

"The predisposing causes may be considered over-exertion, insufficient diet, bad forage, and impure water.

"The symptoms by which the disease may be recognized may be of intense or comparatively mild form, according to the intensity of the attack. When the disease assumes a malignant form, great depression of the vital powers rapidly occurs. The patient may be found trembling, showing more or less symptoms of stupor; the eyes half closed; head pendant; respiration accelerated; the mouth, eyes, throat, and glands in the region of the throat and jaws swelled; mucous membranes highly congested, and of a dark hue; petechial spots on gums, and the mucous membrane of the gums of a very dark colour, with more or less yellowish tint; the tongue is also enlarged and coated; mouth dry, and breath offensive; sometimes the patient ; generally complete loss of appetite; pulse very feeble and quick, frequently hardly perceptible; the circulation of the blood seems to be all but stopped; at the submaxillary artery the current is in severe cases, not to be felt; effusion of serum and bloody serum in areolar tissue of the swelled parts; cough, and generally cough of a marked kind, when present, the patient does not lie down, or only lies a short time; sometimes no cough, and in such cases the pulse will be found not only very feeble, but irregular and intermitted, significant of cardiac disorder. Great difficulty in swallowing, and in severe cases attendant with symptoms of choking; and when this is the case, signs of the lungs having become involved are more speedily evinced, even to the threatening of asphyxia; nasal discharge thick, and sometimes bloody, in the latter stages frothy; bowels occasionally constipated, and fæces coated with bloody mucus; urine scanty, and of a high colour; fever continued. As the disease advances the above symptoms become more urgent, and soon evince whether the throat, windpipe, bronchiæ, and lungs are, or the heart, is chiefly affected. In some few cases, the symptoms are those associated with disordered stomach. These symptoms continue from one hour to several days, according to the intensity of attack. Relapse occasionally occurs from ten days to three weeks after the first recovery. Cases of relapse seldom recover.

Symptoms.

"The treatment consists in the administration of diffusible stimulants, such as spirits of nitrous ether, carbonate of ammonia, or, when these are not to be obtained, brandy or rum in frequent doses; also of camphor and nitre twice a-day. Mustard embrocations or stimulants of cantharides should be applied to the sides when pneumonic symptoms predominate, and a stimulant over the left side when cardiac symptoms prevail. When febrile symptoms abate, quinine in one or two-drachm doses, with stimulants of ether or brandy, may be given morning and evening. Enemata of warm water, if the bowels be constipated, warm clothing, with bandages at night whenever the climate is cold at night. The diet consists of gruel, green grass, and boiled grain; and a small quantity of common salt should be given in all food and drink.

Treatment.

"The patient should be kept as quiet as possible, well sheltered from the sun by day, and from the cold by night. Exercise should be forbidden. In cases where exercise had been unwisely given, the patient has suddenly fallen down and died. The treatment above recommended I have found successful in most cases I have had to treat; but I must note that the cases I have had under treatment have been in the highlands, where the disease generally assumes a comparatively mild form, and cases that have occurred within twelve or fourteen days after the arrival of the horses from the lowlands and passes up to the highlands, the districts in which the disease itself, or the seeds of the disease, are contracted, and where it occurs in a more malignant form.

"The *post-mortem* appearances will of course depend on what particular organs are affected during life. In cases where cardiac symptoms have predominated, the peri-

“cardium will be found so distended with serum of a yellow or bloody colour, that the
“serum will spurt out some feet on the sac being punctured. The heart itself is found
“very soft in texture and dark in colour; and with very slight pressure the finger is easily
“pushed through its structure. The pericardium covering the heart is covered more of
“less with petechia, and these are found to be more abundant on the endocardium
“especially at the roots of the bicuspid and tricuspid valves and elevated portions of both
“ventricles; and between the valves and walls of the heart more or less yellow fibrinous
“clots are collected. The blood in the heart and circulatory system generally is semi-
“coagulated, and more or less resembling treacle.

“When the disease has chiefly affected the lungs, these organs are found more or less
“hepatized. In cases that have been of very rapid course, the hepatization consists of the
“escape of blood into the substance of the lungs; in those that have been of comparatively
“protracted course, the hepatization is of a more usual kind, and clots of yellow fibrinous
“deposit may be observed throughout the structure of the lungs, leading to the appearance
“somewhat like grey hepatization; but the deposits are soft and yielding, not hard and
“compact, as in true grey hepatization. The trachea, bronchiæ, and air-cells are full of
“mucous effusion; and from the admixture of air seem choked with frothy mucus. The
“mucous membrane throughout the aerial passages show ptechiæ in abundance, especially
“well-marked and very dark in the neighbourhood of the epiglottis and ridges of larynx.
“In some cases, the villous coat of the stomach is found of a dark-red or even purple colour;
“in one case a portion of it was all but black, an appearance that might be mistaken for
“the effects of irritant poisoning; ulceration or perforation not present; the structure
“of the walls of the stomach softened. In a few cases, where great difficulty of degluti-
“tion had been observed during life, and symptoms of choking occurred, the œsophagus was
“found impacted with food, and in two instances some portions of food were found in the
“trachea and bronchiæ.

“In conclusion, I would beg to state that, although the losses from the disease were
“at first considerable, since the horses have not been kept at Zula or the lowlands, but
“sent up by usual marches through the Suru Pass to Senafè, very few horses have been
“attacked, and those that have become affected have had the disease in a mild form, only
“one or two deaths having occurred. Indeed, I believe that horses may now be imported
“to Zula, and sent to Senafè during the dry season, without losing more than one or two
“per cent. from the disease.

“Of the 454 horses of the 3rd Regiment of Sind Horse so brought from Zula to
“Senafè, not one horse became affected.

CHAPTER XXXIII.

ENGINEER DEPARTMENT.

HIS ROYAL HIGHNESS the Field-Marshal Commanding-in-Chief, on the 26th September, 1867, transmitted to the Secretary of State for War a letter from the Director of the Royal Engineer Establishment, containing a proposal to send out the materials for constructing a railway in Africa for the use of the Force to and from the point of disembarkation. Proposal to
to send out
railway
materials.

The proposition of the Director of the Royal Engineer Establishment was to send out a contractor's line of railway, with about 500 navvies, who might be increased afterwards, if necessary, to follow up the Army, laying the rails as fast as they could. He proposed that this railway should be laid following the sinuosities of the ground, with as nearly as possible a regular slope ascending to the table land, that it should have a gauge of $3\frac{1}{2}$ feet, laid on cross sleepers 5 feet long ($9'' \times 4''$ section), and be worked with light open waggons (to be constructed for the special purpose) by mule or horse traction. He further proposed that the materials should be sent forthwith from England for it, and to form an independent wharf sufficient for its own purposes, and that the whole work should be constructed, subject of course to the directions of the Commander-in-Chief, as a distinct operation, each section being brought into use for the Army as completed. Description.

The Director considered that tonnage to the extent of 1,000 tons would suffice for the materials and tools for the construction of five miles of such a railway, and for a large proportion of the staff; and that 2,000*l.* per mile allowed a wide margin to cover all expenses, if 30 miles of the railway only were constructed, exclusive of rolling stock, the cost of which would depend upon the amount of traffic. He considered that if the railway were constructed, one mule would probably do the work of 20 with pack-saddles, and if it only extended across the low lands to the foot of the hills, it was more than probable, the nature of the country being considered, that it would more than pay itself in money in a few months, and that it would undoubtedly be the means of saving many valuable lives. Tonnage
required.

As to the time requisite for its construction, he considered that 500 able-bodied navvies could lay two or three miles a week, across a level country, where there was not much earthwork, and it was not improbable that they might, in ascending, continue to advance at a very good rate, so that by increasing the number of workmen, if the Expedition did not come to an end before the commencement of the rainy season in March, the railway might by that time be completed up to the table land or any other point indicated by the General in command. Time re-
quired for
construc-
tion.

This project was not, however, entertained, for it appeared that the Government of Bombay had already had the subject under consideration, and were prepared, if required, to furnish both labour and materials from India; they, however, entertained doubts of the expediency of incurring the heavy expenses requisite until the features of the country were better known.

Railway
material
ordered in
Bombay.

Shortly after, however, the arrangements for the construction of a railway were commenced at Bombay, and the Chief Engineer received orders, on the 8th November, to obtain the following material and rolling stock:—40-pound rails, with spikes and sleepers sufficient for 20 miles, allowing for sidings, &c.; 60 trucks, 5½-gauge; 6 locomotive tank engines, turn-tables, switches, crossings, signals for 30 miles of line; a small fitting and repairing shop, with establishments for fitting, working the line, and labour for laying the permanent way, and for maintenance. Implements and tools for laying permanent way, and for maintenance, were also ordered; and plate-iron girders, of 20 feet span, for bridges.

Labourers
sent from
Bombay.

One thousand labourers were enlisted, and organized in the following manner:—4 maistrees (head masons and road-makers); 4 subness (clerks), to muster and keep the accounts of the men; 20 muccadums; 200 beldars (pioneers) and miners, and 800 labourers; 1 muccadam, being in charge of a section of 25 men; and 1 subness and 1 maistree, in charge of 5 sections, or 125 men. The beldars and miners were supplied with sootkees (heavy hammers) crowbars and wedges, and with implements necessary for blasting rock. A few plate-layers and persons skilled in such work were also sent.

Establish-
ments and
machinery
despatched
from Bom-
bay.

In order that the line should be laid with the greatest possible despatch, and that the arrangements for working, maintaining and repairing the rolling stock should be as complete and efficient as it was possible to make them, the following establishments and machinery were despatched from Bombay:—

Materials.

Materials.

Rails, 24 feet	8,800
Sleepers	35,500
Fish-plates	18,700
Bolts and nuts	42,700
Dogspikes	147,000
Points and crossings, complete sets	20

Tools.

Picks	600
Powras (spades)	600
Shovels	400
Crowbars	250
Mining bars for 200 men	1,000
Tamping, ditto	100
Needles	200
Sootkees for 200 men	200
Hammers, sledge	150
Hammers	50
Packing picks	50
Screw spanners	30
Jimcrows	5
Wheelbarrows	100
Bellows	8
Anvils	8
Smith's tools	sets 8
Iron guns, pales and slings	20
Buckets	100
Tanks, small	30
Gummels (trowels)	600
Handles, spare	600
Steel for tools	cwt. 1
Grindstone	1
Saws, cross-cut	10
Ropes of sizes	—

Tools—continued.

Chains of sizes	—
Pulley blocks	—
Handsaws	20

Stores and Plant.

Locomotives	4
Trucks	60
„ brake	6
„ water	4
Lorries	8
Couplings	10
„ chains	200
Pumps	1
Force pump	1
Locomotive tank for threshing engines	—
Watering tanks	3
Semaphores, complete	3
Clocks	4
Guards' watches	12
„ bells	12
Screw jacks	10
Station lights	6
Signal flags	sets 50
Guards light	20
Water hose	yards 100
Railway grease	casks 15
Paint brushes	—
Oil, turpentine, &c.	—
Bolts and nuts, iron	cwt. 1
Steel	—
Spare gear of engines and trucks	—
Oil cans	12
Weighing platforms	3

Tools.

Stores and
plant.

<i>Establishments.</i>				<i>Machinery</i>			
Engineers	1			Portable Engine, horse power	16	Establish-	
Platelayers and Inspectors	3			Screw-cutting gap lathe, self-acting	1	ments.	
Overseers and Surveyors	2			Lathes, small	2		
Muccadums	3			Shaping machine	1		
Coolies or Platelayers	60			Drilling	1		
Some coolies and men from the Army Works Corps assisted in the construction of the line.				Punching and shearing machine	1		
				Slotting machine	1		
				Screw-cutting machine	1	Machinery.	
				Taps and dies of sizes sets	5		
				Ratchet braces	5		
				Circular saw bend	1		
				Saws, circular, sizes	8		
				Fan, with pullies	1		
				Standards for shafting	40		
				Shafting and couplings yards	90		
				Smiths' tools sets	50		
				Piping and nozzles for forges	50		
				Vice benches, complete	30		
				Belting feet	400		
				Forges, rivetters'	10		
				Rivetters' tools sets	15		
				Grindstones	4		
				Keys, journals, driving pullies, &c., in proportion to shafting.			
				Brass furnace, complete, with fire-bricks, clay, crucibles, moulding sand, &c., casting tongs, &c.			
				Fitters' tools in proportion to the above scale of workmen.			
				Stores: oil, cotton waste, coal, resin, tow, worsted tallow, red and white lead, copper wire, iron, steel bolts and nuts, rivets, brass, copper, for twelve months' consumption.			
<i>Traffic Department.</i>							
Traffic Manager	1						
Locomotive Foreman	1						
Stationmasters	3						
Station Clerks	3						
Storekeeper	1						
Storekeeper's Assistants	2						
Store Clerks	10						
Traffic Manager's Clerks	2						
Drivers	4						
European Firemen	4						
Native	8						
Guards	6						
Signalmen	20						
Pointsmen	20						
<i>Fitters' Shop.</i>							
Under the superintendence of the locomotive foreman and engineer of the line.							
European Fitters	2						
Native Fitters	12						
Firemen	12						
Blacksmiths	40						
Hammermen	40						
Rivetters and holders	20						
Carpenters	15						
Labourers	20						

Wooden buildings for commissariat stores, hospitals, and quarters for officers permanently stationed at Zula, &c., were sent from Bombay, the number and details of their construction will be found in the annexed report of the Commanding Engineer. Application was also made for building materials from England as shown below; they, however, only arrived at the termination of the campaign, and were transmitted to India.

MATERIALS for Ten Blocks of Buildings, each containing Four Officers' Quarters (sent from England).

Yellow fir, framed and fitted pieces	11,863	Tar casks	23	Materials	
Doors and frames	100	Whiting	2	for building	
Windows and frames	100	Asphalted felt cases	18	sent from	
Staircases	20	Furnaces for heating tar casks	2	England.	
Ventilators	50	Tar ladles	3		
Boards, flooring	1,550	Best brace and set (30 bits)	1		
" roofing	1,575	" handsaws ($\frac{1}{2}$ rip)	6		
" lining	5,994	" jack planes	3		
" weather	2,356	" smoothing planes	2		
Nails casks	113	" trying planes	2		
Tar brushes, handled dozen	2	B. Best spike bits dozen	1		
Tar ladles	3	Best gimlets (box-head)	1		
Tar pots with hooks and S. hooks	3	" awls, handled	1		
Ironmongery casks	1	" hammers	1		
				2 x 2	

Large hammers and handles	3	Best firmer chisels to 1½ inch, handled . sets	1
„ pincers pair	4	„ „ gauges to 1 „ „	1
„ screw drivers	6	„ set stone, stocked	1
Best axes and handles	2	„ large mallets	2
„ adzes „	2	Glass cases	13
½-inch screw augers, and ditto best	2	Putty drums	8
Best C. S. saw files dozen	4		

Reports regarding the progress made in the construction of piers, buildings, railway, roads, telegraph, water supply, and other engineering works were periodically made to the Quartermaster-General's Department, and have been constantly referred to in the preceding pages in the fortnightly reports submitted to the Quartermaster-General, Horse Guards, by Captain Holland, Assistant Quartermaster-General.*

Report by
Lieutenant-
Colonel
Wilkins.

