walls lined with a glaze very like the glaze which occurs in the vermicular cavities of ordinary laterites. The height of the tubuli which are less distinct in the lower parts of the bed, and whose formation is due to the action of percolating water depends upon the thickness of the bed, and the glazed sides show much stalactitoid waviness of surface.

Iron-Clay.

The section seen in Páijargudd hill shows a thick-bedded mass of iron-clay with little or no tubulation, resting on a clayey trap of generally gray or purplish colour, finely streaked and mottled with reddish-brown, orange, or dull yellow. The vesicular markings noticed at Vallabhgad are also seen here, but are less common.

Pisolotic Iron-Clay.

A very peculiar pisolitic form of the iron-clay, varying in colour from pale brownish pink to bright or deep red or purple, is observed in several places, chiefly on Yellurgad, on Bailur, and on the Kásarsudda ridge south-west of Chándgad. Where this pisolitic iron-clay occurs the rock has a decidedly jaspideous texture and look, its colour varying from pale brownish pink to bright or deep red or purple according to the percentage of peroxide of iron.

A very extensive show of lateritoid iron-clays occurs at and to the east and west of the Rám pass. The rock there forms a nearly level ridge with a ragged scarped edge and a slope of great fallen masses. This ridge stretches north-east into the higher spur west of Hire, while, to the west, it joins the Isápur plateau north of Párgad, along the north side of which it forms a very distinct and generally vertical scarp thirty to sixty feet high. The Rám pass bed rests in some places direct on a basaltic flow without the intervention of the thick clayey trap. It is probably distinct from the summit bed, as it is considerably lower and does not lie in a level plane.

At apparently the same level are several ragged-edged plateaus south and west of the high Kásarsudda ridge about the head waters of the Ghatprabha. To the same set belong the beds on the high ground south-west of Patna and at Kodali on the north side of the Tilári ravine.

Sedimentary Iron-Clay.

South of the Tilári ravine at Kolik, Chigoli, Kankumbi, Huland, and stretching west towards Chorle and to the extreme western points of the Sudda fort spur, overlooking Goa, are continuous sheets of the iron-clay belonging to a bed or beds occurring very much at the same level. Southward, past the top of the Párvár pass, these sheets join those at the foot of the Jámboti ridge and pass south-east, forming, near Ambgaon and Chapoli, a well-defined plateau which caps the extreme southern promontory of the great Deccan trap area overlooking the Mahádáyi ravine. From the edge of this ravine the iron-clay beds seem to be represented on its southern side by a similar set which form a plateau round Gausi. To the north of the Rám pass, this set, which for convenience may be called the water-shed series, is represented in the plateau near the source of the Ghatprabha and in the valley of the Harankáshi.

The bed of iron-clay which forms a well defined plateau on the

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high spur south of Chapoli is of sedimentary origin. The sides which are well scarped show a vertical thickness of fifteen to twenty feet of the tubulated variety of iron-clay, the tubulation being very strongly and clearly developed.

From the number of quartz pebbles imbedded in the clayey mass it may be inferred that this iron-clay represents wholly or in part an altered intertrappean pebbly clay of the kind found in various typical intertrappean beds.

Along the south side of the Jámboti ridge, on the path leading from Chikhli to Ámti, are several alternations of iron-clay and basalt at different levels, the iron-clay apparently forming distinct terraces corresponding to altered trap-flows or intertrappean beds.

Three sets of small iron-clay plateaus, occupying rather lower levels than those of the water-shed series, occur in the valleys of the Márkándeya, Támraparni, and Ghatprabha. Those of the first and last sets form small groups of barren flat-topped hills, those on the Márkándeya near Unchgaon on the Belgaum-Vengurla road, and those on the Támraparni to the south of Arkur. Besides these there are similar minor and less marked plateaus in the upper parts of the valleys of these rivers.

The iron-clay at Belgaum occupies a deep bay or hollow on the east side of the basaltic rise on which the new European barracks have been built. The basaltic high ground here forms an angle, the apex of which lies north-west of the town, and, in that angle, the iron-clay is most largely exposed in two sections, one in the well in the soldiers' garden, the other in a deep well-like pit. In the soldiers' well the iron-clay had not been pierced at a depth of thirty-five to forty feet, and in the pit the thickness exposed exceeded (in 1872) a depth of fifty feet vertical and yet the underlying trap rock was not reached. In the well section the rock is not so clearly shown from the smaller size of the opening, but in the quarry the unweathered surface of the walls shows the rock to great advantage. The rock is very different in character from the summit bed or water-shed series. Instead of being vertically tubulated or nearly horizontally disposed, this iron-clay consists of an aggregate of nodular fragments in a quasi-conglomeratic mass, the quasi-pebbles being arranged in rudely horizontal lines. Beyond these lines there are no traces of bedding, but the downward decrease of the percentage of iron in the rock is very clearly shown. No traces of any enclosed mineral of pre-trappean origin are to be found. The whole formation appears to be a sub-aërial accumulation of pluvial detritus of older iron-clay beds. The iron-clay exposed in ballast pits close to the reservoir north of the pit and close to the post office and *Idgáh* is truly vesicular and far more ferruginous. No sections showing the relations between the vesicular iron-clay of the pit and the nodular rock are exposed in the hollow east of the cantonment or in the church hill. Both varieties are much covered by thick red sandy soil which is so largely developed over both iron-clay and trap and gneiss, and in places is so much charged with nodular pieces of iron-clay that it is often impossible to draw any line showing the true boundary of the trap and the older iron-clay and gneiss.

Sedimentary. Iron-Clay.

Beds of iron-clay strongly resembling the typical iron-clay beds are found as outliers of the trap area. In most cases they were probably once continuous with iron-clay beds belonging to the Deccan trap series.

The iron-clay plateau, the boundary between the Belgaum and Kánara districts, extends from Gausi southward up the slope of the eastern spur of the Darshnidongar in North Kánara. The iron-clay[1] resting upon and passing down into the weathered surface of the underlying gneiss is continued along the ridge to the very summit of the mountain where it is cut short by a sudden scarp. This scarp trends from the summit to the east on both sides of the ridge, the northern scarp joining the west scarp of the main mass of the Gausi plateau, and the southern scarp running east by south of Mendil and ending in a bluff to the east of Degaon. The passage of the base of the iron-clay into the lower gneiss is clearly seen in various sections in the scarped edges of the iron-clay plateau, in the beds of the streamlet near Gausi, and in the stream that flows west from Talevádi. In these beds the descent from the pure iron-clay into decomposing gneiss is clear, the quartzose laminæ remaining after the softer parts have been replaced by the clayey mass. In the small stream that rises south-west of Mendil south of Talevádi, the upward passage of a micaceous schistose gneiss into iron-clay is very clear. The iron clay is frequently a breccia in structure owing to the presence of numerous small angular fragments of white vein quartz which are very frequently seen in similar iron-clays far away from the gneiss rocks and wholly of trappean origin.

A small and well-marked iron-clay plateau, twenty to thirty feet thick, forms an outlier on the top of the Bidarbhávi hill five miles south-east of Yellurgad. It shows much vertically tubular structure, and the amount of iron contained decreases speedily with the depth. The rock is also very distinctly bedded. Below the base of the scarp no rock is satisfactorily seen in place; but the sides of the hill are covered with broken iron-clay or masses doubtfully in place. Nor is the gneiss exposed for some distance from the base of the hill, the nearest visible portion of Deccan trap being the south spur of Yellurgad. From its external resemblance, as compared with Yellurgad, it probably represents an altered inter-trappean or infra-trappean deposit.

Tertiary Deposits.

Of later tertiary and alluvial deposits there are three; fresh-water sedimentary rocks, fossil-bearing river rocks, and old and new river alluvia. Of these the most noticeable are the fossil-bearing river rocks under a covering of black clay. They are of dark brownish-black stiff clay with partings and thin beds of gritty or sandy clay. The fossil-bearing beds are shown in the banks of a stream that flows into the Ghatprabha at Chikdauli, three miles north-east of Gokák. At the point where the bones were found[2] the section is, (4) regur or

[1] Though, as seen from the north, from various points along the Jámboti ridges or from the lower iron-clay terraces of Ambgaon and Chapoli, the Gausi plateau strongly resembles a normal iron-clay capped trap area, no positive trace of the Deccan trap was found by Mr. Foote.