The details of the progress of the railway and the various works will also be found in the following General Report on Engineering Operations, by Lieutenant-Colonel H. St. C. Wilkins, R.E., dated Zula, 30th May, 1868:—

Examina-
tion of
Massowah.

“The officers of the reconnoitring party, despatched from Bombay on the 16th of September last year, having, on the 2nd of October, examined the port of Massowah and the water supply of that port on the plains of Mucculloo, five miles distant from the sea, formed the opinion that that harbour was too small to accommodate more than half-a-dozen vessels, and that the water supply was of too limited and precarious a nature to meet the requirements of the Expedition. The “Euphrates” and the “Coromandel,” containing the exploring force, then steamed southwards into Annesley Bay, and the water supply at Negoosa, on the promontory of Buri, was examined without satisfactory results. Crossing the bay, the vessels took up a position off the village of Zula, and the water supply from the Hadas River promising fairly, and an investigation of the shores round the bay, combined with information obtained presenting no better prospect, it was determined to make Zula the base of exploration in the country.

Construction
of piers at
Zula.

“The beach at Zula shelving very gradually into the sea, it became at once a matter of great importance to commence the construction of a suitable pier for landing purposes. Some iron girders and stout rafters had been brought up in the steamers to assist in forming a pier, but from the nature and formation of the shore it was apparent that a long pier would have to be constructed from local resources. The plain bounding the sea was covered with low bushes, but unfortunately no stone was to be had; under these circumstances, fascines were prepared from the brushwood, and being strongly staked down formed retaining fences for the filling in.

“Arrangements were at once made for the collection of native craft from Massowah and neighbouring ports, and the conveyance of stone from the opposite side of the bay, commenced towards the middle of October. Sea-walls were then built outside the fascines, and by degrees the pier was run out 900 feet into the sea, giving a depth of 5 feet at low water springs. The greater portion of the pier was filled with stone.

“This stone pier was completed sufficiently to be used in landing the advanced brigade and their horses in November; and by the middle of December the pier was in general use, having a tramway laid from its head to some distance up the beach, thus greatly facilitating the landing of Commissariat, Land Transport Train, Ordnance, and other stores. A tramway was laid down on the beach, running down to low water line as early as October, and was of much service previous to the pier coming into use.

Works at
Zula.

“In this month also a road, 50 feet in breadth, was cleared through the jungle from the pier to the camp, 1¼ miles distant.

“By the end of November the works executed at Zula comprised the nearly

* See pages 3, 19, 72, 86, and 107.

"finished stone pier, a cleared road to camp from the sea, the clearing out of the old village wells in the bed of the Huddas River, and the construction of 20 new ones, whereby about 2,000 men and 2,000 animals were watered daily, a large store shed, and a water-shoot 480 feet in length, raised on trestles above the sea, for conveying to the tanks which were being collected on shore sweet water condensed by Her Majesty's ship 'Satellite.'

"The satisfactory progress made with the Zula works generally up to the close of the year is attributable to the untiring zeal and energy displayed by the officer in executive charge, Captain W. W. Goodfellow, Field Engineer, and second in command of Royal Engineers with the Force.

"It is unnecessary for me to bring this officer's subsequent services to His Excellency's notice, those services having been performed under His Excellency's own observation. I would wish, however, to record how highly I appreciate Captain W. W. Goodfellow's services, and how much I feel indebted to him for his support and example, and for the cheerfulness and fertility of resource he has so constantly displayed.

"On his Excellency's arrival at Zula early in January, many additional Commissariat and other sheds had been erected, and the commencement made of a second pier, a pile pier, the materials for which had been prepared and sent out from Bombay.

"Captain Chrystie, R.E., Field Engineer, assumed charge of the Zula works on the 1st January, and in his hands the pile pier made rapid progress, and was nearly completed up to the artificial island by the 5th of February, when Captain Chrystie was ordered to Senafè, and was relieved at Zula by Captain Wood, R.E., Field Engineer.

"Captain Wood completed the pile pier, and built a new head to the stone pier, greatly improving it. Captain Wood's work was distinguished by its solidity and permanent character. That the piers were not damaged by the late gales is attributable to this officer's good work at the head of the piers. Captain Wood was unfortunately taken ill, and had to go on board the hospital ship; Lieutenant Lee, Royal Engineers, Assistant Field Engineer, assuming charge of the Zula works.

"I have much pleasure in testifying to the excellent character of the works carried out by this officer, who has had many years' experience on public works.

"Lieutenant Lee completed the works at Zula as they now stand.

" *Railway.*

"A tramway having been proposed to be laid on the lowland country between Zula and the base of the mountains at Kumayli, a distance of about 12 miles, Lieutenant Willans, R.E., Assistant Field Engineer, commenced surveying the line in November, and the works were commenced in December, when the ships with the plant from Bombay began to arrive. Railway.

"An iron girder bridge of three spans of 20 feet was constructed over a branch of the Hadas River in December, and about a mile of earthworks were constructed and rails laid by the end of January. Girder bridge.

"Six miles of railway, with a branch of half a-mile to the Commissariat sheds, were completed by the 19th February, and the Commissariat Department commenced running all their stores and provisions to the sixth-mile siding. This enabled the Land Transport Train to move the whole of their animals from Zula, thus relieving the water condensing operations enormously, and saving considerably in time and animals in the trip from the coast to Senafè. Length of line completed.

"All Commissariat and other stores now sent out to the sixth-mile siding were

" conveyed away by carts and baggage animals sent out from Kumayli, and which
 " returned to that post the same day.

" A second Commissariat siding was opened for traffic at the ninth mile from
 " Zula, on the 28th March, thus further reducing the labour of the transport animals.

" At the end of April the railway was completed within a mile of the camp at
 " Kumayli. The traffic on the line had now become so great that the Commissariat
 " Department absorbed the whole of the rolling stock. It was found that, what with the
 " Commissariat requirements, and the increased time taken up by the lengthened journey,
 " trains for the conveyance of railway plant could no longer be given. With extreme
 " reluctance it was then decided that the works must be brought to a close by the
 " construction of a loop-line and terminus at about a mile from Kumayli.

" The heat on the plains was so great when the works were being closed that
 " not more than five and a-half to six hours' work could be obtained from the work-people.

" By great good fortune, water was obtained from the wells at the fourth,
 " seventh, and ninth miles on the road, by the excavation of wells 50, 65, and 85 feet
 " in depth respectively at each point.

" Watering-tanks for the engines were set up by the side of the line and fed
 " from these wells by piping.

" A good supply of water being obtainable at the fourth mile, 'Pioneer Wells,'
 " the locomotive workshops were established at this place. It was also found desirable
 " that the whole of the locomotive establishment should be permanently situated at the
 " 'Pioneer Wells,' so as to be close to their works.

Description
 of railway.

" The railway, properly speaking, is only a tramroad, so far as the rails and
 " rolling stock are concerned. The rails are light, and the rolling stock consists of con-
 " tractor's engines and trucks. Nevertheless the tramroad has been called upon to do
 " the duty of a railway, and it has, by constant care and management, been kept up to
 " the work required of it.

" The main line from Zula to Kumayli is $10\frac{1}{2}$ miles in length, and altogether
 " 12 miles 106 yards of rails have been laid. In six miles the plain rises pretty
 " gradually from the sea to a height of about 100 feet above that level. The railway line
 " then passes through a low range of hills, keeping the bank of the river. There is some
 " heavy work on this portion of the line in cuttings, embankments, and bridges. The
 " line then descends about fifty feet into the Kumayli Plain, and rises to a height of 348
 " feet at the Kumayli terminus.

" Eight iron girder bridges and a large number of drains have been constructed
 " on the line.

" The whole of the railway earthworks, embankments, cuttings, bridges, and
 " drains have been executed by troops of the Force and by men of the Army Works
 " Corps. A few civilian plate-layers, some from Bombay, and some obtained from the
 " shipping and departments of the Army, have superintended the plate-laying. The
 " greater portion of the railway works have been constructed by the 23rd Punjab Pioneers,
 " commanded by Major Chamberlain, and the 2nd Bombay Grenadiers, under Lieutenant-
 " Colonel Muter. I am particularly desirous that the services of these two corps, in per-
 " forming a duty so utterly new to them, should be brought to his Excellency's notice.
 " The cheerfulness and willingness on the works of the men of these corps, inspired by
 " the spirit and tone of their officers, have been most conspicuous, and is deserving of
 " the highest praise. The Punjab Pioneers are very clever, and quite artistic in all they
 " do, under the guidance of their skilful commander. The wells made by them at the
 " station called 'Pioneers' Wells,' and at the Bridge, are models of skill in well-digging.

"The 2nd Grenadiers worked on the line during the hot season, but they always evinced the greatest alacrity and desire to further the work.

"I respectfully wish to bring to His Excellency's special notice the services of Captain Darrah, R.E., Field Engineer, who has superintended the railway works from the commencement to the completion, as well as the services of his assistants, Lieutenant Willans, R.E., Assistant Field Engineer, Lieutenant Pennefather, R.E., Assistant Field Engineer, Lieutenant Baird, R.E., Assistant Field Engineer, Lieutenant Graham, 108th Regiment, Assistant Field Engineer.

"Lieutenant Willans, R.E., commenced the railway survey on the 16th November, and he remained on the works, superintending the bridges, till the 15th March, when he was ordered to the front. He returned to Zula on 20th May, and resumed his position on the railway.

"Lieutenant Pennefather joined the railway works on the 23rd December, and he has never left the works for a day up to this time.

"Lieutenant Baird, R.E., arrived from Bombay on the 28th February, and he at once took up the appointment of traffic manager of the line.

"Lieutenant Graham, 108th Regiment, joined Captain Darrah on the 20th January, and he has been on the works the whole campaign.

"As the railway works have been carried out under my own supervision, I am able to speak from personal observation of the devotion to duty displayed by Captain Darrah and his assistants.

"Early and late, day by day, for upwards of five months, have these officers, under most trying circumstances of climate, strained to the utmost of their ability and strength to further the success of the Expedition so far as the railway was concerned.

"His Excellency should be informed of the exemplary conduct throughout of the undermentioned non-commissioned officers employed on the railway works from nearly their commencement to the completion. All skilled men, the value of their services have been increased by their good conduct:—

"Corporal Heinig, R.E.; Serjeant Webb, Corporal Recks, Privates Cooper and Cox, 1st Battalion 4th King's Own Regiment; Private Miller, 45th Foot.

"The difficulties of constructing a railway with unprofessional labour have been greatly enhanced from the circumstance of five different descriptions of rails having been provided for the work on four different principles of fixing.

"Had it been possible to land and carefully stack each description of rail prior to plate-laying, the variation in the rails would not have been the cause of much inconvenience.

"As it happened, this difference of pattern proved most annoying, for the disembarkation of the plant just kept pace with the requirements of the works, and the line was fed from hand to mouth throughout, consequently there was no time for sorting and stacking.

"The Kurrachee rails have given the greatest trouble in laying and maintenance, being very much worn and bent, and being a joint chair and not a fish-plated rail.

"The 40 lb. fish-plated rail would have been more useful if the fish-plate holes had fitted those in the rails. In five cases out of ten they did not fit, nor would the bolts go through the holes.

"My opinion is that railways required for the operations of war should be carried out entirely as a civil work by engineers and contractors who make it their

" business to construct railways, and who would bring to bear on the works their own
" experience and that of professional establishments.

" In the present case it is worthy of remark, as a set-off, that, although the rail-
" way works have not been constructed so well and so quickly as they would have been
" by a professional contractor, yet the line was made in time to be exceedingly useful,
" and the difference of expense between the two systems is very great.

" I understand the tender of an eminent contractor for making the Abyssinian
" railway was at the rate of 6,000*l.* a mile, which would have brought up the cost of the
" whole line to about 72,000*l.*, exclusive of rails and plant.

Cost of
railway.

" As near as I can ascertain, the cost of making the Abyssinian railway has been
" about 6,000*l.*, exclusive of rails and plant.

" It must not be supposed from this statement that the contractor (had the line
" been let to him) would have made a large profit. His expenses would have been very
" great for labour and superintendence.

" Roads.

Roads.

" Early in November last year, when it was determined to explore the Kumayli
" Pass, No. 1 Company of Bombay Sappers were sent to work in the Suru Defile under
" Lieutenant Jopp, R.E., Assistant Field Engineer.

Kumayli
Pass.

" From the time of the Kumayli Pass being adopted as a route, strenuous exer-
" tions were made to construct a cart road through the Suru Defile. The road was com-
" pleted by the 31st January, the works having been well carried out under the directions
" of Lieutenant A. K. Jopp, R.E., Lieutenant (now Captain) Sturt, R.E., and Lieutenant
" Coaker, R.E., who are deserving of His Excellency's notice.

Suru Defile.

" The Suru Defile occupied the labour of two companies of Sappers and two
" companies of Beloochees for three months. The road, when completed, had a breadth
" of about 10 feet, and was constructed on the principle of ramping over boulders and
" obstacles, instead of attempting their removal by blasting. The boulders which it was
" necessary to remove with the miner's drill, were found to be of the toughest descrip-
" tion of granite, and for some time the Sappers were unable to make any impression
" upon them.

Cart road
between
Zula and
Adigrat.

" Almost simultaneously with the construction of the Suru Defile Road was the
" work of clearing a cart road the whole way from Zula to Senafè, a distance of 63 miles,
" taken in hand. The rise in this road, in the length of 63 miles, is 7,400 feet.

" About a mile of defile road at Rahaguddy had to be built much in the same
" manner as the Suru; and at 1½ miles from Senafè a ghât road, 1½ miles in length,
" had to be cut out of the mountain side.

" The whole road was open for cart traffic in the early days of February.

" The road was kept in a perfect state of repair up to the 8th of May, when
" thunder storms commenced breaking over the passes and doing serious damage to the
" made roads.

Cleared
road from
Adigrat to
Magdāla.

" A cart road was also made between Senafè and Adigrat, a further distance of
" 37 miles. Two pieces of ghât road occur on this line, the Guna-guna and Karsaba
" Ghâts. From Adigrat to Antalo so much of the route was cleared as to render it
" passable for the G-14 Battery to be driven to that post.

" Beyond Antalo to Magdāla the road can only be described as a track passable for
" laden mules and elephants.

" A detailed description of the roads will be found in the accompanying report.

"An alternative route was commenced by the Hadas River, but was abandoned through sickness of the troops engaged, and from other causes.

"Captain Hills, R.E., Field Engineer, who held the post of Field Engineer at Kumayli and Senafè during the campaign, has exerted himself in a very creditable manner in exploring for the best line of road to be taken to the Hadas.

"Water Supply.

"When large bodies of troops and followers had landed at Zula, and animals of the Transport Train accumulated in great numbers, it became necessary to condense a supply of water. Water supply.

"About 200 tons of water were landed daily from steamers in the harbour by means of a wooden shoot which conveyed the water to iron tanks, from which a long wooden trough was kept constantly filled. Amount landed daily.

"The troops soon moved up country, and, on the opening of the sixth-mile siding on the railway, the whole of the Transport Train animals being moved to Kumayli, the supply required from the condensers became greatly reduced.

"The allowance of water to every individual in Zula, officers, soldiers, and followers, has been $1\frac{1}{2}$ gallons daily per head, a by no means wasteful allowance when the climate is considered.

"A water supply for about 5,000 animals, and proportion of men, was provided at Kumayli in December and January, but on these numbers being greatly increased in March, it became necessary to increase this water supply.

"Force, suction, and chain pumps were set up at the wells, capable of watering 10,000 to 15,000 animals and 5,000 men, and long ranges of troughs were provided, rendering the watering of animals an easy operation.

"Lieutenant Le Messurier, R.E., Assistant Field Engineer, came out from England specially to set up the new American tube wells and pumps at the different posts; this energetic officer took charge of the whole water supply generally, and, with his assistants, inaugurated and carried out a very efficient system of water supply at each post, as far as Adigrat.

"Lieutenant Le Messurier's creditable exertions have doubtless come under his Excellency's own observation; it only remains, therefore, for me to bring to his Excellency's favourable notice the services of Lieutenant Le Messurier's assistants, Lieutenant Clarke, R.E., Lieutenant Sargeant, R.E., Lieutenant Protheroe, M.S.C., Lieutenant Mainwaring, R.E., Assistant Field Engineers.

"The waterworks between Kumayli and Adigrat being of a permanent character, are detailed in the accompanying Report. Waterworks between Kumayli and Adigrat.

"Lieutenant Le Messurier has favoured me with the following remarks upon the water supply between Adigrat and Magdāla :—

"Beyond Adigrat no stores could be carried, and paved slopes were made into the nullahs for the animals, Norton's tube wells supplying drinking water.

"Beyond Antalo, four Norton's tubes and driving apparatus, complete, were carried on six mules as far as Lat. They were then of necessity left behind, and finally reached Magdāla on the eve of our departure, enabling us, however, to obtain a supply of pure drinking water, after a want of it for sixty hours. Antalo.

"Water was obtained from the following sources :—

"Lake Ashangi, measuring $3\frac{1}{2}$ miles by $2\frac{1}{2}$ miles, and 17 fathoms in depth, and possessing the peculiarity of having no outlet; the River Ayangua, rising at Lat, and Ashangi.

- “ ‘ said by some to be the source of the Takazze ; the Tellare River crossed at Dildi
 “ ‘ the Takazze River crossed at Muja.
 Wadela. “ ‘ On the Wadela Plateau the supply was obtained from the Santara, Gazo, Gashoss
 “ ‘ and Fanta Rivers, running into the Jedda.
 Jedda. “ ‘ The Jedda River, about 2,500 feet below the Wadela and Talanta Plateau, was dry
 “ ‘ on the advance of the Army on 4th of April, and nearly so on its return on 23rd of April.
 “ ‘ The distance in a straight line from one plain to the other is less than three miles,
 “ ‘ and the journey to accomplish by the King's road nearly ten miles.
 Talanta. “ ‘ Water was found on Talanta Plain in pools in the small valley.
 “ ‘ The formation here apparently was basaltic trap, while on the Wadela it was sand-
 “ ‘ stone.
 Bashilo. “ ‘ The Bashilo River, 8 miles north of Fahla, running and knee deep, after several
 “ ‘ severe thunder showers, was the only water crossed deserving the name of river.
 “ ‘ It was the main source of supply to the Army when encamped before Magdāla.
 Magdāla. “ ‘ The water in the small native wells in the immediate vicinity of Magdāla was
 “ ‘ unfit for any purpose, owing to the number of dead animals, &c., and the small supply
 “ ‘ obtained from the well dug by the troops, though clean, was of a peculiarly bitter taste.
 “ ‘ A medical officer assured me that it was not injurious.’

Telegraph.

“ Telegraph.

- “ Lieutenant St. John's telegraphic operations have not come under my observa-
 “ tion beyond the Passes.
 “ A Statistical Report by Lieutenant St. John is contained in the accompanying
 “ Report of engineering operations.
 “ I can, however, bear testimony to the value of Lieutenant St. John's telegraph.
 “ I may say the telegraphic communication has been simply invaluable, and it has
 “ not failed when most wanted.

Engineer
park.

“ Engineer Park.

- “ I have now to bring to his Excellency's notice that the Engineer park, having
 “ had the advantage of being formed with great care in Bombay, under Captain Greig's
 “ directions, has always been enabled to comply with the requisitions made upon it. It
 “ has fulfilled its purpose completely, and, therefore, calls for no further remarks.
 “ Captain Greig has expressed himself well satisfied with the exertions of his
 “ assistants, Lieutenant Saxton, R.E., Assistant Field Engineer, and Cornet Dalrymple,
 “ Assistant Field Engineer.
 “ In concluding this remaining portion of my Report, it remains for me to bring
 “ to his Excellency's favourable notice the services of my Brigade-Major, Captain Charles
 “ Goodfellow, V.C., R.E., Field Engineer, which have been so valuable by reason of his
 “ energy of character and experience in the conduct and management of public works.

“ Royal Engineers and Sappers and Miners.

- “ Of the Royal [Engineers and Madras and Bombay Sappers and Miners, the
 10th Com- “ undermentioned companies have been present with the Force:—10th Company Royal
 pany R.E. “ Engineers. Madras Sappers and Miners, G, H, and K Companies. Bombay Sappers and
 Miners, Nos. 1, 2, 3, and 4 Companies.
 “ The 10th Company, Royal Engineers, are divided into, (1) Telegraphists, (2)
 “ Signallers, (3) Well-borers, and (4) Photographists.

“ The telegraphists have been employed between Zula and Antalo only, under the orders of Lieutenant Puzey, and under the general superintendence of Lieutenant St. John, R.E.

“ The signallers made themselves useful to the Army the whole way from Senafè to Magdāla, and their services were more especially valuable whilst the Army crossed the ravines of the Takazze, the Jedda, and the Bashilo, and on the advance on Magdāla, in communicating with distant points relative to placing guns in position.

“ His Excellency is aware of the services of Lieutenant Morgan, R.E., the officer under whom these men worked so willingly and efficiently. Army signallers.

“ The well-borers made themselves generally useful on the line of march from Kumayli, to close to Magdāla, proving the efficacy of the American pumps as applicable to the line of march of an army. The operations of these men were judiciously directed by Lieutenant Le Messurier, C.E. Well-borers.

“ The photographers have completed a series of views from Zula to Magdāla, illustrating all points of interest on the line of march of the Army. It is to be regretted that rather more professional and artistic knowledge was not brought to bear on this subject. Some beautiful effects of light and shade have been lost, owing to the views not having been taken at the proper time of day. Photographers.

“ Major Pritchard, R.E., commanded the 10th Company Royal Engineers, and was with the photographers throughout the Expedition.

“ *Madras Sappers.*

“ Major H. N. D. Prendergast, V.C., R.E., commanded the detachment, consisting of G, H, and K Companies; Staff Officer with the detachment, Captain Foord. Madras Sappers.

“ The G Company* has been posted at Zula and Kumayli during the whole campaign. The services performed by this company on the public works at Zula, on the railway, and on the Kumayli waterworks, have been excellent.

“ The Sepoys of this company excavated a well on the railway line, 85 feet in depth, without lining of any kind, and proved themselves very skilful workmen.

“ I have much pleasure in recording the good services rendered by Lieutenant Morris, R.E., commanding this company, in superintending the water arrangements at Kumayli. These services have proved most beneficial to the Transport Train Establishment at that post.

“ Lieutenants Protheroe, S. C., and Mainwaring, R. E., have been before mentioned.

“ The H Company† has been employed during the whole campaign on the public works at Zula, and has been most industrious.

“ This company has shown itself ever ready and willing to undertake any work required of it.

“ Lieutenant Pennycuik, R.E., commanding the H Company, appears to have conducted the duties of his position in an efficient manner.

“ Lieutenant Cunningham, R.E., has been employed on detached duty at Antalo.

“ K Company.‡—This company commenced work in the Senafè Pass after a short stay at Zula, and afterwards, when joined by head-quarters, improved the track

* G.—Lieutenant Morris, R.E., Commanding; Lieutenant Protheroe, S. C.; Lieutenant Mainwaring, R.E.

† H.—Lieutenant Pennycuik, R.E., Commanding; Lieutenant Cunningham, R.E.

‡ K.—Captain Elliott, N.I., Commanding; Lieutenant Bird, S.C.; Lieutenant Coaker, R.E.

" route between Antalo and Magdāla, rendering it suitable for laden mules and elephants,
 " and was present at the action of Arogie, and taking of Magdāla.

" Captain Elliott, N.I., Commanding, Lieutenant Bird being subaltern officer.

" Lieutenant Coaker, R.E., was detached from the company on its arrival at
 " Zula, and worked with the 4th Company Bombay Sappers throughout the campaign.

" Bombay Sappers and Miners.

Bombay
Sappers.

" With Head-Quarters, Captain Macdonnell, R.E., commanding; Lieutenant
 " Merewether, R.E., Adjutant.

" No. 1 Company* arrived at Zula from Aden in October. After a short time,
 " this company was sent to the Suru Defile, and worked on the road in the pass till
 " December. It then marched to Senafè, and was employed on the ghât till the end of
 " January, when it was moved on to Adigrat, working on the road between Senafè and
 " Adigrat, more particularly on the Karsaba Ghât, for which piece of road great credit
 " is due.

" The company then proceeded to Antalo, and was employed in constructing the
 " telegraph, returning to the Suru Pass in time to repair the damage done during the
 " month of May, and remaining there on duty till all the troops had cleared out.

" This company was commanded by Lieutenant Newport, and I consider did
 " very efficient service under their excellent officer's command.

" Lieutenant Osborne, R.E., was attached to this company in January, and
 " subsequently performed the duties of Adjutant from January to May, during the time
 " Lieutenant Merewether was absent.

" No. 2 Company.†—This company arrived in this country with head-quarters
 " early in December, and, after a short stay at Zula, worked on the Senafè Pass, prin-
 " cipally in the Suru Defile, for which the company deserves great praise. The company
 " was then pushed on to Antalo, and thence to Magdāla, assisting in the road-making,
 " and was present at the action of the 10th of April, and capture of Magdāla on
 " the 13th.

" Captain Sturt, R.E., commanded, and also worked this company, an arrangement
 " which was most beneficial to the interests of the company.

" No. 3 Company.‡—This company worked for two months at Zula, on the stone
 " pier; the men were employed eight hours a-day. It was then moved up into the pass,
 " and worked on the Senafè Ghât. It also worked between Senafè and Adigrat, and
 " between Adigrat and Antalo. Assisted in road work between Antalo and Magdāla,
 " and was present in the action of the 10th, and taking of Magdāla on the 13th April.

" Captain Leslie, S.C., commanded, and the company worked under the orders of
 Lieutenant Jopp, R.E.

" 4th Company.§—Worked two months at Zula, on the stone pier, eight hours
 " a-day; was then employed at Lower Suru, and subsequently in the Senafè Ghât.
 " Assisted in making the road between Senafè and Adigrat and Adigrat and Antalo; also
 " was employed generally in road-making between Antalo and Magdāla, and was present
 " in the action of the 10th, and capture of Magdāla on the 13th April.

* No. 1 Company.—Lieutenant Newport, S.C., Commanding; Lieutenant Osborne, R.E.

† No. 2 Company.—Captain Sturt, R.E., Commanding.

‡ No. 3 Company.—Captain Leslie, S.C., Commanding.

§ No. 4 Company.—Lieutenant Leacock, Commanding.

" Lieutenant Leacock, S.C., commanded this company, working under the directions of Lieutenant Coaker, R.E.

" Captain Macdonnell commanded the Bombay Sappers, three companies, and Major Prendergast, V.C., the K Company Madras Sappers and Miners, during the action of the 10th April.

" Major Pritchard, R.E., being senior officer of Engineers with troops, commanded on the 13th at the capture of Magdāla, the following details:—10th Company, Royal Engineers, K Company Madras Sappers, 2nd, 3rd, and 4th Companies Bombay Sappers; the distribution of Engineer officers and men being under Captain W. W. Goodfellow, second in command of Royal Engineers with the Force."

PROGRESS REPORT of ENGINEERING OPERATIONS carried out by the Engineer Department,
from October 1867 to May 1868.

No.	Name and Locality of Work.	Date of Commencement.	Work Executed.	Date of Completion.	Remarks.
1	ANNESLEY BAY, ZULA. Stone Pier .. (For landing troops, elephants, horses, Transport Train animals, and for general traffic.)	Oct. 1867 ..	<p>Feet.</p> <p>Length of pier .. 943</p> <p>Length of head .. 156</p> <p>Breadth of head .. 92</p> <p>General breadth .. 27</p> <p>Depth of water at head at low water springs 7</p> <p>The stone pier since its first completion has been raised nearly 2 ft. in height over its whole surface.</p> <p>The piling and platform head has also been added.</p>	Jan. 1868 ..	<p>This pier is built of dry rubble stone brought from the opposite side of the bay. Stone pier.</p> <p>The increased width of the head provides accommodation for a condenser and for landing and embarking purposes.</p> <p>The head of the pier is piled, and a platform connects the piles and stone pier. Fender piles protect the pier all round in deep water from damage.</p> <p>The south side of pier as well as the whole of the head has a wooden coping for protection.</p> <p>Rails for the railway traverse the whole length of the pier, and a siding is also provided at the head. Stores delivered at the head, being at once placed on railway trucks, have been run up to the different depôts. Troops for embarkation are taken by rail to the pier head, where they at once embark on the lighters, and are towed out to the ships by steam-tugs.</p>

Progress Report of Engineering Operations, &c.—*cont.*

No.	Name and Locality of Work.	Date of Commencement.	Work Executed.	Date of Completion.	Remarks.
Pile pier.	2	Pile Pier .. (For Commissariat only.)	Dec. 1867 ..	..	<p>The land portion of the pier is constructed of piles, driven 10 feet apart, strong sheeting behind the piles supporting the earth filling.</p> <p>The pile pier is constructed on piers of four piles each at 10 feet apart, central distances.</p> <p>The head of pier and portion in deep water is well protected by strong fender piles, placed one foot from the pier and five feet apart.</p> <p>A double line of rails traverses the whole length of the pier</p>
			<p>Feet.</p> <p>Length of embanked portion of pier .. 380</p> <p>Length of pile pier to artificial island of stone 640</p> <p>Length of stone island 114</p> <p>Length of pile pier island 70</p> <hr/> <p>Total length of pier . 1,204</p> <p>Breadth of pier .. 30</p> <p>Breadth of stone island 65</p> <p>Depth of water at head at low springs .. 8</p> <p>Depth of water at head at high-water springs 13</p>		
Condenser Island.	3	Condenser Island	Nov. 1867 ..	April 1868 ..	A 4,000 gallon condenser erected and working on the island.
Water shoot.	4	Water Shoot ..	Dec. 1867 ..	Jan. 7, 1868	For conveying water from the condenser on the island to the tank depôt on shore.
Sea-wall.	5	Sea Wall and Embankment.	Nov. 1867 ..	April 1868..	Constructed to keep the sea out of the immediate landing-place, to shorten the piers, and to avoid the necessity of filling a large reclamation. Sluices let out rain-water.
Reclamation.	6	Reclamation ..	Nov. 1867 ..	Feb. 1868 ..	Partial reclamations made at lowest levels to guide the drainage.
Grave yard.	7	Grave Yard ..	Feb. 1868 ..	April 1868 ..	
			<p>16,000 s. yds. raised 2 feet.</p> <p>2,333 „ „ 6 inches.</p> <p>Ground enclosed with a short wooden railing, 318 running feet.</p> <p>100 wooden crosses of stout teak, made for numbering the graves.</p>		