[2] Of the fossils the most interesting is an extinct species of rhinoceros. A number

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cotton-soil passing into (3) black clay which contained the head of a rhinoceros, (2) clayey grit, two beds with clayey parting and numerous specimens of *Unio* and *Corbicula* in the gritty bands, and (1) reddish-brown black clay with bovine remains.[1] The bones are in a friable state, somewhat distorted by pressure, and much comminuted or broken by the action of numerous shrinkage cracks in the clay. Some of the bones are much encrusted by chalky deposits.

Alluvial Basins.

The alluvia of the several rivers agree very closely in character. They consist almost entirely of alluvial regur or black soil, with some beds of sand and gravel, frequently cemented by limestone nodules into coarse conglomerate. On the smaller rivers the alluvium in some cases is confined to a well-marked flat surrounded by higher grounds. Four cases of this kind are noted on the Ghatprabha and its tributaries, and in each of the four the alluvial flat or basin lies above a narrow gorge through which the river forces its way. Two of these alluvial areas occur, and both occupy shallow valleys above the eastern edge of the trap hill region. The one occurs along the course of the Márkándeya, some two miles north of Belgaum, and the other along a stream that rises in the Yellurgad hill and joins with those that drain the Belgaum downs. Both end abruptly eastward by the streams entering narrow gorges in the quartzite hills, and in both cases the alluvium is a black clay or a quasi regur.

A third basin to the south of Páchápur is at the meeting of the Márkándeya and the Belgaum river. The black regur-like alluvium in the upper part of the flat contains much nodular limestone. The lower part is wholly covered by thick regur, but in the upper parts between Ankalgi and Hudali there is a great development of pale-reddish and yellowish sandy loam with much limestone in filtration, strongly resembling the tertiary deposit known as loess, which forms steep cliff-like banks twenty-five to thirty feet high.

The fourth alluvial basin begins immediately below Gokák and stretches nearly eleven miles north-east to Tegdi. The lower part of the basin is hidden by a thick covering of cotton-soil through which only one section penetrates. The bone-bearing beds under the regur, which are exposed only in the Chikdauli stream are dark coloured clays with gritty clayey sands, and contain mammalian bones and fresh water shells. The space between is completely masked by cotton soil. It is probable that the Gokák basin joins the alluvial deposit which fills the valley of the Kelvi, a tributary of the Ghatprabha from the south. These alluvial deposits are gravels and coarse loam, the latter resembling the loam of the Belgaum stream at Hudli. These gravels rest on the various older formations that form the bottom and sides of the old valley, namely the gneiss, quartzites, Deccan trap, and inter-trappean beds. The gravel is in

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of bones were found loose in the bed of the stream, and others were obtained in 1871 by digging in the fields. Many of these are bovine and a few belong to a smaller specimen of Rhinoceros deccanensis, the nasal bones of which were not found. The specimen was just adult, and from the absence or very small size of the incisors the animal had probably a large horn.

[1] The bovine animal was in the shape of its molars nearly allied to the bison Gavæus gaurus which still inhabits the thickly-wooded slopes of the Sahyádris.

great part sub-angular and contains pebbles of all the older rocks that occur in the neighbourhood. The gravels or loam have no organic remains.

Alluvial Basins.

The river alluvia consist very largely of regur or cotton soil partly washed up by the river action and partly washed down by rain action from higher grounds. In many cases this reguroid alluvium is undistinguishable from the true regur, as it in great measure assumes the same character if broken by innumerable sun cracks, by which in time the laminated structure due to its sedimentary origin is wholly lost.

Gravel beds of two classes are found, one of them river deposits the other lake deposits. Almost all the larger Karnátak rivers have on their banks deposits of gravel and shingle sixty to eighty feet above ordinary flood level. These shingle beds, there can be little doubt, are relics of the time when the spurs of hills through which the river channels are now cut were barriers that dammed back the river waters into lakes. Of these high level gravel beds the only case noted within Belgaum limits is on the Malprabha, nine miles west of Saundatti. Gravel beds, probably of lake or river origin, are found along the foot of the Kathárigad hills near the village of Tolur, about eight miles north-west of Manoli. In the Tolur bed, though not in such quantity as in some beds near Bádámi, rather water-worn chipped stone tools have been found lying on the surface.

Sub-Aërial Formations.

The reproductive action of open-air influences have produced five formations. Of the iron-clay, which is the chief of these open-air formations details have already been given. The others are (1) conglomerates formed mechanically by the deposition of clay and iron cements; (2) deposits cemented by the chemical precipitation of calcareous matter; (3) pluvial or rain rain caused aggregations; and (4) blown sand.

Cases of the cementing of the remains of the lower Kaládgi quartzites by the deposition of iron-clay are noticed at Somápur a little south-east of Kathárigad, and three miles further west on the plateau east of Murgod. At these places numerous large quartzite pebbles weathered out of sandstone conglomerate have been recemented in very nearly their original position. The new rock looks much like an artificial pavement. A very similar, but even more striking effect, is produced by the cementing of rounded quartzite fragments in the valley south-west of Tumurgudi about eleven miles north-east of Belgaum. This pavement stretches for several hundred yards.

A case of cementation of angular fragments of gritty quartzite into a breccia by the introduction of a red sandy cement is observed in the saddle between the north-east side of One Tree Hill at Belgaum and the south-east corner of the quartzite plateau to the north-east. This breccia might, from its position, be easily mistaken for part of the lower Kaládgi quartzites, the coarse pebbly basement beds of which are exposed close by and seem to rest on highly upturned micaceous schistose beds in a section a little to the north-east of Kanburgi. Instances of the formation of small patches of sub-aërial conglomerates and breccias by the lateritoid decomposition of ferruginous rocks are very common.

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Pluvial aggregations are common chiefly on the slopes of trap hills and at the sides of some of the larger valleys. Much of the quasi-lateritic soil and rock met in such positions is of purely pluvial origin, but as a rule this class of deposits is so mixed with the local results of weathering that no line of separation can be traced. Considerable areas in the neighbourhood of Belgaum are covered with formations thick enough to mask the true sub-rocks.

Large tracts of the quartzite region along the northern slope of the hills north-east of Mamdápur in Gokák are covered with almost pure sand.

Ruined Rock.

Accumulations of ruined rock are met everywhere, and are often very widespread, especially at the foot of the quartzite slopes and scarps where they make the ground very rough and impassable. To the north-east of the Nesargi travellers' bungalow, on the Belgaum-Kaládgi road, they are so thick as to a very great extent to obscure the geological boundary lines.

Soils.

From a geological view point the soils may be divided into two main classes the red and the black. The red soils are primary soils, that is they are the direct result of the decomposition of iron-bearing rocks. The black soils are secondary soils, that is they are the result of primary decomposition changed by accession of organic matter. The black soil is not solely the result of the weathering of trap rocks. Black soil occurs quite as largely and as typically on the gneiss and other azoic rocks as it does on the trap.

Climate.

The pleasantest climate in the district is in a tract parallel with the crest of the Sahyádris, between the western forests and the treeless east. Within this belt lie Belgaum, Kitur, Páchápur, Sankeshvar, and Nipáni.[1]

The dry east winds which blow from October to March and the heavy south-west rains which last from June to October make the climate of Belgaum trying to new-comers. At the same time to the robust and to those who are accustomed to the climate, the two thousand feet above the sea, the moderate heat, and the early and fresh sea-breeze, make Belgaum pleasant and healthy.

The healthy influence is especially noticed in European children who thrive wonderfully and have a bloom on their cheeks during the colder months. Still a long residence enervates. Europeans who have grown up in Belgaum as a rule are pale, delicate, and weak. Newcomers again suffer in consequence of the sudden change from the extreme dryness of the air in the fair season to the great dampness of the rains. Unless with very active exercise the skin does not act, the liver grows sluggish and congested, and languor and drowsiness pass into sleeplessness, loss of appetite, and listlessness. The strong with the help of active exercise after a time throw off these feelings and enjoy vigorous health; but so long as they remain in Belgaum the weakly are doomed to suffer more or less. The climate of Belgaum is unsuitable to those who are liable to

[1] Kies' Southern Marátha, 24.

suffer from sluggishness of the liver, asthma, heart-disease, rheumatism, Bright's disease of the kidneys, or consumption; on the other hand those who have suffered from malarious fevers as a rule improve by a residence in Belgaum.