Progress Report of Engineering Operations, &c.—*cont.*

No.	Name and Locality of Works.	Date of Commencement.	Work Executed.	Date of Completion.	Remarks.
8	Buildings (teak framing), Commissariat.	Oct. 1867 ..	Feet. 1 shed, plank roof and walling .. 120 by 20 1 do. do. .. 300 „ 20 1 do., corrugated iron roof and plank walls .. 300 „ 20 1 do. mat walls 270 „ 20	Dec. 1867 .. Jan. 1868 .. Feb. 1868 ..	Teak-framed sheds for Commissariat, 1,000 running feet in length, 20 feet in breadth
Engineer's Office	Oct. 1867 ..	1 do. planked roof and walls .. 28 „ 13	Dec. 1867 ..		
Condenser Island	Jan. 1868 ..	1 do., planked roof and walling 15 „ 15	March 1868		
Over Condenser Stone Pier.	Jan. 1868 ..	1 do., planked roof and walling 34 „ 24	Feb. 1868 ..		
Post Office ..	Dec. 1867 ..	Teak-framed shed with plank roof and walls, and a second corrugated iron roof 6 inches above planks . 28 „ 13 Additional room of rafters and matting added 30 „ 13	March 1868. April 1868 .		
Ice House ..	March 1868	Roof and walls of deal planking, 16 ft. in height 30 „ 30	April 1868 .		
Shed over Water Tanks.	Feb. 1868 ..	Shed 36½ „ 17	March 1868.		
Sentry Boxes.	March 1868	2 large 12 „ 6 10 small 4 „ 4 (plank roofed and 8 ft. in height.)	March 1868.		
<i>Sheds.</i>					
Rafters, reed mats. Walls and roof thatched with jowlies.					
Commissariat ..	..	3 sheds.. .. 120 „ 20	Dec. 1867 to May 1868		
Land Transport ..	..	6 do. 120 „ 20			
Ordnance ..	..	3 do. 120 „ 20			
Hospital ..	..	2 do. 120 „ 20			
Engineer Department.	..	4 do. 120 „ 20			
Embarkation, Pendall.	..	1 do. 200 „ 20			
General Hospital	March 1868	Teak framing with plank, walls, mat, and thatched roof, glazed windows, outside dimensions 340 by 46 feet. Height of walls 17 feet.	April 1868	This building consists of fever wards 99 feet, 99 feet, 95 feet, and 22 feet respectively, by 22 feet in breadth and 17 feet in height; a verandah 12 feet wide encircles the whole building.	

Progress Report of Engineering Operations, &c.—*cont.*

No.	Name and Locality of Works.	Date of Commencement.	Work Executed.	Date of Completion.	Remarks.
	Hospital Quarters.	..	Two quarters containing rooms 16 by 16 by 12 feet each, and 16 by 8 by 12 feet. Two bath rooms and verandahs 8 by 8 feet. One quarter containing rooms 14 by 14 by 12 ft., 14 by 8 ft., 8 by 8 ft. One quarter containing rooms and verandahs 16 by 16 by 12½ feet in breadth, front, and rear 8 feet. Two cook-house 41½ by 12½ by 9 feet corrugated iron roof and walls. Dead-house 12 by 12 by 10 feet.		
	Reservoirs ..	April 1868 .	One tank 34½ by 11 by 5 ft. One tank 52 by 11 by 6 feet, constructed of strong wooden framing planked and lined with zinc.		
	RAILWAY, ZULA TO KUMAYLI.	Dec. 1867 ..	<p><i>Permanent Way.</i></p> <p>Mls. yds.</p> <p>Main line .. 10 623</p> <p>Branch line .. 0 866</p> <p><i>Sidings, &c.</i></p> <p>Yds.</p> <p>Stone pierhead 93</p> <p>„ tail 100</p> <p><i>Double Line.</i></p> <p>Commissariat pier .. 555</p> <p>Siding, commissariat shed .. 82</p> <p>Siding, Zula Station .. 60</p> <p><i>Pioneers' Well Station.</i></p> <p>Loop line .. 586</p> <p>Sick siding 154</p> <p><i>Commissariat Depôts.</i></p> <p>Loop line at No. 1 .. 224</p> <p>Loop line at No. 2 .. 170</p> <p><i>Kumayli Terminus.</i></p> <p>Loop line .. 112</p> <p>1 376</p> <p>12 105</p>	May 1868 .	<p>Gauge of railway 5 feet 6 inches.</p> <p>Five descriptions of rails used.</p> <p>1. Flanged 30 lb.; too light a rail.</p> <p>2. Flanged 40 lb., fish-plated; third best.</p> <p>3. Flanged 45 lb., fish-plated; second best.</p> <p>4. Flanged 45 lb., Kurra-chee, not fish-plated, joint chairs; bad.</p> <p>5. 50 lb., double-headed, with chairs; best.</p>

No.	Name and Locality of Work.	Date of Commencement.	Work Executed.			Date of Completion.	Remarks.
	RAILWAY. Bridges and Drains.		Number of Water Ways.	Width of each Opening.	Depth of Bed from bottom of Girder.		Construction of Bridges. Railway. Iron girders, the gauge of the railway apart from centre to centre, supported on wooden uprights, braced and strutted above ground, joined by sills deeply sunk below ground. Sleepers secured by being notched to fit girders; girders further secured from movement by tie rods and strap to uprights. Supports to girders placed well into embankment, so as to be in great measure independent of wing walls, which are of dry rubble.
	No. 1 Bridge over Huddas.						
	No. 2.			Ft. ins.	Ft. ins.		
	No. 3.		6	11 6	4 9		
	No. 4.		2	10 0	2 6		
	No. 5.		2	16 0	1 6		
	No. 6. Kumayli Torrent.		2	20 0	7 6		
	No. 7.		2	10 6	5 6		
	No. 8.		3	20 0	12 0		
	Total, 8 bridges.		3	15 6	4 0		
			1	20 0	2 10		
	28 drains.		Number of each Sort.	Number of Openings.	Width of each Opening.		Construction of Drains. Two of similar construction to bridges. The others wooden uprights at sleeper intervals, uprights let well into sills, buried below ground, wings retained by stout planking, and, where necessary, rough rubble.
					Ft. ins.		
			3	3	2 0		
			5	2	2 0		
			2	3	6 0		
			2	1	2 0		
			7	4	12 6		
			1	1	2 8		
			1	1	1 6		
			2	3	2 3		
			1	6	1 9		
			1	5	3 7½		
			1	2	16 6		
			1	1	2 3		
			1	12	3 0		
	Station at Zula ..	..	Platform, 150 feet long. Office, 30 by 17 feet. Shed for shelter, with seats, 93½ by 16½ feet. Shed for stores, and carpenter's workshop. A well (salt) with pump fixed for watering station and neighbourhood. Pointsman's hut.			..	Platform of convenient height for trucks in use, horizontal planking against vertically buried sleepers support the platform embankment; office entirely built of biscuit cases obtained from commissariat; shed of Aden material.

Progress Report of Engineering Operations, &c.—*cont.*

No.	Name and Locality of Work.	Date of Commencement.	Work Executed.	Date of Completion.	Remarks.
	Station at Pioneers Well.	..	Water supplied to engines for the Pioneer Wells, 50 feet deep.	..	Well is 50 feet deep, a tank is raised 30 feet above that, the water is raised into this tank, and the engines at a distance of about 900 feet are by means of piping watered by gravity only; piping is 2 inches diameter.
	Watering station at Willans Bridge over Kumayli Torrent.	..	Well dug for watering, 67 feet deep.	..	Well is close to line, and engines are watered by a force pump from tubs round the well kept ready filled.
	Station at "Kumayli Plain."	..	Siding for Commissariat, well dug 87 feet deep, and water supplied to engines from distance of 1,200 feet. Stand pipe with cock for drinking.	..	The well water is forced into a raised reservoir 114 feet from well, and is led by 4-inch piping 1,200 feet, when a stand pipe feeds the engines.
	Station at "Kumayli Terminus."	..	Two sheds, each 120 by 20 feet. Wooden platform. Waiting shed for officers. Latrines for troops. Ground cleared sufficient to parade a regiment in open column		
	Railway Telegraph.	..	Stations established at Zula,— Pioneers Wells and Kumayli Terminus.		
	Electric Telegraph.	24 Dec. 1867	Zula to Kumayli .. 12		Lieutenant St. John, R.E., commenced work with half a company of Madras Sappers, and some Shohoes. From the 6th mile from Zula to Rahagedi supports cut from mimosa jungle only used. On the 12th Jan. the Madras Sappers were replaced by a company of 23rd Punjab Pioneers under Lieut. Paterson. Posts for the line from Rahagedi to Senafé and six miles beyond cut from jungle by 33rd Regiment. Then 11 miles of Indian Bamboos and remaining 21 miles on juniper poles purchased from Abyssinians at Focada and Adigrat.
		8 Jan. 1868	Kumayli to Suru .. 14		
		20 Jan. 1868	Suru to Undul .. 13		
		1 Feb. 1868	Undul to Rahaguddy .. 16		
		19 Feb. 1868	Rahaguddy to Senafé .. 8		
		9 Feb. 1868	Senafé to Guna-guna .. 13		
		15 Feb. 1868	Guna-guna to Adigrat and beyond .. 8		
		24 Feb. 1868	2nd line (railway) .. 4		
			Total miles .. 113		

Progress Report of Engineering Operations, &c.—cont.

No.	Name and Locality of Work.	Date of Commencement.	Work Executed.	Date of Completion.	Remarks.
ROADS.					
	Cart road from Zula to Senafè. (Post No. 2.)	Nov. 1867	A cart road 63 miles in length, ascending 7,464 feet.	31 Jan. 1868	Principal works in the rocky gorges of the Suru and Rahagedi Defiles and Senafè Ghât, where the road is in hillside cutting.
	Senafè to Adigrat	1 Feb. 1868	A good cart road, 37 miles.	26 Jan. 1868	Principal work the Guna-guna and Karsaba Ghâts, elevation 200 and 400 feet respectively.
	Adigrat to Antalo (Post No. 3.)	5 Feb. 1868	This portion of the route of the Army, though not used for cart traffic, was traversed by the 12-pr. Armstrong battery on wheels. Distance, 78½ miles.	1 Mar. 1868	Principal works, ravine between Adigrat and Mai Wahiz, descent to Dolo, and across the hills between Eikhullet and Antalo.
	Antalo to Lat ..	27 Feb. 1868	Good cleared track for mules and elephants. Distance, 73 miles.	20 Mar. 1868	Principal works: the Alaji pass and the hills between Astala and Makan. Also between Makan and Ashangi, and between Mussagita and Lat.
	Lat to Santara ..	..	Good cleared track for mules and elephants. Distance, 56 miles.	March 1868	Principal works: descent to Marawah, and across the hills between Marawah and Dildi. Also the ascent of the Wofjat hill leading to Wandach, passage of the Takazze, and steep ascent (3,000 feet) to Santara on the Wadela plateau.
	Santara to Abdikum.		Good cleared track for mules and elephants. Distance 30 miles.	April 1868	Very little work required on this portion of the route.
	Abdikum to the Talanta Plateau.	April 1868	Ditto ditto ditto. Distance 16 miles.	April 1868	Much heavy work was spared the troops, owing to Theodore's road across the valley of the Jedda being adopted as a suitable route for the Army to gain the Talanta Plateau.
	Talanta Plateau to Arogie and Magdala.	9 April 1868	Ditto ditto ditto. Distance 14 miles.	13 April 1868	The above remarks are also applicable to the route from Talanta Plateau to Arogie and Magdala, for no work was required across the plateau, and Theodore's road from the plateau to the Magdala Amba, over the Arogie flat, was adopted.

Progress Report of Engineering Operations, &c.—cont.

No.	Name and Locality of Work.	Date of Commencement.	Work Executed.	Date of Completion.	Remarks.
	Zula to Senafé by the Hadas Pass.	23 Feb. 1868	Senafé to Tekonda; 13 miles over rough country opened as a mule track; also from Zula to Hum-hummoo, 21 miles, cleared as a cart road.		This was intended as an alternative line from Zula to the highlands, by the Hadas River, but had to be abandoned owing to two causes. The working parties furnished by the troops being required with the advance force, were withdrawn from the Senafé end of the route, whilst the whole of the working party being struck down by malarious fever at Hamhammo, the Zula end of the road had to be abandoned.
	WATER SUPPLY.				
	Kumayli . .	23 Dec. 1867	4 Dipping wells. 2 Norton's tube wells. 4 Portable hand pumps. 4 Owen's double pumps. 1 Bastier 2½-in. chain pump. Troughing, 2,300 gallons capacity. Reservoir, 3,000 gal. ditto. Guard walls. Toe walls.	25 May 1868	The watering was carried on steadily till the flood of evening of 19th May. The wells, with one exception, were filled with clayey mud. The troughs have been re-erected, wells cleared out, and pumps re-fixed. Discharge of pumps, 10,000 gallons per hour. Water 16 to 18 feet below surface. Its temperature 96°.
	Upper Suru . .	22 Jan. 1868	1 Norton's tube well. 18,000 galls. of water stored. Troughing, 300 gallons capacity. New watering road. Tank for Shohoes.	14 Feb. 1868	Entirely carried away on the evening of the 19th May. 2 Portable hand pumps and 4 galvanized iron troughs supply the wants of troops. Water on the surface.
	Undul Wells . .	3 Jan. 1868	2 Norton's tube wells. 1 Bastier 2½-in. chain pump. 2 Dipping wells. Stone and lime well, 32 ft. deep. Troughing, 1,500 gallons capacity.	23 Feb. 1868	Discharge of pumps, 2,500 gallons per hour. Two portable hand pumps have been erected for use of troops returning. Water 25 to 30 feet below surface. Its temperature 89°.
	Enderta . .	12 Feb. 1868	3 Wells: 30 to 40 have been dug.	23 Feb. 1868	No water. Water supply in a rocky pass, ½ mile to east, improved.

Water
supply

Progress Report of Engineering Operations, &c.—cont.