Seasons.

The Belgaum year may be arranged into three seasons, the cold and dry season from the middle of October till the middle of February; the hot and dry season from the middle of February till the beginning of June; and the wet season from the beginning of June till the middle of October. About the middle of October the cold weather perceptibly sets in, the evening air begins to be chilly, heavy fogs gather soon after sunset, and towards the morning and for some time after sunrise the country is shrouded in thick mist. Towards the end of December or early in January the night temperature is at its minimum. In 1879 December showed a mean temperature of 67°. During the whole period the weather is fine with strong dry easterly winds which make the cold of the coldest month less felt than the damp chill of July and August. The cold season lasts till the middle of February, when both the day and the night temperature begin to rise. The common cold-weather diseases are bronchitis, dysentery, dyspepsia, and malarious fever, which last, though prevalent all the year round, is at its highest from November to January. The hot season sets in about the middle of February and the temperature rises rapidly until it reaches 100° in May. The prevailing wind is from the west. In April and May the great heat causes occasional heavy showers attended with easterly winds, thunder, lightning, and sometimes with hail.[1] Even in May the nights are cool, almost chilly. Dew forms from sunset to sunrise and is sometimes as heavy as gentle rain. Even in the hottest days *pankhás* or damped grass screens

[1] The following accounts of thunderstorms which passed over Belgaum in 1847 (7th April) and 1849 (24th April and 2nd June) are taken from the Transactions of the Bombay Geographical Society, IX. 191-194. During the week ending the 9th of April 1847 the weather was warm, the thermometer at 2 P.M. ranging from 88° to 92°. The afternoons were ushered in by strong squalls from the south-west and north-east, with occasional clouds of dust and whirlwinds. These were usually followed by heavy clouds, and by thunder and lightning at night. About four in the evening of the 7th April the wind rose almost to a storm, accompanied by rattling peals of thunder followed by a fall of hail and rain which lasted for an hour. The thermometer which before the storm had stood at 90°, had at its close fallen to 70°. Upwards of half an inch of rain fell. A native man and woman were struck dead by lightning near the Collector's office. During the whole of April 1849 the weather was very trying. Every evening large dense clouds hung over the town and threatened a thunderstorm. But on every occasion they were blown off by a current of high wind and dust, followed by thunder and most vivid lightning. Up to the 24th there were three or four smart showers of rain and one slight hail shower. On the evening of the 2nd of June (1849) an extremely severe storm of wind and rain passed over Belgaum. Slight rain began at four, but the storm did not burst till five. The rain lasted from five till half-past eight during twenty minutes of which there was an awful hailstorm. Such large hailstones had never been seen at Belgaum. They were neither spherical nor oval, but irregular-shaped as if a number of small stones had united in their descent from the clouds. The thunder was deafening and the lightning very vivid and frequent. The hurricane ruined the plantain groves and smaller fruit trees. Five inches of rain were registered in the Highlanders' Hospital and in the fort a little more than two inches. Scarcely a house escaped without being stripped of some of its tiles. Several lives were lost in the neighbourhood of Shahápur about a mile to the south of Belgaum.

Chapter I. Description. Climate. *Rain.*

are never required. The occasional showers of April and May become more frequent and heavy as the south-west rains draw near. So gradual is the approach of the south-west monsoon that in some seasons it is hard to tell which storm is the burst of the true monsoon. The break of the south-west monsoon, which supplies the district with most of its rain, is generally looked for about the 5th of June. The south-west rains last till the middle of October. They are not followed by a period of complete dryness. At Belgaum showers fall during almost every month in the year. In June July and August the air is so moist that stoves or *sigris* are required to dry houses and clothes.[1]

Near the Sahyádris the south-west monsoon is very constant and heavy. Further east it is fitful, coming in showers separated by breaks of fair weather. To the east of a line drawn from Nipáni, through Saukeshvar, Páchápur, Ankalgi, Marihalli, the Yellurgad ridge, and the Malprabha crossing on the Belgaum-Dhárwár road, the decrease of rain is sudden, and is accompanied by a marked change in the look of the country and in the style of the houses. To the west of this line the houses have tiled pent roofs with wide eaves to carry the water clear of the mud walls. To the east of the line the greater number of houses have flat-terraced roofs of beaten mud able to stand only a moderate rainfall.[2] The eastern plain, besides fitful showers from the south-west monsoon, receives a scanty supply from the north-east or Madras monsoon. The north-east monsoon is looked for by the middle of October. But in some seasons it does not burst till the end of October or even till the middle of November. As a rule the north-east monsoon has little effect west of Kaládgi. Its supply of rain is much less and lasts much shorter than the rainfall of the south-west monsoon. Only in exceptional seasons as in 1874 do the north-east rains pass west to the Sahyádris.[3] The general rule regarding the south-west monsoon is that it is heaviest in the west along the crest of the Sahyádris and grows lighter and less certain as it leaves the western hills and passes over the eastern plain. At the same time the distribution of the supply is greatly affected by the lines of the rivers, by hills, and by other local features. In Sampgaon, which is thirty to fifty miles east of the Sahyádris, the fall both from the south-west and north-east rains is ample and certain. If the south-west rains fail, the want is almost sure to be made good by the north-east rains. The eastern villages sometimes suffer from a scanty fall in the south-west monsoon; but a total failure of crops from drought is said to be unknown. In Parasgad, forty to seventy miles from the Sahyádris, the fall of rain varies greatly in different parts; it is plentiful and certain in the west and grows gradually more uncertain as the plain stretches east, where, along the borders of Navalgund and Nargund in Dhárwár, the seasons are uncertain and the crops are liable to fail. In east Parasgad too the supply of drinking water is very scanty, and in some villages, during the hot weather, water has to be carried several miles.

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[1] Climate and season details are compiled from materials supplied by Surgeon-Major C. T. Peters, M.B.

[2] Mr. Foote in Mem. Geo. Surv. XII. 14. [3] Mr. Foote in Mem. Geo. Surv. 15, 16.

The hills which enclose Gokák on the south and west, and which are about sixty miles from the Sahyádris, seem to intercept the monsoon showers and make the plain to the east of them very subject to drought. In the plain to the east it is a common saying that a good monsoon comes only once in twelve years.

Rain[1] returns registered for the twenty-three years ending 1882 at the seven sub-divisional stations give for the whole district an average fall of nearly thirty inches. Arranged in order of rainfall, 1863 and 1865 are lowest with twenty inches; 1860 and 1876 are next with twenty-one inches; 1864 and 1873 third with twenty-two inches; 1871 fourth with twenty-three inches; 1861 and 1872 fifth with twenty-five inches; 1867 sixth with twenty-six inches; 1862 and 1866 seventh with twenty-seven inches; 1869 and 1880 eighth with twenty-eight inches; 1868 ninth with twenty-nine inches; 1881 tenth with thirty-two inches; 1870 eleventh with thirty-three inches; 1875 twelfth with thirty-five inches; 1879 and 1882 thirteenth with thirty-seven inches; 1877 fourteenth with thirty-nine inches; and 1874 and 1878 are highest with forty-one inches. Considering how near the district is to the Sahyádris the average fall of thirty inches is low. In Khánápur, whose sub-divisional station is twenty miles from the Sahyádris and in which are situated nearly all the forest reserves, the yearly rainfall varied from twenty-three inches in 1861 to seventy-seven inches in 1878, and averaged fifty-one inches; and in Belgaum, which is twenty-five miles from the Sahyádris, the fall varied from thirty-three inches in 1880 to seventy-one in 1882, and averaged forty-seven inches; at Chikodi, about fifty miles from the Sahyádris, the fall varied from eight inches in 1869 to thirty-seven inches in 1877, and averaged twenty-one inches; at Gokák, about sixty miles from the Sahyádris, it varied from seven inches in 1876 to thirty-three inches in 1877, and averaged seventeen inches; at Athni, about ninety miles from the Sahyádris, it varied from seven inches in 1876 to thirty-four inches in 1878, and averaged nineteen inches; at Saundatti, about sixty miles from the Sahyádris, it varied from ten inches in 1863 and 1865 to forty-one inches in 1874, and averaged twenty inches; and at Sampgaon, about forty miles from the Sahyádris, it varied from nine inches in 1863 to thirty-eight inches in 1874, and averaged twenty-three inches. The following statement gives the details:

Belgaum District Rainfall, 1860-1882.

Station.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.
Belgaum	38	58	51	53	39	46	46	39	50	49	55	36
Sampgaon	15	22	25	9	16	14	20	19	24	23	27	17
Khánápur	30	23	44	30	27	34	47	36	57	59	66	50
Chikodi	14	23	26	16	18	17	23	26	21	8	23	17
Saundatti	12	14	15	10	23	10	19	26	18	23	25	15
Gokák	10	14	16	12	12	11	18	17	18	22	21	13
Athni	27	20	17	12	13	19	15	18	16	16	18	13
Average ...	21	25	27	20	22	20	27	26	29	28	33	23

[1] The rain figures must be received with caution as in several cases the returns do not agree.

Chapter I. Description. Climate. *Rain.*

Belgaum District Rainfall, 1860-1882—continued.

Station.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	Average.
Belgaum	45	40	57	64	36	46	54	54	33	41	71	47
Sampgaon	15	15	38	34	18	30	37	36	27	26	30	28
Khánápur	51	49	74	67	51	64	77	70	46	70	65	51
Chikodi	16	11	25	23	16	37	34	32	21	22	27	21
Saundatti	15	13	41	20	16	37	28	26	24	26	21	20
Gokák	15	10	26	18	7	33	25	22	21	18	27	17
Athni	20	16	31	28	7	31	34	21	28	24	20	19
Average ...	25	22	41	35	21	39	41	37	28	32	37	29

The following statement gives for the twenty-seven years ending 1882 the rainfall at the town of Belgaum for each month in the year. Of the twelve months in the year, February is the driest month with a fall varying from 0·53 of an inch in 1873 to 0·04 of an inch in 1865, and averaging 0·02 of an inch; January comes next with a fall varying from 0·94 of an inch in 1870 to 0·04 of an inch in 1860, and averaging 0·03 of an inch; December is third with a fall varying from 2·88 of an inch in 1863 to 0·02 of an inch in 1865, and averaging 0·33 of an inch; March fourth, with a fall varying from 2·44 of an inch in 1876 to 0·02 of an inch in 1866, and averaging 0·48 of an inch; November fifth, with a fall varying from 5·37 inches in 1878 to 0·04 of an inch in 1877, and averaging 1·13 inches; April sixth, with a fall varying from 4·85 inches in 1865 to 0·03 of an inch in 1866, and averaging 1·85 inches; May seventh, with a fall varying from 10·68 inches in 1856 to 0·67 of an inch in 1861, and averaging 2·77 inches; September eighth, with a fall varying from 9·26 inches in 1874 to 0·09 of an inch in 1860, and averaging 3·29; October ninth, with a fall varying from 7·97 inches in 1880 to 0·18 of an inch in 1864, and averaging 4·47 inches; August tenth, with a fall varying from 22·43 inches in 1861 to 2·25 inches in 1876, and averaging 8·68 inches; June eleventh, with a fall varying from 17·61 inches in 1862 to 0·54 of an inch in 1881, and averaging 9·85 inches; and July is the wettest month, with a fall varying from 29·37 inches in 1882 to 2·78 inches in 1877, and averaging 14·57 inches. The goodness or badness of a year depends less on the fall for the whole year than on its distribution during the rainy months. In 1871, though the fall was only thirty-six inches, it was not a famine year, because the rain was evenly distributed, eight inches in June and July, seven inches in August, one inch in September, and five inches in October. So also the 1880 fall of thirty-three inches was fairly distributed, five inches falling in June, eight in July, three in August, two in September, and seven in October. On the other hand, the year 1876 with a fall of thirty-six was a famine year, because the rain was badly distributed. Six inches fell in June, twenty-one in July, two in August, one in September, and 0·97 of an inch in October. In 1877 of a fall of forty-six inches, sixteen fell in June, three in July, eight in August, seven in September, and seven in October. Owing to the failure of rain in July the year would have been one of great scarcity, but for a timely fall in September and October. The year of heaviest rainfall was 1882 with seventy-one inches. Next to 1882 were 1875, with sixty-

four inches, and 1861 with fifty-eight inches. The limit of the yearly normal rainfall may be said to be between forty and fifty inches :

Belgaum City Rainfall, 1856-1882.

Month.	1856.		1857.		1858.		1859.		1860.		1861.		1862.		1863.		1864.		1865.		1866.		1867.		1868.		1869.	
	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.
Jan. ...	0	00	0	00	0	00	0	00	0	04	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00
Feb. ...	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	04	0	00	0	00	0	00	0	00
March..	0	00	0	40	0	72	0	36	0	09	0	66	0	37	1	59	0	03	0	38	0	02	0	74	0	66	0	00
April ...	1	56	2	45	1	05	2	87	3	37	0	49	0	37	2	63	1	45	4	85	0	03	0	86	2	32	0	69
May ...	10	63	7	71	6	08	2	87	0	93	0	67	1	11	0	00	2	16	2	96	0	53	1	94	5	22	0	64
June ...	11	66	13	08	3	49	4	98	6	74	4	25	17	61	18	60	8	18	3	91	11	30	7	95	15	04	13	97
July ...	12	10	6	53	13	08	22	61	10	23	25	36	8	79	9	37	19	31	14	68	17	71	11	39	10	06	14	33
Aug. ...	6	33	17	52	4	06	6	11	11	66	22	43	10	41	11	04	6	64	13	88	9	17	7	75	13	08	7	69
Sept. ...	2	86	1	17	2	37	5	24	0	09	2	38	5	13	1	47	1	17	0	27	1	11	1	83	1	26	3	14
Oct. ...	2	57	1	10	6	76	3	40	5	17	1	48	6	20	3	44	0	18	4	21	6	40	6	07	2	49	4	70
Nov. ...	0	08	3	14	1	31	1	74	0	00	0	07	0	19	1	69	0	12	0	31	0	00	0	00	0	00	1	79
Dec. ...	0	16	0	00	0	00	0	00	0	00	0	00	0	77	2	88	0	00	0	02	0	06	0	00	0	00	1	79
Total...	48	00	59	11	38	72	50	18	38	28	57	83	50	95	52	70	39	24	45	51	46	42	38	53	50	13	48	74

Month.	1870.		1871.		1872.		1873.		1874.		1875.		1876.		1877.		1878.		1879.		1880.		1881.		1882.		Average.	
	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.
Jan. ...	0	94	0	83	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	3
Feb. ...	0	00	0	00	0	00	0	53	0	00	0	00	0	00	0	00	0	00	0	05	0	00	0	00	0	00	0	2
March..	0	26	0	43	0	12	0	22	0	00	0	80	2	44	0	00	0	00	0	00	1	59	0	00	1	13	0	48
April ...	2	47	1	33	2	22	2	05	0	60	3	64	1	19	3	66	2	63	0	64	1	58	1	01	2	07	1	85
May ...	2	96	1	84	1	05	5	43	5	04	1	37	0	00	1	23	1	20	5	35	1	13	1	63	3	23	2	77
June ...	9	43	8	33	11	30	4	16	12	64	15	40	6	01	16	43	5	60	13	40	5	30	0	54	16	74	9	85
July ...	18	60	8	22	15	13	14	42	15	31	25	01	21	11	2	78	12	09	8	66	8	72	18	40	29	37	14	57
Aug. ...	8	61	6	54	3	62	4	78	6	26	8	29	2	25	7	69	14	34	17	18	3	63	10	00	6	61	8	68
Sept. ...	6	14	1	65	5	69	4	80	9	26	3	30	1	94	6	63	6	10	1	40	2	54	3	27	8	81	3	29
Oct. ...	5	22	5	24	3	48	3	49	6	76	4	74	0	97	7	42	6	64	3	81	7	97	1	96	2	82	4	47
Nov. ...	0	66	1	85	0	04	0	58	0	77	1	11	0	00	0	04	5	37	4	40	0	59	4	36	0	34	1	13
Dec. ...	0	00	0	00	2	74	0	00	0	09	0	02	0	00	0	60	0	00	0	07	0	09	0	00	0	03	0	33
Total...	55	29	36	24	45	39	40	46	56	64	63	68	35	91	46	48	53	97	54	91	33	05	41	17	71	15	47	47

Information[1] compiled by Mr. Chambers shows that in Belgaum city, during the sixteen years ending 1872, the average number of rain days varied from 0·1 in February to 25·2 in July. The details are :

Belgaum City Rain Days, 1856-1872.