No.	Name and Locality of Work.	Date of Commencement.	Work Executed.	Date of Completion.	Remarks.
	Rahagedi ..	2 Feb. 1868	Troughing, 350 gallons capacity.	14 Feb. 1868	Supplied by gravitation from springs in the rock.
	Senafê Ghât ..	14 Feb. 1868	2 Norton's tube wells. Tank, capacity 300 gallons. Road cleared.	18 Feb. 1868	Supplied by a spring.
	Senafê	4 Feb. 1868	14 Norton's tube wells. Aqueduct 250 feet long. Troughing, 700 gallons capacity. 1 Bastier 2½-in. chain pump.	23 Feb. 1868	Ground on which the works stood submerged by the flood on 22nd March, and sources of the water fouled by the drainage from the Transport lines; an objection to the position of these lines was made on 3rd Feb. 1868.
	Senafê	30 Mar. 1868	Re-erection of Bastier 2½. Ditto, Norton's tube wells. Ditto, Troughing, 96 ft. long. Large cuts for the easier flow of storm water. Protecting bank built.	31 Mar. 1868	Moved to a new position higher up stream. Irrigating channel.
	Guna-guna ..	18 Feb. 1868	1 Norton's tube well. Troughing, 100 gallons capacity.	10 Mar. 1868	Supply regulated by sluice from an old irrigating channel.
	Focada	19 Feb. 1868	5 Norton's tube wells. 2 Owen's portable pumps. Troughing, 400 gallons capacity. Native well. Sheep pond.	10 Mar. 1868	Water 4 ft. to 6 ft. below surface.
	Adigrat	22 Feb. 1868	2 Norton's tube wells. Tank, 7,000 galls. capacity. Troughing, 300 galls. do. Stream strongly dammed.	10 Mar. 1868	Supply regulated by a sluice gate. Cuts and waste weirs to carry off the storm waters.

The Establishment attached to the Engineer Department was as follows:—

Establishment.

Commissioned Officers	25	<i>Railway—cont.</i>				
Overseers, Public Works, Bombay	2	Native ditto, Pointsmen, Platelayers, Signal- men, &c.				61
<i>Army Works Corps.</i>						
Commissioned Officers	2	<i>Zula Works.</i>				
Artificers and labourers	973	Mechanical Engineers and Stokers				11
<i>Engineers' Park.</i>						
Lascars	61	Chinese Carpenters				48
Artificers	42	Jewish ditto				26
<i>Railway.</i>						
European Subordinates, as Storekeepers, Station- masters, Drivers, Fitters, &c.				Masons		27
				Smiths and Hammermen		26
East Indian ditto				Artificers		16
<i>Waterworks.</i>						
				Plumbers and Pipelayers		7

The Madras and Bombay Sappers, and the 10th Company Royal Engineers have not been included in the above establishment.

Final dis-
posal of
Engineering
Stores.

At the close of the campaign, the railway plant and the various engineering stores that had been supplied from England and India were disposed of in the following manner:—

The rails were left in the country in order that, if considered worth removal, a party might be sent from Aden to take them away. The locomotives were sent to Bombay. One flooring of the pile pier was removed at the close of the embarkation, but the piles were left standing. All the buildings that had been erected at Zula were required to the very last, and as the transport required for their conveyance, and the delay their removal would entail, would not repay their value, they were abandoned. The whole of the telegraph stores, including instruments, batteries, small stores, copper and homogeneous wire, and the 50 miles of covered wire (Cooper's case) brought to Abyssinia, were sent to Bombay for use in India. The army signal and photograph apparatus were sent back to England with the 10th Company Royal Engineers, and the Norton's tube wells and Bastier chain pumps were sent to Bombay.

CHAPTER XXXIV.

PHOTOGRAPHIC DEPARTMENT.

HIS ROYAL HIGHNESS THE FIELD-MARSHAL COMMANDING-IN-CHIEF, on the 13th September, 1867, forwarded to the Secretary of State for India a letter from the Director of the Royal Engineer Establishment, recommending that a party of one non-commissioned officer and six men of the Royal Engineers, trained photographers, should be attached to the Expedition, with the view of photographing sketches and plans made by Staff Officers. On the 18th September, the Secretary of State for India approved of this arrangement, which was accordingly ordered, and the party was attached to the 10th Company Royal Engineers.*

Photo-graphic establish-ment sanctioned.

The sum of 447*l.* 6*s.* 9*d.* was sanctioned for the purchase of materials and implements for the Photographic Establishment, which consisted of two complete equipments, so arranged and packed as to be employed independently of each other.

The following report by Lieutenant S. Anderson, R.E., dated the 2nd August, 1869, describes the equipment sent to Abyssinia for photographic purposes.

Lieut. Anderson's Report.

"In consequence of the nature of the country only admitting of transport on pack mules, it was essential that all the apparatus and stores should be packages suited to pack-saddle transport, and each package not exceeding in weight 80 to 90 lbs. The equipment was designed primarily for use as a field printing-press, in other words for photographing, and, in so doing, multiplying or reducing Staff officers' sketches, and reproducing copies of them as rapidly as possible for distribution. The largest size plate that could be easily manipulated in the field—namely, 9 inches by 11 inches—was provided; and a sliding and folding camera, brass-bound, was considered the strongest and least liable to be affected by heat or insects. For the latter reason, a camera with Russia leather gussets, which is the most portable and compact form of camera, was considered inadmissible. A Dallmeyer's triplet lens, to cover a 12-inch by 10-inch plate, was provided, as it is equally adapted for copying and landscapes, and can also be used for groups. It was specified to cover a 12-inch by 10-inch plate, so as to provide for taking in a 9-inch by 11-inch well up to the corners. For the purpose of copying, it was requisite to provide a folding cone, which fitted to the front of the camera, and could be removed at pleasure. A thick white quilted cover was provided, to fit over the camera when it was exposed to the sun: and this preserved the camera most effectually. A folding tripod stand was provided for the camera, which packed away well in the lid of the box containing the camera and its spare stores. The bath was made of ebonite, and was packed in a mahogany case. In the box to match the camera box, were fitted all the materials for a day's supply; and when full, the weight of each of these two boxes was as nearly as possible 100 lbs.

Description of equipment.

"Considerable difficulty was experienced in deciding upon the best form of tent.

* For the detailed particulars regarding the formation and organization of the 10th Company Royal Engineers, see Chapter XXII, page 136.

"The box tents of Messrs. Rouch and Thomas had the great advantage of being very
 "compact and portable, and very quickly as well as easily set up; but in the case of
 "injury from being roughly handled, or being stove in by a blow, it was considered that
 "they might be irretrievably placed *hors de combat* in the rough treatment experi-
 "enced on a campaign. The Chatham pattern tent, the framework of which was
 "designed by the late Captain Fowke, R.E., had the eminent advantage of being very
 "little liable to injury, and of being very easily repaired, if either the framework or
 "cover were injured. It possessed the disadvantage of taking some time to erect. It
 "was also considered that in the event of the tent being required for preparing paper,
 "as well as taking negatives, it was desirable that the men should have as much circ-
 "ulation of air about them as possible, for the noxious fumes to escape, and the Chatham
 "tent was very superior to the box tent in this respect. It was decided consequently to
 "adopt the Chatham tent, although it required to be purposely made, and cost 5*l.* more
 "than the box tent. An extra white cover was provided to keep the tent as cool as
 "possible, when necessarily pitched in the sunshine. The lid of the box in which the
 "tent was packed was made to unhinge easily, and served as a table in the tent. The
 "tent-cover was provided with several pockets. The framework of the tent was hinged,
 "and packed into a leather bag 3 feet 11 inches long. It was found impossible to reduce
 "the length of this package. For extra protection, a common deal box with a hinged
 "lid was provided for the bag containing legs, which necessarily formed a separate
 "package. For the purpose of copying plans, &c., it was necessary to provide a portable
 "copying table, and head-board for supporting the drawing. The copying table was
 "made in three leaves, extreme length of all being 7 feet 6 inches, which admitted of the
 "camera being placed sufficiently back from the drawing to reduce it to one-fourth of
 "its original size. The leaves were of mahogany, bound together by ribbons and very
 "long brass screws. The whole table was supported on two pairs of trestles, sufficient
 "to raise the table about 3 feet off the ground. The camera was made to slide mathe-
 "matically true between the ribbons of the table, on which the scale of reduction could
 "be conveniently measured, and the position of the camera adjusted accurately
 "accordingly. The head brass measure was made to hinge at right angles to the table,
 "and was made to clamp firmly and securely by brass bars to the table. The table was
 "supported very rigidly on the trestles by brass screws with a broad head, countersunk
 "in the table and passing through the leaves of the trestles, where they were firmly
 "bolted. This table and trestles packed into a box, the longest outside dimensions of
 "which were 2 feet 8 inches. This box balanced with the tent-box and small deal case
 "containing the framework of the tent, the whole making up an ordinary mule-load of
 "about 175 lbs.

"In the selection of a lens for use in the field, it was necessary to provide a lens for
 "copying plans, free from distortion, to be also available for views and architectural
 "subjects, and for taking groups. Dallmeyer's triplet achromatic lens fulfils all these
 "conditions. A size of this lens to cover 10-inch by 12-inch plates was selected, so as to
 "ensure covering well up to the edges the 9-inch by 11-inch plates provided with the
 "equipment. The advantages claimed for this lens by Mr. Dallmeyer, are—first, that it
 "produces an image free from distortion; second, that it is available for groups, views,
 "and copying; third, that it is free from special or chromatic aberration; fourth, that it
 "covers with equal illumination a circular area embracing an angle of 45°, and when
 "stopped down for taking views, when the time of exposure is not limited, it embraces
 "an angle of 80°; fifth, that the field covered by it is as flat as possible, consistent with
 "good marginal definition.

"By using a small stop, this lens possesses the great advantage of great depth of

“ focus: in other words, it is able to take a view looking down the nave of a building, for
 “ example, all parts of which appear in perfect focus. For groups and instantaneous
 “ effects, the lens is used with the largest possible aperture, so as to attain the maximum
 “ of rapidity; but for the landscape, where time of exposure is of minor importance,
 “ smaller diaphragms are employed, bearing in mind that depth of focus can only be
 “ obtained by the use of small stops.

“ As the lens above described is not adapted for taking portraits, though it may be
 “ used for vignette heads and sitting figures by removing the centre combination, a
 “ portrait lens was provided with the equipment. As the expense of these portrait lenses,
 “ to cover the larger sizes of plates, such as the 9-inch by 11-inch, or 10-inch by 12-inch,
 “ is much increased, it was decided to select a portrait lens which, covering a plate
 “ 8½ inches by 6 inches completely, would also cover sufficiently well the principal part
 “ of a 9-inch by 11-inch plate. The lens selected is known as Ross's 3 A portrait lens,
 “ wide angle and extra rapid, and is available for taking single portraits a few feet from
 “ the sitter, or groups 20 to 30 feet distant. It is also available for taking instantaneous
 “ views of objects, such as horses or ships, in motion. This lens only consists of a back
 “ and front combination, both achromatic, the back combination being 4 inches in
 “ diameter, and the front combination 3¼ inches. As it is essential in portrait lenses
 “ that the time of exposure should be a minimum, it is necessary to provide large
 “ lenses which admit a great flood of light, and to use as small a stop as possible.
 “ The cost of this lense, with diaphragm, is 26l. 15s., that of Dallmeyer's triplet
 “ being 10l. 5s.

“ A special form of portable still was adopted, the portions of which all packed into
 “ an outer vessel of block tin, the whole apparatus packing in a deal box 2 feet long,
 “ 1 foot 2 inches wide, and 9 inches deep.

“ The remaining portion of the equipment consisted of the ordinary photographic
 “ stores, of which no special description here is necessary. It was found that the ebonite
 “ bottles were not well adapted for carrying the nitrate of silver bath, in consequence of
 “ some impurity in the ebonite; and this suggested that 40-ounce glass bottles, covered
 “ with wickerwork, would be better, and would probably be as strong. The ebonite
 “ bottles might be carried extra, in case of accident. Three appendices are attached to
 “ this Report:—

“ 1st. The general Memorandum on this subject, prepared by General Simmons for
 “ the information of Staff officers on the Abyssinian Expedition.

“ 2nd. A detailed price list of every article and package comprising the equipment,
 “ with the weights and sizes of the packages.

“ 3rd. A few memoranda drawn up by Serjeant Harrold, the non-commissioned
 “ officer in charge of the apparatus, detailing the result of the manner in which the
 “ various apparatus and chemicals fulfilled their requirements. The result is very
 “ satisfactory.

“ Six photographers were attached to the 10th Company Royal Engineers in Abys-
 “ sinia. Of these, one fell sick on arrival at Senafè. The remainder were available for
 “ work on the march to Magdala; and in addition to the marches they made with the
 “ other troops, they were employed in the evening and early morning taking negatives
 “ of plans and views. The men sat up at night sensitizing paper. Impressions were
 “ supplied, on requisition by the Quartermaster-General's Department. In all, 15,200
 “ prints of plans and views were supplied, all the copies of the plans being mounted on
 “ linen.

“ At Adigrat some of the chemicals fell short, and, on a telegraphic demand from the

‘ Commander-in-Chief, the following additional articles were despatched :—Ten 15-oz bottles Mawson’s collodion, ten 15-oz. bottles Thomas’s collodion, ten quires of albu-
“ menized paper, six pints Newman’s amber diamond negative varnish, 1 lb. bicarbonate
“ of soda.

“ The whole equipment, after all the rough usage in Abyssinia, was brought back to
“ the Royal Engineer Establishment uninjured.”

The following memorandum was prepared by General Simmons for the information of Staff Officers of the Force :—

General
Simmons’
memo-
randum.

“ The best maps of any country which can be procured are generally very insufficient
“ for military purposes, furnish but little information suitable for selecting the routes of
“ columns, and are very deficient in the details required for manœuvring troops in the
“ presence of an enemy.

“ It is evident, therefore, that for an army in active operations, this information
“ must be obtained through the exertions of the Staff, who should be continually
“ occupied in preparing and correcting maps, and supplying them for the guidance of
“ columns, whether to direct their movements by road, or their manœuvring into position
“ for attack.

“ Every road within the lines of an army, or which can be embraced within its
“ operations should be examined and surveyed, the work being pushed as far to the front
“ and on the flanks as practicable.

“ For this purpose, and for obtaining information respecting the enemy, recon-
“ noissances are constantly being pushed to the front and flanks, the routes taken by
“ which should in all cases be sketched and reported on as carefully as time and
“ circumstances will permit.

“ Information thus obtained forms the basis upon which the movements of an army
“ are determined, and when those movements have been decided it becomes essential,
“ with a view to their exact execution, that the sketches of the routes to be traversed
“ and of the ground on which the manœuvres are to be made, together with such of the
“ information as the Commanding General may desire should be available for distribution
“ with his orders with the least possible delay.

“ The readiest and most accurate mode of copying these sketches, as also maps, is
“ by photography.*

“ With a view to its application for these purposes, a photographic equipment has
“ been arranged at the Royal Engineer Establishment at Chatham, and men of the Royal
“ Engineers have been instructed in its use, but as the utility of its application will
“ depend upon the Quartermaster-General’s Department, who are charged with the
“ duties of obtaining and supplying information respecting routes, positions, encamp-
“ ments, &c., the following memoranda have been drawn up for their information :—

“ I. The photographic equipment supplies the means of copying and printing plans
“ or documents, either full-sized or on any given reduced scale, the limit of size being

* “ Photography was much used for this purpose during the late war in the United States, and in fact, the
“ maps so circulated which amounted to 1,200 in one month during General Grant’s advance to the Rapidan, in
“ 1864, were found essential to the progress of the army.”