Month.	Days.	Month.	Days.	Month.	Days.	Month.	Days.
January ...	0·2	April ...	4·7	July ...	25·2	October ...	10·8
February ...	0·1	May ...	6·3	August ...	24·3	November..	2·2
March ...	1·5	June ...	20·3	September.	14·2	December..	1·1

The greatest fall recorded in any one day in each month varied from 6·07 inches in August to 0·05 in February. The details are:

Belgaum City Greatest Rain Days, 1856-1872.

Month.	Inches.	Month.	Inches.	Month.	Inches.	Month.	Inches.
January ...	1·06	April ...	2·28	July ...	5·83	October ...	2·87
February ...	0·05	May ...	4·63	August ...	6·07	November..	2·19
March ...	0·83	June ...	5·51	September.	2·20	December..	2·60

[1] The climate details from pages 43-51 are from Chambers' Meteorology of the Bombay Presidency, 131-167.

Chapter I. Description.

Climate.

Warmth.

The two daily observations taken at the Belgaum Observatory at 9-30 A.M. and 3-30 P.M. show for the nineteen years ending 1874 a mean temperature of 77·7. The greatest excess of temperature was 1·0° in 1869 and the greatest decrease was 1·6° in 1857. The details are :

Belgaum City Mean Temperature, 1856-1874.

Year.	Mean.	Over Mean.	Year.	Mean.	Over Mean.	Year.	Mean.	Over Mean.
1856 ...	76·8	−0·9	1863 ...	...	...	1870 ...	77·3	−0·4
1857 ...	76·1	−1·6	1864 ...	77·7	0·0	1871 ...	77·6	−0·1
1858 ...	76·8	−0·9	1865 ...	78·0	+0·3	1872 ...	78·2	+0·5
1859 ...	78·6	+0·9	1866 ...	78·2	+0·5	1873 ...	77·7	0·0
1860 ...	77·9	+0·2	1867 ...	77·3	−0·4	1874 ...	77·0	−0·7
1861 ...	77·9	+0·2	1868 ...	78·4	+0·7			
1862 ...	78·0	+0·3	1869 ...	78·7	+1·0			

At the Belgaum Observatory, which is (1878) in the enclosure of the European General Hospital, besides rainfall, thermometer and barometer readings have been recorded since 1851. The observations are under the charge of the senior medical officer. The record comprises two sets of observations made every day at 9-30 A.M. and at 3-30 P.M., and a complete set of twenty-four hourly observations for one day in every month. The instruments and phenomena noted at each observation include the barometer, dry and wet bulb thermometers, the direction of the wind, the cloudiness, and the rainfall. Once a day the maximum and minimum thermometer reading in the shade, the maximum thermometer reading exposed to the sun's rays during the day time, and the minimum thermometer reading laid upon grass exposed to the sky at night are recorded. The observations are registered on printed forms, which when filled are forwarded by the head of the medical department to the Superintendent of the Colába Observatory in Bombay where the calculations are checked and the results compiled. Once a year the registers and compilation are sent by the Superintendent to Government to be forwarded to Her Majesty's Secretary of State for India. In the Belgaum Observatory the self-registering thermometers are placed in a wooden revolving stand, at a distance of 18½ feet from the nearest building, and four feet from the ground: they are fully exposed to the air, and protected from the sun's rays, but it is impossible to prevent rain from getting at them during the revolving storms which occur at the beginning of the south-west monsoon. The thermometer readings are supposed to be too high, as the stand is not suited to a tropical sun. The barometer, and dry and wet bulb thermometers are in a shed in the north-east veranda of the hospital guard-house. The shed which measures thirteen feet by eight by six is built of wooden bars two inches apart; it has a flagged floor, and a post in the middle stretching from floor to roof: this post supports the barometer on one side and the dry and wet bulb thermometers on the other side, the thermometers being four feet seven inches from the floor and two feet seven inches and three feet one inch from the wall.

An examination of the temperature returns in the city of Belgaum for the nineteen years ending 1874 shows that during five months in the year February, March, April, May and June the temperature was

above, and that during the seven remaining months the temperature was below the mean. Adopting the return corrected for the daily inequality, August was the coldest month with an average of 3·3° below the mean, December came next with 3·2°, January third with 2·9°, July fourth with 2·4°, September fifth with 2·2°, November sixth with 1·5°, and October seventh with 0·3°. Of the five hot months February and June are the coolest with 0·4° in excess of the mean, March comes next with 3·8°, May next with 4·7°, and April is the hottest, being 6·4° above the mean. The details are :

Belgaum City Monthly Temperature, 1856 - 1874.

Month.	At 9-30 A.M. and 9-30 P.M.	Corrected.	Month.	At 9-30 A.M. and 9-30 P.M.	Corrected.
January ...	−2·1	−2·9	July ...	−4·8	−2·4
February...	+2·1	+0·4	August ...	−5·0	−3·3
March ...	+6·1	+3·8	September.	−3·3	−2·2
April ...	+8·2	+6·4	October ...	−1·0	−0·3
May ...	+5·8	+4·7	November..	−1·6	−1·5
June ...	−1·5	+0·4	December..	−2·9	−3·2

The corrections are found from the daily inequalities at the several hours in each month. They are the means of these inequalities for the hours 9 A.M. and 10 A.M. and 3 P.M. and 4 P.M., and are applied subtractively.

The following table shows for the city of Belgaum, for each month, for the monsoon quarter June to August, and for the whole year, the excess of the mean temperature at the several hours of the day above the mean temperature of the twenty-four hours; also the number of complete days' observations, which are generally not more than one in each month, of the year from which the means are derived :

Belgaum Temperature in Local Civil Hours, 1856 - 1874.

Month.	6	7	8	9	10	11	12	13
January	−8·2	−7·3	−4·6	−1·2	+2·0	+4·4	+6·3	+7·9
February	−9·3	−7·9	−4·0	0·0	+3·2	+5·8	+7·6	+9·2
March	−8·3	−6·6	−3·1	+0·7	+4·0	+6·7	+8·6	+10·1
April	−7·8	−5·6	−2·3	+0·5	+4·8	+7·2	+9·3	+10·8
May	−6·0	−4·3	−2·1	+0·4	+2·8	+5·4	+7·8	+9·2
June	−2·4	−1·3	−0·3	+0·9	+2·1	+2·9	+2·5	+4·2
July	−1·8	−1·1	−0·6	+0·8	+1·6	+2·2	+2·3	+2·8
August	−2·7	−2·0	−0·7	+0·8	+2·1	+3·0	+3·9	+4·3
September	−3·5	−2·5	−1·0	+0·6	+2·5	+4·1	+5·3	+5·7
October	−4·4	−3·5	−1·9	−0·2	+1·9	+3·7	+4·7	+5·5
November	−6·7	−5·8	−3·4	−0·2	+2·2	+4·1	+5·5	+6·4
December	−7·2	−6·4	−4·0	−0·6	+2·2	+4·1	+5·8	+6·9
June to August ...	−2·3	−1·5	−0·3	+0·8	+1·9	+2·7	+3·2	+3·8
Year	−5·7	−4·5	−2·3	+0·2	+2·6	+4·5	+5·9	+6·9

Month.	14	15	16	17	18	19	20	21
January	+9·0	+9·6	+9·1	+7·8	+5·1	+3·3	+0·6	−1·0
February	+10·4	+10·2	+9·6	+8·1	+5·9	+2·3	+0·4	−1·7
March	+11·1	+10·9	+9·8	+7·7	+4·0	+0·8	−1·6	−2·9
April	+11·4	+10·4	+8·1	+5·0	+2·3	+0·3	−1·5	−2·6
May	+10·0	+9·3	+7·8	+5·1	+1·9	−0·2	−1·5	−2·5
June	+3·8	+3·0	+2·3	+1·6	+0·4	−0·5	−0·9	−1·2
July	+3·0	+2·4	+1·8	+1·3	+0·3	−0·2	−0·6	−0·9
August	+4·2	+3·7	+3·0	+1·9	+0·6	−0·4	−1·1	−1·4
September	+5·4	+5·0	+4·0	+2·3	+0·7	−0·2	−1·0	−1·6
October	+5·9	+6·0	+5·6	+4·3	+2·1	+0·8	−0·3	−1·1
November	+7·4	+7·4	+6·7	+5·7	+3·6	+2·0	+0·6	−0·9
December	+7·9	+8·1	+7·7	+6·4	+4·2	+2·2	+0·3	−0·7
June to August ...	+3·7	+3·0	+2·4	+1·6	+0·4	−0·4	−0·9	−1·2
Year	+7·5	+7·2	+6·3	+4·8	+2·6	+0·9	−0·5	−1·5

Chapter I.

Description.

Climate.

Warmth.

Belgaum Temperature in Local Civil Hours, 1856-1874—continued.

Month.	22	23	0	1	2	3	4	5	Complete Days.
January ...	−2·1	−3·7	−4·1	−5·4	−6·1	−6·7	−6·9	−7·6	16
February ...	−2·6	−3·9	−5·3	−6·1	−6·8	−7·4	−8·2	−8·3	17
March ...	−4·0	−5·0	−5·7	−6·5	−7·0	−7·9	−8·3	−8·6	17
April ...	−3·6	−4·2	−5·2	−6·0	−6·7	−7·5	−8·1	−8·0	17
May ...	−3·4	−4·4	−4·9	−5·2	−5·7	−6·0	−6·5	−6·8	17
June ...	−1·6	−1·9	−2·2	−2·2	−2·5	−2·8	−2·8	−2·7	17
July ...	−1·2	−1·4	−1·5	−1·5	−1·7	−1·8	−1·8	−1·9	17
August ...	−1·8	−2·0	−2·3	−2·4	−2·7	−2·8	−2·9	−3·1	16
September ...	−2·1	−2·5	−2·7	−3·2	−3·2	−3·5	−3·6	−3·9	16
October ...	−1·6	−2·4	−2·8	−3·5	−3·9	−4·4	−5·0	−5·1	16
November ...	−1·9	−2·6	−3·6	−4·5	−5·0	−5·4	−5·8	−6·3	13
December ...	−1·7	−2·5	−3·3	−4·2	−5·0	−5·7	−6·5	−7·0	13
June to Aug.	−1·5	−1·8	−2·0	−2·0	−2·3	−2·5	−2·5	−2·6	
Year	−2·3	−3·0	−3·6	−4·2	−4·7	−5·1	−5·5	−5·8	

The average daily range of temperature for the year is almost double the range for the wet months from June to August. The range during the cold half-year is generally large, compared with the range of the hot and wet half. The daily range for the year is 13·3° and for the wet months 6·4°.

A comparison of the range of the mean temperatures of the different months for the same series of years shows that the variation is least 11·5° in July, August comes second with 12·4°, June third with 16·3°, September fourth with 16·5°, October fifth with 21·7°, November sixth with 23·9°, December seventh with 25·4°, May eighth with 27·5°, January ninth with 28·3°, February tenth with 30·1°, April eleventh with 32·0°, and March twelfth with 32·8°. The details are :

Belgaum City Daily Range, 1856-1874.

Month.	Mean Maximum.	Mean Minimum.	Range.	Annual Variation.	Month.	Mean Maximum.	Mean Minimum.	Range.	Annual Variation.
January ...	86·1	57·8	28·3	+5·1	August ...	78·3	65·9	12·4	−10·8
February...	80·8	59·7	30·1	+6·9	September.	81·4	64·9	16·5	−6·7
March ...	96·0	63·2	32·8	+9·6	October ...	86·2	64·5	21·7	−1·5
April ...	98·4	66·4	32·0	+8·8	November..	85·0	61·1	23·9	+0·7
May ...	94·5	67·0	27·5	+4·3	December..	84·1	58·7	25·4	+2·2
June ...	83·3	67·0	16·3	−6·9					
July ...	78·0	66·5	11·5	−11·7	Year ...	86·8	63·6	23·2	

During the same period the highest recorded monthly mean temperature varied from 92·5 in July to 109·5 in April, and the lowest from 46·7 in December to 62·7 in July. The details are :

Belgaum City Highest and Lowest Monthly Temperature, 1856-1874.

Month.	Maximum.	Minimum.	Range.	Month.	Maximum.	Minimum.	Range.
January ...	95·4	50·0	45·4	July ...	92·5	62·7	29·8
February...	99·7	47·3	52·4	August ...	93·5	61·5	32·0
March ...	103·9	50·2	53·7	September.	93·0	59·4	33·6
April ...	109·5	54·4	55·1	October ...	95·7	53·0	42·7
May ...	108·2	59·0	49·2	November..	94·0	49·0	45·0
June ...	103·1	61·2	41·9	December..	92·6	46·7	45·9

The following statement gives for each of the six years ending 1882 the thermometer readings taken at Belgaum :

BELGAUM CITY HIGHEST AND LOWEST MONTHLY TEMPERATURE, 1877-1882.

YEAR.	January.			February.			March.			April.			May.			June.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1877	79	62	73	89	64	71	93	68	80	93	71	89	100	70	90	92	71	78
1878	78	64	72	88	63	73	96	67	82	97	73	83	95	74	83	95	72	79
1879	81	61	70	87	64	73	93	62	78	99	70	84	101	71	80	86	70	74
1880	84	58	68	86	64	75	98	70	79	99	71	72	97	74	79	90	69	76
1881	82	56	73	86	59	71	96	65	85	97	[illegible]	84	99	71	84	95	73	80
1882	83	60	71	88	61	73	89	63	77	90	[illegible]	84	89	74	85	85	71	76

YEAR.	July.			August.			September.			October.			November.			December.		
	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
1877	84	70	76	81	70	74	82	71	75	81	68	75	84	60	72	84	62	76
1878	85	70	76	85	71	76	86	72	78	85	70	77	83	64	74	82	68	69
1879	87	70	74	78	70	72	80	67	71	81	68	70	80	58	69	81	59	67
1880	71	69	70	78	68	72	76	69	72	85	67	81	82	65	76	81	58	71
1881	80	71	73	81	70	73	80	67	73	83	66	74	84	61	69	82	57	71
1882	83	70	74	79	70	74	77	70	73	84	65	75	84	62	74	83	61	71

The mean is the mean of four daily observations.

Pressure.

The mean barometric pressure for each year of complete observation is shown for the city of Belgaum in the following table. The means are derived from two daily observations one at 9-30 A.M. the other at 3-30 P.M. : *BELGAUM CITY BAROMETRIC PRESSURE, 1856-1874.*

YEAR.	Mean.	Excess.	YEAR.	Mean.	Excess.	YEAR.	Mean.	Excess.
1856 ...	27·369	+·046	1863 ...	...	...	1870 ...	27·289	−·034
1857 ...	27·326	+·003	1864 ...	27·345	+·022	1871 ...	27·304	−·019
1858 ...	27·331	+·008	1865 ...	27·338	+·015	1872 ...	27·292	−·031
1859 ...	27·325	+·002	1866 ...	27·335	+·012	1873 ...	27·303	−·020
1860 ...	27·324	+·001	1867 ...	27·337	+·014	1874 ...	27·298	−·025
1861 ...	27·322	−·001	1868 ...	27·331	+·008			
1862 ...	27·302	−·021	1869 ...	27·308	−·015			

The observations during the same series of years (1856-1874) show that, in the six months between October and April, the barometric pressure is over the mean, and in the six months between April and October the pressure is below the mean. The month of least pressure is June with 0·096 below the mean, July is next with 0·095, August third with 0·062, May fourth with 0·049, September fifth with 0·025, and April sixth with 0·016. Of the six months of excessive pressure, October is lowest with 0·011, March second with 0·030, November third with 0·062, February fourth with 0·064, December and January fifth and sixth with 0·089 each. The details are : *BELGAUM CITY MONTHLY BAROMETRIC VARIATION, 1856-1874.*

MONTH.	At 9-30 A.M. and 3-30 P.M.	Corrected.	MONTH.	At 9-30 A.M. and 3-30 P.M.	Corrected.
January ...	+·094	+·089	July ...	−·096	−·095
February...	+·067	+·064	August ...	−·062	−·062
March ...	+·030	+·030	September.	−·032	−·025
April ...	−·019	−·016	October ...	+·009	+·011
May ...	−·048	−·049	November..	+·065	+·062
June ...	−·098	−·096	December..	+·089	+·089

Chapter I. Description. Climate. *Pressure.*

In the following table are shown for Belgaum, for each month and for the whole year, the excesses of the mean barometric pressure at the several hours of the day above the mean barometric pressure for the twenty-four hours :

Belgaum City Hourly Barometric Pressure, 1856-74.