“ that the copy of any one print shall not exceed 9 × 11 inches. If larger plans are
“ required, they must be produced in prints of that size, to be united afterwards by
“ mounting on canvas or paper. If plans have to be reduced to a less proportion than
“ one-fourth, it can be done by repeating the process of reduction, requiring more time
“ therefore, and greater expenditure of materials.

“ The first copy of any plan may be expected in about two hours, after which the
“ copies will succeed each other at the rate of about four per hour of sunlight.

“ II. It is desirable that the scales upon which all sketches are made should be, as
“ far as possible, uniform, for which purpose an order should be issued to the Staff
“ Officers composing an army, defining the scales to which they should conform in all the
“ sketches made by them; if this be done, it will not be necessary that a scale should
“ be drawn on each plan or sketch, but it will be sufficient merely to state upon it the
“ scale to which it has been drawn.

“ For sketches of a position or battle-field, 6 inches to a mile ($\frac{1}{10560}$) will be found a
“ good scale. Plans drawn on this scale and shaded according to the scale of shade laid
“ down by the Council of Military Education, and approved by His Royal Highness
“ the Field-Marshal Commanding-in-Chief, may be reduced by photography to 3 or even
“ 2 inches to a mile, but not well smaller.

“ For the purpose of reduction it is desirable that all printing and conventional signs
“ should be very clear, and in larger and heavier characters than would be employed if
“ the sketch were intended to be simply for the 6-inch scale.

“ For sketches of a road or of a line of country executed on the march, 2 inches to
“ a mile is a good scale, but it is to be observed that the scale of shade laid down by
“ the Council for the 6-inch scale will not be applicable for this smaller scale, for which
“ the lines should be stronger and heavier.

“ Plans or sketches on this scale may be reduced, if required, to a scale of 1 inch.
“ but for this purpose care must be taken that the printing and writing is very clear, and
“ rather heavier than it would otherwise be.

“ III. It is desirable that every sketch should have a north point marked upon it,
“ and that notice should be given to the whole army of the scales determined as above,
“ with a view to conformity in all the sketches which are made by other officers than
“ those of the general Staff, from whom much valuable topographical information may
“ thus be obtained adapted for immediate incorporation with the general plans of the
“ country.

“ All officers, but especially those—such as Engineer and Cavalry Officers—whose
“ duties frequently take them to a distance from the main road followed by the army,
“ should be encouraged to send sketches of the routes they follow, and the localities
“ they visit, with memoranda of their resources, which will always be useful in the
“ compilation of general maps and plans for the information of the Commanding
“ General.

“ IV. All sketches and surveys should be carefully examined by an officer, who
“ should be a good draftsman; and where more than one sketch has been taken of the
“ same ground, he should be careful to collect upon one of them all the information
“ which is to be obtained from the others, or else compile a fresh sketch upon which all
“ reliable information should be shown.

“ In many cases when sketches have been made of different tracts of country
“ adjacent to each other, they may be combined into one, the object being to cover each
“ sheet of paper with reliable information as completely as possible.

" V. Each sketch or plan, before being photographed, should have a scale of distances clearly drawn upon or attached to it, which being photographed at the same time as the plan, will form the scale upon which distances are to be measured on the copy.

" VI. The paper to be used in sketching should, with a view to the clearness of the photographs, be as white as possible, a blue rather than a yellow tinge being preferable.

" VII. Each photograph equipment consists of 18 packages, numbered 1 to 18, so arranged as to be carried in wagons, or on seven mules, according to the following Table:—

Mule Load. No.	Package. No.	Contents.	Weight of each package. lbs.
1	1	Camera.	100
	2	Chemicals.	95
			195
2	3	Dark tent.	50
	4	Framework of tent.	22
	5	Copying table.	82
			154
3	6	Printing frame.	90
	7	Glasses.	90
			180
4	8	Glasses.	95
	9	Glasses and paper.	85
			180
5	10	Chemicals.	95
	11	Chemicals.	95
			190
6	12	Chemicals.	95
	13	Chemicals.	95
			190
7	14	Portable still.	39
	15	Chemicals.	60
	16	Paper.	40
	17	Tools.	65
	18	Mountain frames.	17
			211

" These loads have been so arranged that packages Nos. 1 to 7 inclusive, may be detached for an emergency from the remainder. They will suffice to take the negatives

“ of two dozen plans and to strike off a total of 200 prints, after which they would require to be replenished from the supply stores in the other packages.

“ VIII. Each equipment provides for taking 12 dozen negative (9 by 11 inches), and four dozen smaller negatives ($8\frac{1}{2}$ by $6\frac{1}{2}$ inches), and the materials carried with it will suffice to strike off 1,700 prints.

“ IX. Means are also provided in the equipment for mounting a large proportion of them (about 1,200) of the plans on canvas, to prevent them from being torn when in use ; but, of course, a short additional delay will occur if the plans have to be mounted.”

The following is a detailed list of one photographic equipment, the second equipment being a duplicate of the first. The apparatus was supplied by Mr. Meagher, Southampton Row, High Holborn, and the chemicals by Messrs. Rouch, Strand :—

PHOTOGRAPHIC EQUIPMENT.

No. of Case.	External Dimensions of Case.		Weight.	Contents.	Value.			Cost, detailed description of equip- ment.
		ft. ins.			£	s.	d.	
1	Length	2 5 $\frac{1}{2}$	100	Camera	34	12	0	
	Width	0 11						
	Depth	1 6 $\frac{1}{2}$						
2	Length	2 4 $\frac{1}{2}$	98	Chemicals	20	7	3	
	Width	1 2						
	Depth	1 6						
3	Length	2 8	60	Photographic tent..	15	13	0	
	Width	1 4						
	Depth	0 8						
4	Length	3 11	33	Frame work of ditto	15	13	0	
	Width	0 8						
	Depth	0 5 $\frac{1}{2}$						
5	Length	2 8	82	Copying table	6	15	0	
	Width	0 10 $\frac{1}{2}$						
	Depth	1 6						
6	Length	2 3 $\frac{1}{2}$	96	Printing frame	13	1	0	
	Width	1 1 $\frac{1}{2}$						
	Depth	1 2 $\frac{1}{2}$						
7	Length	2 2	90	Glasses and portrait lens..	40	6	0	
	Width	1 1 $\frac{1}{2}$						
	Depth	1 0						
8	Length	2 4	85	Glasses, &c.	10	9	2	
	Width	1 0						
	Depth	1 2 $\frac{1}{2}$						
9	Length	2 3 $\frac{1}{2}$	95	Glasses and frames ..	17	8	9	
	Width	1 0 $\frac{3}{4}$						
	Depth	1 3						
10	Length	2 4 $\frac{1}{2}$	95	Chemicals	26	8	6	
	Width	0 11						
	Depth	1 2 $\frac{1}{2}$						
11	Length	2 4 $\frac{1}{2}$	100	,,	10	15	11	
	Width	0 11						
	Depth	1 3						

Photographic Equipment—*continued*.

No. of Case.	External Dimensions of Case.		Weight.	Contents.	Value.
		ft. ins.	lbs.		£ s. d.
12	Length	.. 2 3½	80	Chemicals	10 13 7
	Width	.. 1 0½			
	Depth	.. 1 2½			
13	Length	.. 2 3¾	85	,,	6 13 7
	Width	.. 1 0½			
	Depth	.. 1 2¼			
14	Length	.. 2 0	39	Portable still	4 15 0
	Width	.. 1 2			
	Depth	.. 0 9			
15	Length	.. 2 0	60	Miscellaneous	7 19 2
	Width	.. 1 1½			
	Depth	.. 0 10½			
16	Length	.. 1 9½	40	Prepared paper	5 18 6
	Width	.. 1 2			
	Depth	.. 0 6½			
17	Length	.. 2 4	65	Set of tools	5 16 10
	Width	.. 0 12			
	Depth	.. 0 12			
18	Length	.. 2 4	17	Mounting frame	2 10 0
	Width	.. 0 12			
	Depth	.. 0 12			
Total Cost of one Equipment					234 13 7

No. 1 Box.

Gross weight, 100 lbs.

amera, &c.

	£	s.	d.		£	s.	d.
11 by 9-inch sliding and folding camera, brass bound, complete	8	15	0	1 ebonite bath for 11 by 9-inch mahogany case	1	17	0
2 extra single backs	3	1	0	1 silver dipper for bath	0	16	6
1 extra front	0	4	6	2 16-oz. ebonite bottles in tray	0	8	0
1 extra flange for triplet lens	0	4	0	1 ebonite funnel, and 1 glass funnel to rest ½-inch teak box to contain the above: length, 2 feet 5½ inches; width, 11 inches; depth, 1 foot 6½ inches; outside dimensions covered with painted canvas and bound with iron	0	3	0
1 folding cover for enlarging	2	10	0				
1 12 by 10-inch Dallmeyer's triplet lens; rack and pinion adjustment, waterhouse diaphragms	10	5	0				
1 leather case for ditto	0	13	6				
Focussing cloth and cover for camera	0	10	6				
1 folding tripod stand and lead	1	12	0	Total	34	12	0

No. 2 Box.

Chemicals, &c.

For a few days work.

	£	s.	d.		£	s.	d.
Ebonite trays, 3 feet 13 inches by 11 inches and upwards	1	8	0	Packet of filter papers	0	1	6
2 40-oz. ebonite bottles (bath)	0	13	4	2 chamois leathers	0	3	0
2 40-oz. " " developing.. .. .	0	13	4	1 knife, 1 pair scissors	0	5	9
2 15-oz. collodion, in tins	1	0	0	1 paper knife, 2 pairs forceps	0	3	10
2 5-oz. iodizer, in tins	—	—	—	3 cleaning cloths	0	3	0
1 15-oz. amber varnish	0	10	6	3 silk handkerchiefs.. .. .	0	6	9
2 oz. cyanide of potassium	0	9	6	Packet of cotton wool	0	2	0
2 " liquor ammoniæ	—	—	—	Scales and weights, 9-inch	1	7	6
2 " acetic acid	—	—	—	1 spare 10 oz. glass bottle	0	0	6
2 " bottle, with litmus paper	—	—	—	Camel-hair brush	0	1	2
2 " nitrate silver	0	8	0	American clips, 3 dozen	0	2	6
12 drachms chloride of gold	4	4	0	Square and straight edge	0	12	9
2 portable water buckets	1	13	0	Stand for drying negatives	0	5	6
4 20-oz. ebonite bottles	0	16	0	$\frac{3}{4}$ -inch teak box to contain the above.			
2 10 " " "	0	5	2	Length, 2 feet $4\frac{1}{2}$ inches; width, 1 foot			
2 square ebonite cups	0	2	3	2 inches; depth, 1 foot 6 inches; covered			
6 ebonite developing cups	0	9	8	with painted canvas, and bound with			
1 pneumatic plate and holder	0	4	6	iron	3	12	0
Tin canister, 12 by $3\frac{1}{2}$ -inch diameter	0	1	6				
Blotting paper	0	1	0	Total	20	7	3

No. 3 Box.

Dark Tent.

Gross weight, 60 lbs.

	£	s.	d.		£	s.	d.
Chatham pattern tent, with black calico cover, and extra white cover, with straps complete	12	0	0	1 folding mahogany table for mounting prints, &c., 2 feet 6 inches by 2 feet 6 inches. Dimensions of tent box: Length, 2 feet 8 inches; width, 1 foot 4 inches; depth, 8 inches	1	0	0
Tent box, $\frac{1}{2}$ -inch teak, ebonite sink 16 by 14 inch by 3 inches deep, and pipe to ditto	1	15	0	Total	14	15	0

No. 4 Box.

Framework of Tent.

Gross weight, 33 lbs.

	£	s.	d.		tain the same.	Dimensions: Length,	£	s.	d.
Frames of well seasoned ash, with brass sockets, screws, and nuts, according to pattern in canvas bag (price included in 12 <i>l.</i> above);	—	..	..	—	3 feet 11 inches;	width, 8 inches;	depth,		
1 pine packing case with hinged lid, to con-					5½ inches ..		18	0	0
								18	0
								0	0

No. 5 Box.

Copying Table.

Gross weight, 82 lbs.

	£	s.	d.		£	s.	d.
Copying table, extreme length 7 feet 6 inches in three leaves, with head-board for supporting drawings. Leaves bound together by ribbands and brass screws, extra long, supported upon 2 sets of tressels, and the leaves secured to them by screws counter-sunk into the leaves	15	0		$\frac{5}{8}$ -inch pine box to contain the above, covered with canvas and bound with iron. Dimensions : Length, 2 feet 8 inches ; width, $12\frac{1}{2}$ inches ; depth, 1 foot 6 inches ..	2	0	0
				Total.. .. .	6	15	0

No. 6 Box.

Printing Frames.

Gross weight, 96 lbs.

	£	s.	d.		£	s.	d.
8 mahogany printing frames for 9 by 11-inch plates, extra strong	6	8	0	bound with iron. Dimensions: Length, 2 feet 3½ inches; width, 1 foot 1½ inch; depth, 1 foot 2½ inches	1	18	0
60 yards of linen in two pieces, for mounting prints	4	7	4	Total	13	11	4
Box, ½-inch teak, covered with canvas and							

No. 7 Box.

Glasses, &c.

Gross weight, 90 lbs.

	£	s.	d.		£	s.	d.
Ross's No. 3 A. portrait lens for 8½ by 6½ inches, for instantaneous views, with waterhouse diaphragms	26	15	0	Spare focussing cloth	0	6	6
Leather case for ditto	0	13	6	¾-inch teak box, covered with canvas and bound with iron, to contain the above. Dimensions: length, 2 feet 2 inches; width, 1 foot 1½ inches; depth 1 foot ..	2	12	0
1 tin of salted paper, 4½ quires	1	5	0	Total	40	6	0
2 plate boxes, each holding 2 dozen, 9 by 11 inches	1	16	4				
60 yards linen in two packets	4	7	4				

No. 8 Box.

Glasses, &c.

Gross weight, 85 lbs.

	£	s.	d.		£	s.	d.
5 ebonite trays to rest 12 by 10 inches and upwards, and to pack flush	2	1	0	¾-inch deal box covered with canvas and bound with iron to contain the above. Dimensions: Length, 2 feet 4 inches; width, 1 foot; depth, 1 foot 2½ inches ..	2	5	0
2 4-oz. ebonite bottles for hydro. sulph. of ammonium	0	13	4	Total	10	9	2
2 boxes of 9 by 11-inch plates, each holding 2 dozen	4	6	8				
1 box of 2 dozen, 8½ by 6½ inches	1	3	2				

No. 9 Box.

Glasses, &c.

Gross weight, 95 lbs.

	£	s.	d.		£	s.	d.
2 plate boxes, 9 by 11 inches each, holding 2 dozen	4	16	8	with painted canvas and bound with iron. Dimensions: Length, 2 feet 3½ inches; width, 1 foot 0¾-inch; depth 1 foot 3 inches	2	12	0
1 box of 2 dozen, 8½ by 6½ inches	1	3	2	Total	10	4	1
2 printing frames	1	12	0				
4 ebonite funnels	0	10	3				
¾-inch deal box to contain the above, covered							

No. 10 Box.

Chemicals.

Gross weight, 95 lbs.

	£	s.	d.		£	s.	d.
8 15-oz. collodion in tin cases	4	0	0	¾-inch teak box to contain the above, covered with painted canvas and bound with iron. Dimensions: Length, 2 feet 4½ inches; width, 11 inches; depth, 1 foot 2½ inches	3	6	6
3 tin cases of hypo. sulp. of soda, each holding 12 lbs.	0	9	0	3 tiers for soda, and two for other chemicals	0	10	0
2 tin cases of hydro. sulp. of ammonia, each 15 ozs.	0	3	0	Total	26	8	6
22 2-oz. bottles, nitrate of silver	17	12	0				
1 packet cotton wool	0	4	0				
4 glass rods	0	2	0				
4 10-oz. empty bottles	0	2	0				

No. 11 Box.

Chemicals.

Gross weight, 100 lbs.

	£	s.	d.		£	s.	d.
1 packet of cotton wool	0	4	0	1 30-oz. bichloride mercury	0	6	8
1 10-oz. glass measure	0	2	6	¾-inch teak box to contain the above,			
1 4-oz. " "	0	1	6	covered with canvas, and bound with			
1 oz. nitric acid in wooden case	0	4	0	iron. Dimensions: Length, 2 feet 4½			
2 10-oz. glass bottles, empty	0	1	0	inches; width, 11 inches; depth, 1 foot			
3 tins of hypo. sulph. of soda, each contain-	0	5	3	3 inches	3	6	0
ing 12 lbs.	0	9	0	Tins	0	10	6
9 15-oz. acetic acid	1	16	0				
5 " amber varnish	2	12	6	Total.. .. .	10	15	11
5 " alcohol	0	7	8				
2 " absolute ether	0	9	4				

No. 12 Box.

Chemicals.

Gross weight, 80 lbs.

	£	s.	d.		£	s.	d.
1 packet of cotton wool	0	4	0	4 15-oz. acetic acid	0	14	3
Scales and weights complete	1	17	0	2 " cyanide of potassium	0	8	4
Camels' hair brush	0	1	2	1 30-oz. bichloride of mercury	0	6	8
3 ebonite funnels	0	4	10	1 hydro. sulph. of ammonia	0	1	7
3 " cups	0	2	3	Tins	0	10	0
8-oz. glass measure	0	2	0	¾-inch teak box to contain the above,			
4-oz. " "	0	1	6	covered with canvas, and bound with			
2 2-oz. " "	0	2	6	iron. Dimensions: Length, 2 feet 3½			
1 brass spirit lamp	0	6	6	inches; width, 1 foot 0½ inch; depth,			
1 pneumatic plate holder	0	4	6	1 foot 2½ inches			
6 spare tops for "	0	6	0				
Hardwick's chemistry	0	7	6	Total.. .. .	10	3	7
13 15-oz. meth. alcohol	0	16	6				

No. 13 Box.

Chemicals.

Gross weight, 85 lbs.

	£	s.	d.		£	s.	d.
1 packet of cotton wool	0	4	0	1 spare test tube for ditto	0	2	0
10 16-oz. tins, acetate of soda	0	14	7	2 spare glass stoppers			
8 " proto. sulph. of iron	0	6	8	Tins	0	10	0
2 " tripoli powder	0	6	0	¾-inch teak box for the above, fitted with a			
1 " kaoline	0	1	0	tray; box covered with canvas and bound			
8 15-oz. iodizers	—			with iron. Dimensions: Length, 2 feet			
1 4-oz. liq. ammonia	0	1	10	3¾ inches; width, 1 foot ½ inch; depth, 1			
4 2-oz. empty bottles	0	2	0	foot 2½ inches	3	6	6
3 2-oz. iodide of potassium	0	11	6				
1 2-oz. iodine	0	2	6	Total	—	13	7
1 Argentometer	0	5	0				

No. 14 Box.

Portable Still.

Gross weight, 39 lbs.

	£	s.	d.		£	s.	d.
2 gallon oval still complete, with copper				2 feet; width, 1 foot 2 inches; depth, 9			
body to order	3	5	0	inches	1	10	0
Box, ¾-inch teak, covered with canvas and							
bound with iron. Dimensions: Length,				Total.. .. .	4	15	0

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No. 15 Box.

Chemicals.

Gross weight, 60 lbs.

	£	s.	d.		£
Packet cotton wool	0	2	0	1 ebonite funnel	0 2 2
Blotting paper, $\frac{1}{2}$ ream	0	10	0	9 white cloths	0 9 0
Packet of tamony	0	1	9	2 silk handkerchiefs	0 4 6
3 dozen assorted corks	0	1	0	Packet of filter paper	0 1 9
2 packets tacks	0	0	6	Tins	0 10 0
7 packets of pins	0	1	0	$\frac{3}{4}$ -inch deal box to contain the above, covered with canvas, and bound with iron. Dimensions: Length, 2 feet; Width, 1 foot $1\frac{1}{2}$ inches; depth, $10\frac{1}{2}$ inches ..	3 6 6
9 pieces of tape	0	2	6	Total	7 19 2
1 hammer	0	1	4		
2 screw drivers	0	1	8		
8 15-oz. pyro. gallic acid ..	1	14	0		
2 memorandum books	0	3	6		
4 chamois leathers	0	6	0		

No. 16 Box.

Paper.

£	s.	d.		iron. Dimensions: Length, 1 foot $9\frac{1}{4}$ inches; width, 1 foot 2 inches; depth, $6\frac{1}{2}$ inches	£
3 tins of paper, 2 of salted and 1 of albume- nized, each tin $4\frac{1}{2}$ quires. . . .	3	19	2		1 10 0
1 plate glass for squaring prints	0	9	6	Total	5 18 8
$\frac{3}{4}$ -inch deal box to contain the above, covered with canvas, and bound with					

No. 17 Box.

Tools.

Gross weight, 65 lbs.

£	s.	d.		£	s.	d.
Smoothing plane	0	4	0	1 small glue pot and brushes	0	2 0
Dovetail saw	0	5	3	1 hand pad of 12 bits	0	6 3
2 hammers	0	2	4	3 gimblets	0	1 0
1 pair of pincers	0	1	3	1 packets of nails, 2 of tacks	0	2 9
1 pair of cutting pliers	0	2	0	3 packets of screws, 2 balls of twine ..	0	4 7
1 pair of compasses	0	0	10	1 gauge, 1 spoke shave	0	2 7
6 bradawls	0	1	3	3 pencils, 1 marking gauge	0	2 3
1 oil stone	0	1	2	$\frac{3}{4}$ rabbit plane, 1 square	0	4 0
2 turn screws	0	3	4	2 lbs. glue, 2 lbs. marine glue	0	4 2
1 oil can	0	1	0	1 hand vice, 2 towels	0	6 0
1 wood scraper	0	1	0	$\frac{3}{4}$ -inch deal box fitted for the above, covered with canvas and bound with iron. Di- mensions: Length, 2 feet 4 inches; width, 12 inches; depth, 12 inches	2	2 6
1 scraper sharpener	0	1	0	Total	5	16 0
2 files	0	3	3			
2 three-cornered ditto	0	0	11			
1 two-foot rule	0	2	9			
5 firmer chisels	0	3	7			
2 mortice chisels	0	3	0			

No. 18 Box.

Mounting Frames.

Gross weight, 17 lbs.

£	s.	d.		£	s.	d.
4 portable mahogany frames and strainers, and brass fixing screws and nuts for mounting linen	2	2	6	inches; width, 12 inches; depth, 12 inches	0	7 6
$\frac{3}{4}$ -inch pine case, hinged lid, to contain the above. Dimensions: Length, 2 feet 4				Total	2	10 0

The following memoranda were drawn up by Serjeant Harrold, the non-commissioned officer in charge of the apparatus, detailing the results:—

Serjeant
Harrold's
memoran-
dum on
apparatus
and
chemicals.

Folding and sliding camera, answered very well.

Cone to lengthen camera, for copying purposes, was very serviceable.

Dallmeyer's triplet lens, very good, either for views or copying, and answers very well for taking groups.

White cover for camera, very good for protecting the camera from the heat.

Folding tripod. There should have been a few extra studs for fixing legs to the iron triangle, as some of them got broken, and had no means of replacing them.

Ebonite bath, very good, with one exception—that is, when the cover is screwed down, the gutta-percha sticks fast to the ebonite, owing to the heat and pressure.

Silver dipper, good.

Ebonite bottles and funnels, good. Glass bottles for carrying bath solution would be better than ebonite, covered with wickerwork.

Developing cups (ebonite), good.

Collodion and iodizers should be stoppered with cork, with the glass stopper tied round the neck of bottle.

Chloroform and amber varnish, not good for the field, but very good for indoor work.

Portable water-bucket, good.

Pneumatic plate-holders, very good.

Scissors and forceps, camel hair brushes, square and straight-edge, and stand for drying negatives, very useful.

Dark tent, very good if supplied with gorp, as it is very easily upset.

Folding mahogany table for mounting prints, copying table, printing frames, and Ross's portrait lens, very good.

Salted and albumenized paper, good.

Plate-boxes would be much better to have a single plate in each groove.

Ebonite trays answer very well.

Nitric acid should be carefully stoppered; it destroyed several other articles in box.

Ether, very badly stoppered.

Empty glass bottles, very useful.

Argentometer, very good.

Two-gallon still, very serviceable.

Packet of tammony, and spare corks, very useful.

Flat-headed tacks, very useful for mounting linen on table.

Packet of pins, very useful.

Plate glass for squaring prints should have had a wooden case, and placed in bottom of box, as it got broken, being placed inside of the lid.

Carpenters' tools, very useful.

Portable mahogany frame for mounting plans was never used, being too small for the size of plans to be mounted.

The whole of the boxes composing the equipment were good and serviceable. Some of the locks were rather weak. Nos. 1 and 2 boxes were rather heavy for a long march.

Chemicals, all very good.

CHAPTER XXXV.

SCIENTIFIC DEPARTMENTS.

On the 16th September, 1867, the Secretary of State for India asked the Government of Bombay, by telegraph, if scientific men to accompany the Expedition were available in India, or should be sent from England.

In reply, the Governor of Bombay telegraphed that he would send a member of the Geological Survey from Bengal, and probably two other scientific men for botanical and meteorological observations. Gentlemen were also sent from England to represent some of the scientific societies. The following are the names of the gentlemen sent from India to England and attached to the Force:—

Names.	Profession.	From.
Mr. C. Markham, Assistant in the India Office	.. Geographer..	.. Geographical Society, England.
Mr. R. R. Holmes, Assistant, British Museum..	.. Archæologist ..	.. British Museum ..
Mr. W. Jesse, Civil Engineer	.. Zoologist ..	.. Zoological Society ..
Surgeon Cook, M.D., Bombay Army	.. Meteorologist ..	.. India Army .. Bombay.
Mr. W. T. Blanford, Geological Survey of India	.. Geologist ..	.. Geological Survey .. Calcutta.

Sir R. Napier was informed that it was not the intention of Her Majesty's Government that these gentlemen should be placed in any official position, or invested with any departmental authority; but he was requested to give them every assistance in his power, and all information that the several public departments could afford, in furtherance of their researches. The above-named gentlemen were informed that, when within the limits of Abyssinian territory, their movements must be entirely subject to the control and sanction of the Commander-in-Chief.

The appointments made in England were submitted to the Treasury, who sanctioned liberal rates of pay and allowances for expenses.

Pay of
Geographer.

The geographer, an assistant in the India Office, received his full ordinary salary, one moiety being paid by the Treasury, the other by the Indian Department. He was also indemnified against loss, by having a free passage to and from Abyssinia, and his maintenance, including necessary expenses, the cost of instruments, &c.

Pay of
Archæo-
logist.

The archæologist was to receive 2*l.* per diem, besides rations, lodgings, &c.,* and 1,000*l.* was inserted in the estimates to cover the cost of excavations or collections.

Pay of
Zoologist.

The zoologist received a free outfit, amounting to 361*l.* 3*s.* 5*d.*, as well as free lodgings and rations, and 2*l.* per diem. The expenses of preparing and sending home zoological and archæological specimens were also allowed by the Government.

Meteorolo-
gical instru-
ments.

For the purpose of meteorological observation, the following equipment was sent:—Two mountain barometers, with empty tubes fixed; two spare tubes for each, filled; two spare tubes for each, empty; two wooden tripod cases, enclosing the barometers, and serving as stands; two copies of instructions for filling and fixing the spare tubes; one aneroid barometer, reading to 23 inches; two thermometers for solar radiation;

* For defraying incidental expenses when off the line of march.

two thermometers for terrestrial radiation; one Regnault's hygrometer, with aspirator jar. The meteorologist drew his pay as a Surgeon in the Indian Army and an allowance, making the aggregate of his monthly pay 100*l*.

Pay of Meteorologist.

Mr. Blanford, the Geologist and Natural Historian, was allowed by the Government of India the pay to which he was entitled in India, 1,155 rupees per mensem and forage for two horses. He was allowed, as assistants, three Native taxidermists, one at 50 rupees, the other two at 40 rupees each per mensem and free rations. A sum of 277 rupees was also granted to him for stores, bows, powder and shot.

Pay and establishment of Geologist.

GEOGRAPHER.

Mr. Clements Markham, Assistant Secretary of the Public Works Department in the India Office, and Secretary to the Royal Geographical Society, was appointed as Geographer to the Force in October 1867, and landed at Zula on the 12th December. He accompanied the head-quarters during the march and until the capture of Magdāla, making observations for latitude, variation, and elevation above the sea, and also keeping a meteorological journal, and recording observations on the physical characteristics of the country.

Proceedings of the Geographer.

The results of his labours are comprised in three maps of the region traversed, and eight geographical memoirs, which have since been published in the journal of the Royal Geographical Society for 1868.

ARCHÆOLOGIST.

Mr. Richard R. Holmes, F.S.A., who was deputed by the trustees of the British Museum to accompany, on their behalf, the Expedition to Abyssinia, landed at Zula on the 24th January, 1868, and proceeded at once to join the head-quarters at Senafè. From this place he accompanied the force on its journey through the country, taking every opportunity of examining the villages and churches on the route. In only one or two instances, however, was he able to make any discovery of antiquarian interest. The remains of the libraries, which to a greater or less extent were in the possession of each religious community were found to be, without exception, modern, and of small interest. No trace of really ancient MSS. could, after careful search, be discovered, nor was there in any case any relic even of ecclesiastical furniture to which an early date could be assigned. The state of intestine warfare in which the country had for so long a time been plunged seemed to afford a solution for this dearth of material of historic interest.

Proceedings of the Archæologist.

From the same cause it appeared that even the simplest arts had fallen into disuse. Only in two or three buildings in ruin could it be seen that squared masonry was employed in the architecture. A profusion of rude pictorial decoration covered the interior of the modern churches, and was interesting to the archæologist, as it exhibited in a fossilized form the traditionary types of the earliest Byzantine school of painting. Of the originals, however, of these designs, which must have been imported into the country in times cœval with the introduction of Christianity, no traces could be discovered.