Month.	Local Civil Hours.							
	0	7	8	9	10	11	12	13
January	+·012	+·028	+·050	+·066	+·065	+·046	+·022	—·010
February	+·005	+·025	+·046	+·061	+·058	+·045	+·023	—·005
March	·000	+·022	+·045	+·059	+·059	+·048	+·027	—·001
April	+·012	—·027	+·046	+·056	+·055	+·045	+·028	—·001
May	+·014	+·028	+·043	+·055	+·055	+·035	+·017	—·002
June	—·006	+·006	+·020	+·030	+·026	+·020	+·011	—·000
July	—·008	+·002	+·016	+·024	+·030	+·024	+·016	+·001
August	—·004	+·009	+·026	+·038	+·038	+·030	+·016	+·001
September	—·007	+·012	+·032	+·042	+·037	+·026	+·010	—·015
October	+·004	+·021	+·040	+·050	+·048	+·032	+·009	—·016
November	+·011	+·029	+·019	+·065	+·064	+·042	+·014	—·015
December	+·002	+·020	+·041	+·053	+·056	+·040	+·017	—·013
Year	+·003	+·019	+·038	+·050	+·049	+·036	+·017	—·007
June to August ...	—·006	+·006	+·021	+·031	+·031	+·025	+·014	+·001

Month.	Local Civil Hours.							
	14	15	16	17	18	19	20	21
January	—·033	—·049	—·051	—·044	—·033	—·016	·000	+·010
February	—·031	—·046	—·052	—·045	—·033	—·016	+·001	+·016
March	—·025	—·046	—·055	—·048	—·035	—·017	—·002	+·014
April	—·030	—·049	—·056	—·049	—·032	—·017	—·007	+·009
May	—·024	—·041	—·051	—·047	—·033	—·019	—·003	+·007
June	—·011	—·023	—·029	—·028	—·017	—·005	+·007	+·013
July	—·010	—·019	—·028	—·027	—·020	—·009	+·004	+·014
August	—·015	—·027	—·037	—·031	—·022	—·008	+·006	+·020
September	—·033	—·047	—·049	—·039	—·029	—·013	+·005	+·021
October	—·038	—·049	—·048	—·036	—·020	—·004	+·011	+·020
November	—·039	—·051	—·054	—·044	—·032	—·014	+·005	+·017
December	—·035	—·046	—·049	—·039	—·029	—·014	+·002	+·014
Year	—·027	—·041	—·047	—·040	—·028	—·013	+·002	+·014
June to August ...	—·012	—·023	—·031	—·029	—·020	—·007	+·006	+·016

Month.	Local Civil Hours.								Complete Days.
	22	23	0	1	2	3	4	5	
January ...	+·013	+·008	—·002	—·008	—·017	—·025	—·025	—·014	16
February ...	+·018	+·014	+·003	—·009	—·016	—·033	—·022	—·011	17
March ...	+·020	+·014	+·005	—·008	—·016	—·022	—·023	—·015	17
April ...	+·016	+·015	+·002	—·008	—·017	—·019	—·015	—·004	17
May ...	+·013	+·016	+·009	—·004	—·014	—·020	—·018	—·006	17
June ...	+·020	+·021	+·012	+·001	—·007	—·016	—·021	—·022	17
July ...	+·019	+·017	+·011	—·001	—·009	—·017	—·019	—·013	17
August ...	+·026	+·020	+·006	—·006	—·016	—·025	—·026	—·021	16
September ...	+·029	+·022	+·014	+·005	—·004	—·008	—·011	·000	16
October ...	+·024	+·015	+·006	—·006	—·013	—·021	—·024	—·015	16
November ...	+·023	+·015	+·005	—·004	—·015	—·022	—·024	—·015	13
December ...	+·019	+·011	+·008	—·001	—·010	—·016	—·016	—·005	13
Year	+·020	+·015	+·006	—·004	—·013	—·020	—·021	—·012	
June to August.	+·022	+·019	+·010	—·002	—·011	—·019	—·022	—·019	

The following table shows for each month of the year the greatest and least values of the barometric pressures observed at 9-30 A.M. and at 3-30 P.M. :

Belgaum City Monthly Range of Barometric Pressure, 1856-1874.

Month.	Maximum.	Minimum.	Range.	Month.	Maximum.	Minimum.	Range.
January ...	27·624	27·192	·432	July ...	27·411	27·078	·333
February...	27·602	27·200	·402	August ...	27·426	27·104	·322
March ...	27·534	27·185	·349	September..	27·470	27·085	·385
April ...	27·538	27·111	·427	October ...	27·518	27·085	·433
May ...	27·466	27·082	·384	November ..	27·599	27·196	·403
June ...	27·403	27·043	·360	December ..	27·650	27·202	·448

Vapour.

The values of the pressure of vapour made use of have been calculated by Glaisher's Hygrometrical Tables from the observed temperatures of the dry and wet bulb thermometers. The annual variations give high values of the vapour pressure in the hot and wet months, that is from May to September, and low values in the cold months. The month of maximum pressure is June. The mean daily variation for the year shows a minimum towards the end of the night hours with a fairly regular progress during the intervals. The variation during the wet months has high values during the day and low values during the night. The daily range of the wet months is very small compared with the daily range of the cold months, and the low range continues till late in the year with the late continuance of the rains.

The following table shows for the nineteen years ending 1874 the mean pressure of vapour from observations taken at 9-30 A.M. and at 3-30 P.M.

Belgaum City Pressure of Vapour, 1856-1874.

Year.	Mean.	Excess.	Year.	Mean.	Excess.
	In.	In.		In.	In.
1856 ...	·634	+·044	1866 ...	·571	−·019
1857 ...	·580	−·010	1867 ...	·643	+·053
1858 ...	·615	+·025	1868 ...	·602	+·012
1859 ...	·571	−·019	1869 ...	·586	−·004
1860 ..	·560	−·030	1870 ...	·594	+·004
1861 ...	·551	−·039	1871 ...	·599	+·009
1862 ...	·585	−·005	1872 ...	·619	+·029
1863 ...	...	...	1873 ...	·608	+·018
1864 ...	·547	−·243	1874 ...	·599	+·009
1865 ...	·595	+·005			

Clouds.

The cloudiness of the sky is estimated in lengths of the celestial hemisphere, the unit being one-tenth of the whole sky. Cloudiness is great during the wet months, and small during the cold months. The following table shows the average cloudiness of the sky in each month of the year from observations taken at 9-30 A.M. and 3-30 P.M., during the same series of nineteen years :

Belgaum City Cloudiness, 1856-1874.

Month.	Tenths.	Month.	Tenths.
January	2·7	July	8·6
February	2·3	August	8·4
March	3·1	September	7·6
April	4·1	October	6·0
May	5·2	November	4·0
June	8·2	December	3·0
		May to October	7·3
		November to April	3·2
		Year	5·3

Chapter I. Description. Climate. *Winds.*

From March to September the prevailing winds are from the west and south, and from October to February from the east and north. The easterly element continues to some extent until April or May, and does not cease until the south-west rains begin. On the other hand, the westerly element is present all the year round, beginning at about two or three in the afternoon and continuing until eight the following morning. Thus during the fair and during the hot months, that is from November till May, while the sun is above the horizon, the wind blows from inland, and towards the interior when the sun is below the horizon. This shows that the prevailing Belgaum winds are essentially different from the coast winds, where in the fair season the land wind blows at night and the sea breeze during the day. The winds of May and October are intermediate between those of the south-west monsoon and those of the dry weather. The observations of the direction of wind taken at Belgaum at 9-30 A.M. and 3-30 P.M. have been grouped together in months. Each group includes the observations of the nineteen years ending 1874 for each month. The following are the results:

Belgaum Winds, 1856-1874.

Direction.	At 9-30 A.M.											
	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
N. ...	13	33	50	54	29	4	...	4	7	46	16	11
N.N.E. ...	...	...	2	6	...	1	...	...	...	1	...	...
N.E.N.	68	79	106	92	28	6	1	7	7	62	109	66
E.N.E. ...	4	12	8	11	2	...	...	1	1	9	2	2
E. ...	162	103	78	53	11	3	1	2	5	114	232	232
E.S.E. ...	15	15	4	6	...	1	...	1	...	12	24	16
S.E. ...	135	82	42	24	6	5	...	...	1	34	57	111
S.S.E. ...	10	3	4	2	...	...	...	...	...	3	5	7
S. ...	29	25	20	20	12	8	...	2	3	35	12	6
S.S.W. ...	1	...	...	1	...	10	5	1	...	...	...	...
S.W. ...	29	31	50	65	64	156	191	109	78	29	8	10
W.S.W. ...	...	...	1	...	4	19	40	57	23	2	1	...
W. ...	23	52	84	81	265	269	238	316	305	101	8	8
W.N.W. ...	...	2	2	4	12	6	12	8	17	1	...	...
N.W. ...	...	15	28	33	55	11	...	8	27	17	3	3
N.N.W. ...	...	1	1	3	8	...	...	...	2	...	...	...
Calm ...	38	26	47	55	31	9	6	11	34	59	33	24
Sums ...	527	479	527	510	527	508	494	527	510	525	510	496

Direction.	At 3-30 P.M.											
	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
N. ...	9	12	16	13	7	...	...	...	3	28	21	7
N.N.E. ...	...	2	1	...	...	...	...	...	...	...	1	..
N.E. ...	60	79	40	37	4	1	1	...	5	68	110	100
E.N.E. ...	4·5	8	2	3	...	...	...	...	1	2	2	...
E. ...	173·5	104	80	32	6	1	...	3	2	113	233	243
E.S.E. ...	11	4	1	2	...	...	...	...	...	6	13	11
S.E. ...	87	50	30	18	4	...	1	...	4	23	23	53
S.S.E. ...	3	4	1	1	...	...	...	1	...	1	2	2
S. ...	26	23	17	10	7	5	1	..	3	43	18	9
S.S.W. ...	2	...	...	...	1	7	8	6	1	...	1	...
S.W. ...	53	76	123	135	114	167	191	106	83	55	7	23
W.S.W. ...	1	1	3	7	15	29	45	44·5	23	8	...	3
W. ...	34	84	167	212	333	268	237	356·5	350	117	14	5
W.N.W. ...	...	1	1	2	10	5	2	1	7	2	...	...
N.W. ...	4	10	25	11	22	4	1	4	8	14	5	2
N.N.W. ...	...	...	...	2	...	...	...	...	...	...	...	...
Calm ...	59	21	20	19	4	4	8	5	20	45	49	38
Sums ...	527	479	527	510	527	491	495	527	510	525	509	496

The coefficients and angles of formula representing the daily variation in the duration of different winds are :

Belgaum City Duration of Winds, 1856-1874.

Hours.	November to January.				February to April.				June to September.				Total.			
	c1	c1	c2	c2	c1	c1	c2	c2	c1	c1	c2	c2	c1	c1	c2	c2
		° ′		° ′		° ′		° ′		° ′		° ′		° ′		° ′
6 ...	1·11	78 35	1·17	164 11	·49	291 22	·68	161 2	1·87	253 53	1·52	149 33	·53	254 39	1·14	157 16
7 ...	1·13	81 52	1·21	163 2	·41	278 20	·73	172 53	1·87	253 13	1·51	148 0	·56	248 0	1·14	162 41
8 ...	1·06	80 48	1·08	162 44	·22	333 26	·80	146 29	1·86	254 41	1·48	150 50	·47	251 34	1·13	154 48
9 ...	1·39	92 53	0·96	182 59	·22	65 46	·72	146 19	1·86	253 25	1·48	150 30	·35	229 34	·97	161 56
10 ...	1·55	98 55	0·80	198 53	·27	70 12	·82	165 7	1·87	255 9	1·53	152 12	·35	226 10	1·00	166 40
11 ...	1·58	95 13	0·87	203 38	·51	79 48	·59	194 45	1·86	256 56	1·50	155 9	·25	216 52	·89	174 14
12 ...	1·68	92 23	1·05	186 2	·57	87 59	·73	175 18	1·86	253 25	1·46	148 10	·25	198 26	·97	163 49
13 ...	1·72	90 20	1·17	186 53	·73	67 19	·35	154 53	1·83	251 52	1·41	145 24	·19	188 58	·90	159 9
14 ...	1·65	97 18	1·08	185 52	·52	76 46	·95	146 39	1·75	252 42	1·33	145 43	·26	204 37	1·07	156 48
15 ...	1·48	98 11	1·01	184 32	·07	146 19	1·20	155 22	1·81	250 58	1·35	145 15	·43	224 4	1·13	155 56
16 ...	1·39	96 12	1·23	186 5	·37	239 18	1·17	153 39	1·85	251 4	1·47	145 14	·51	231 20	1·22	155 19
17 ...	1·27	92 15	1·27	183 36	·47	252 43	1·18	154 18	1·87	255 27	1·54	154 36	·58	246 32	1·26	162 0
18 ...	·85	104 22	1·08	184 14	·75	263 4	1·44	158 25	1·88	255 13	1·54	152 36	·76	248 29	1·31	160 19
19 ...	·60	107 32	1·06	166 21	1·36	264 5	1·58	173 40	1·90	255 58	1·59	153 55	1·00	253 44	1·38	162 13
20 ...	·39	94 24	1·12	164 29	1·39	265 2	1·61	173 35	1·88	253 36	1·53	148 54	1·04	255 2	1·38	160 54
21 ...	·47	106 7	1·10	175 19	1·27	257 43	1·51	164 39	1·88	255 49	1·56	154 6	1·02	252 17	1·36	161 34
22 ...	·42	98 8	1·20	170 23	1·26	263 9	1·38	171 13	1·87	256 42	1·54	156 36	1·02	256 22	1·37	163 25
23 ...	·48	79 9	1·15	155 26	1·17	261 58	1·46	172 9	1·87	254 29	1·52	151 45	·96	255 32	1·34	159 57
0 ...	·46	98 51	1·24	157 10	1·24	259 19	1·18	165 14	1·89	256 51	1·58	156 11	·99	255 58	1·34	160 21
1 ...	·53	70 12	1·20	161 34	1·38	261 42	1·27	172 46	1·89	256 33	1·59	154 43	1·03	258 48	1·35	161 26
2 ...	·57	62 59	1·04	155 39	1·26	272 16	1·31	180 0	1·89	257 8	1·59	156 40	·98	261 13	1·27	161 42
3 ...	·61	64 32	1·07	151 31	1·23	275 37	1·07	179 27	1·89	255 36	1·58	153 16	·95	263 19	1·19	159 54
4 ...	·68	65 42	1·14	150 30	1·00	283 7	1·16	188 24	1·88	254 56	1·57	151 48	·86	223 42	1·22	160 23
5 ...	·72	67 1	·99	151 7	·82	282 41	1·23	175 49	1·88	255 49	1·54	153 46	·80	263 30	1·25	159 49
Means ...	·97	90 0	1·06	172 52	·54	270 0	1·07	167 32	1·87	254 46	1·51	151 34	·65	250 10	1·19	160 48
Complete Days.	42				47				63				183			