For various reasons it appeared to Sir R. Napier inexpedient that any deviation from the line of march should be made by any one attached to the force. The main site of interest to the antiquary was therefore passed by. Axum, the ancient capital of the Abyssinian kingdom, was well known to contain many remarkable relics of early civilization. Travellers from Salt downwards had given accounts of its obelisks and inscriptions, and had circumstances on this occasion proved favourable, an attempt would have been made to carry on excavations at this interesting spot. A visit, however, of even a day's duration was found to be impracticable, and the only relic of the ancient kingdom which was procured was a coin of the seventh century found by a soldier near Lake Ashangi.

Mr. Holmes spent a considerable time on his return to Zula in inspecting the excavations carried out at the ruins of the ancient port of Adulis by Captain Goodfellow (see report at page 398), and in examining the country round, particularly in the hope of discovering the inscribed throne mentioned by Cosmos Indicopleustes as existing on the river bank near the ancient town, but he was unable to succeed, principally on account of the rapidity with which the re-embarkation of the force was conducted.

An account of the characteristics of the ancient churches, the remains of which were investigated, has been published in the proceedings of the Society of Antiquaries.

ZOOLOGIST.

Report of
Zoologist.

The following is an extract from the report of Mr. W. Jesse, as published in the proceedings of the Zoological Society of London :—

“My late arrival on the scene of action having prevented me from accomplishing anything like the work I wished to carry out, I eagerly seized upon an opportunity which presented itself, after the close of the campaign, of supplying the deficiencies thus occasioned.

“I heard from Mr. W. T. Blanford, Geologist to the Expedition, that he Captain Mockler (political officer), and Mr. Münzinger (Her Britannic Majesty's Consul at Massowah) contemplated an excursion into the Bogos country; and I therefore wrote to the Consul begging his permission to make one of the party. This permission I subsequently received, and under these auspices found means to fulfil my mission more completely than I had anticipated.

“On the 27th of January, 1868, I left England, and on the 24th of February we cast anchor in Annesley Bay. My arrangements on shore not being completed, I obtained a boat and crew from the Captain and started with a party to the head of the bay. I spent a couple of days here, examining the surrounding country and shooting. I procured specimens of the Naked-necked Francolin of the plains, one species of hornbill, and a variety of other birds, the most important of which were eight specimens of the *Dromas ardeola*. These latter I especially wished to bring home, both as skeletons and in spirits. Unfortunately I could not carry out this intention, as, instead of returning safely in about two hours' trip to the 'Great Victoria,' we were nearly wrecked on the opposite shore; and the energies of our crew and selves were so severely tried by wind and rain that we, with difficulty, and utterly exhausted, reached the fleet at the end of 24 hours. My specimens being spoiled, this was rather a discouraging commencement of my duties. I may here remark that I did not again obtain specimens of this bird until on my voyage home, at Suakin.

“On the 27th I landed at Zula, and reported myself to General Stewart, there awaiting orders from the Commander-in-Chief. In a few days I received an intimation from his Excellency that I should find ample scope for my researches in the neighbourhood of Zula; it was, however, at that time impossible to prosecute them with any result, on account of the country being utterly devastated of wood and grass, offering but small opportunities for the zoologist. I obtained a few specimens, when an attack of sickness put an end to my endeavours, and compelled me to go on board the hospital ship. After some days I returned ashore; but in the course of a few hours I had a relapse, which induced me to leave the plain and move up towards the highlands. I was also disappointed in not meeting at Zula with the taxidermists Lieutenant R. C. Bevan had given me reason to expect would be there; but before quitting the place

"I was fortunate enough to find a man who eventually proved of use to me in this department.

"The country lying between the sea and the foot of the hills at Kumayli was of the most barren description—to the seaward sandy, and nearer the hills broken ground, bearing, at the period of which I speak, but few traces of vegetation beyond those of low thorny mimosas and a stunted species of cypress. The plain is intersected by dry watercourses, running from the hills towards the sea. The presence of salt in the soil is to be detected from the sea even up to Kumayli. Along the seashore are belts of mangroves, affording shelter for many species of waterfowl. About an hour's ride from Zula towards the head of the bay are some hot springs, near a large grove of tamarisks. It was at this place I found spoor and dung of elephants, three species of antelope, and one of bustard. The tenants of these barren districts, as far as I could ascertain, are elephants (during the wet season), three species of antelope, wart-hogs, a small hare, one species of hyena (probably the spotted), one of jackal (probably *Canis anthus*), a jungle cat (supposed to be identical with the Syrian cat, of which I obtained a female and cubs), also a jerboa-like rodent. Scorpions are here numerous and large. For further details I shall refer to my collections at a later date. The character of the fauna of the plains is migratory, changing almost monthly from the hills to the plains, and *vice versa*.

"Proceeding up the passes, the only object worthy of special notice was the curious rodent named by Mr. Blyth *Pectinator spekii*, the existence of which was made known to me by Mr. Blanford, and of which I obtained specimens. I should have procured more specimens had not my taxidermist fallen ill with fever, and my own health continued far from good.

"On arriving at Senafè I made that place my head-quarters, and health rapidly improving, I set to work in the surrounding neighbourhood. Here, on one of my excursions, a companion who had separated from me was robbed of one of my rifles, and returned to camp stripped. Unfortunately, this happening out of my reach, I lost the opportunity of procuring a skeleton of one of the inhabitants for our investigation in England. From Senafè I made a short trip to Adigrat, adding somewhat to my collection.

"The rapid and successful termination of the Abyssinian campaign brought my labours to an unexpected close; but I continued working until Lord Napier's return to Senafè obliged me to return.

"I here found the list of birds numerically increased. About Senafè and Rahagedi the 'koodoo,' or 'aggazin' (*Strepsiceros kudu*), was found in small herds, and a fine young buck came into my possession alive—a present to the Society from Dr. Knapp, Surgeon to the 25th Bengal Native Infantry. Unfortunately, two consecutive attacks of dysentery reduced the animal to such a state of weakness that it was impossible to save it—a fact which I much regretted, as I believe at that time the Society did not possess a specimen alive in their gardens. The 'klipp-springer' antelope existed in these regions; and the 'Beni-e-Israel' antelope I found in the valleys at the back of Senafè, as also the 'wart-hog.'

"Two species of 'ground squirrel,' one striated, the other not, and one species of ichneuemon came under my notice up the passes.

"On the hills in the neighbourhood of Senafè I found another species of hare, about equal in size to a three-quarter-grown English leveret, and of the same colour. A small sandy strong-haired rat I also procured a specimen of, which was unavoidably lost.

“ On the return journey I spent a few days at Undul Wells, with a view of obtaining a more specific knowledge of the fauna of that elevation, having reason to believe it differed materially from that of the higher and lower zones. I did not, however, obtain much satisfactory information until my subsequent trip, at a later date, into Northern Abyssinia.

“ I arrived with the rear guard at Zula, where, after having made some additions to my collection, I prepared seven cases to be sent to England. As I have before stated, I obtained permission from Her Britannic Majesty's Consul at Massowah to join him, Captain Mockler, and Mr. Blanford, in an expedition into the Bogos country, which, although already explored by Brehm and Heuglin, I thought worthy of attention. Had opportunity offered, I should, in accordance with my instructions and my own wishes, have visited the country towards Lake Assal. During the third week in June we were occupied in preparing for our proposed trip. We sent our baggage and provisions round to Massowah by buggalow, and our animals by land. We ourselves started on board the ‘General Havelock’ for Massowah, where we had to remain a few days arranging our affairs.

“ On the 22nd June we left Massowah for the mainland, assembling our caravan at about four miles distance, at Makulla, and started the next morning with 38 camels, eight horses, and about 30 men. We halted at Sahati, *en route* for Ailat, and heard there of lions, but found no traces of them, so proceeded to Ailat the following day. Our camp here was situated on the banks of a wild nullah, watered by a hot spring at no great distance. This place is noted but too truly for its man-eating lions and panthers. It is a legend in the village ‘that no man dies in his bed.’ During one or two days I accompanied Captain Mockler (Mr. Blanford being lame) in pursuit of a lioness, tracks of which we had seen close to our tent, but with no success, Captain Mockler only obtaining one shot, which was without effect.

“ On the 27th of June, after some premonitory symptoms, I received a sunstroke, which completely put an end to my researches. My friend Mr. Blanford was more fortunate, and laid the good foundation of his subsequent collection. On the 29th, at about 12 o'clock at night, I was awake from my sick bed, along with my companions, by shrieks of the most fearful kind. It was pitch dark, and we rushed out of our tents with our arms in our hands, to find our followers in a state of most dire terror and confusion, filling the air with cries of ‘the Lion, the Lion’; and then a dusky form was seen to bound away over the thorn fence and disappear in the darkness. After having in some degree quieted the fears of our people, we called the roll, and found that one of my gun-bearers, a Shankgalla of huge proportions, lay dead in the midst of us, his throat bearing but too terrible marks of the manner in which the poor fellow had perished. I may add that, only the night before, Mr. Blanford's butler had been severely wounded in the head by the claws of what we supposed to be a panther. These brutes had passed by our camels, horses, milch-goats, and fires without harming anything. In the morning, after a useless search for the brute of the preceding night, on which we naturally desired to wreak our vengeance, we buried the poor victim, covered him with a pile of stones, and left for Asoos. From here we started the same day, and halted at Kuserit.

“ On the 31st we left Kuserit, and, halting at Anagully, arrived in the evening at Kanzal, where I managed to stroll out, but I was still very ill. I fired at two panthers without effect. At 6 P.M. on the 4th of July we started across the desert to Ain, on the river Lebka, which rises in the hills and flows across the plain to the sea. I stopped to look at a Bedouin village, consisting of about 100 mat huts. The inhabitants were a portion of nomad tribes which pasture their flocks, during the wet season,

“ on the coast, moving up towards the highlands as the pasturage fails. We passed
“ through the ostrich country, but we did not see any. During the night, the moon
“ being up, we saw several herds of Antelopes.

“ We arrived at Ain at about 10 o'clock. In the afternoon I went out, and suc-
“ ceeded in procuring some specimens. This place is very prettily situated, forming
“ quite an oasis in the desert. A bright stream runs through grass and high reed jungle,
“ bordered with tamarisk and other tress; a back ground of rugged barren hills, rising
“ tier above tier, enhances the beauty of the scene.

“ On the 7th of July we left Ain for Mohaber; and when there I began to regain my
“ health. Between Ain and Mahabar we found spoor of elephants, evidently in a state of
“ migration from the lowlands to the highlands. At Mohaber I added considerably to
“ my collection, particularly by specimens of a small hawk, which I take to be the *Nisus*
“ *sphenurus* of Rüppell. Mr. Blanford obtained several. The night before our arrival
“ a native had been killed by a lion. The animal left his track by the water side, and it
“ was taken up by Mr. Blanford and Captain Mockler without effect. I took up the
“ track of a solitary elephant with a like result. At 5 o'clock A.M. the next day we con-
“ tinued our march, halting at Kelamet for lunch, and arrived at 6 P.M. at Kokai, or the
“ city of the lions. Between Kelamet and Kokai the scenery improved greatly, exchanging
“ rather stunted tamarins and barren mimosas for the baba tree, or *Adansonia*, the cactus-
“ like *Euphorbia*, and a dense jungle, with a strong undergrowth of rank grass and aloes.

“ Here the climate was truly European, and indeed, at night intensely cold. The
“ fauna began to show the peculiarities which I had expected at Undul Wells, and in
“ which I was disappointed; the transition was so sudden that on the first day I pro-
“ cured three species of 'Roller,' a parrot, and several other birds.

“ The next morning we found on inquiry that elephants were in the neighbourhood;
“ so, having supplied my taxidermist with materials for his day's work, I joined Captain
“ Mockler and Mr. Blanford in an excursion in search of them.

“ I remained two days longer in this neighbourhood collecting with success, and then
“ proceeded over the pass to Bejuk on the river Anseba. Here I had a good week,
“ securing many specimens I had hitherto failed to obtain. On the 14th of July we
“ went out in pursuit of a rhinoceros we had heard of the day before, and which
“ Mr. Blanford and I had the good fortune to shoot. The next morning I went out
“ with my attendants and *posse comitatus* of natives, to bring in the skeleton, and on
“ arriving at the place I witnessed a scene precisely similar to that described by Sir
“ Samuel Baker as taking place over the carcass of a hippopotamus; women, old and
“ young, the former hideous, scratching, screaming, and fighting over the entrails, pulling
“ furiously at these or at one another's hair, it mattered not which so that possession of
“ the prey was secured; the men jabbering like jackals, fighting with sticks and knives,
“ one and all knee-deep in filth and blood; so that between them, in about four hours,
“ the skeleton was utterly bared of meat and skin, leaving not an atom for the vultures.

“ On the 18th we had the first earnest of the rainy season, which was ushered in by
“ a terrific storm of rain and hail, some of the hailstones being as large as small walnuts.
“ The Anseba, an affluent of the Barka, from a dry bed with an occasional waterhole
“ became a splendid river, varying from 50 to 100 yards in width, and flowing between
“ banks of dense jungle and fine forest trees. The spoor of elephants, black rhinoceros
“ and lions were plentiful along the banks, so much so as to give the appearance of a
“ place frequented by giant rabbits. The valley here varied from 15 to 20 miles in width,
“ the jungle and forest limiting itself to about a couple of miles on each side. The
“ remainder of the ground was stony and barren, rising gradually towards the hills, and

“ intersected by numerous nullahs running into the Anseba. Here we came in for a glimpse, on two occasions, of another species of Antelope, slightly larger than the ‘ Beni-e-Israel.’ Unfortunately I had but a momentary view of it, and never succeeded in obtaining a specimen. On the 19th we left Bejuk for Waliko, seeing on the road plenty of spoor of elephants and rhinoceros; from the dung of the latter I collected a few coleoptera. While at Waliko, finding a great scarcity of birds, I followed up more closely the tracks of the rhinoceros, passing through very dense jungle that is never penetrated by sun or air, by means of their paths, which are from two to three feet broad, and formed like galleries in a mine, about four feet high—and so entering their dens, which are very curious, having the appearance of immense arbours; they vary in size from 13 to 20 feet square, and have in some cases a smaller retreat adjoining.

“ On the 24th, Mr. Blanford and I went out birding, and came upon fresh tracks of two lions; they had followed elephants’ spoor for over two miles. The herd consisted of three old ones and a young one. The next day we left for Maraguay, where Captain Mockler shot a doe koodoo, and I procured a few birds, one species of ‘ Indicator.’ Mr. Blanford obtained a new kingfisher, of which I also secured a specimen the next day. I also shot a pair of fine ground-hornbills (*Bucorax abyssinicus*), which I prepared as skeletons. The rains having set in, and the term of our excursion drawing to a close, we left Maraguay on the 31st of July on our return journey. When I arrived at Waliko, to which place Captain Mockler had preceded us, I found that he had been charged by a herd of some 20 elephants, and had been forced to make good his escape into a tree, after hard running, and having left a bullet in the head of a large bull. At a later date I found myself in the same disagreeable predicament, and under a like disagreeable necessity. At Waliko I found two species of crested cuckoo and the English cuckoo. I also obtained a bateleur eagle, two species of tortoise, and a small squirrel. I must here state that Waliko is not, as represent in the map, on the right side of the river, but on the left, running down stream. From here we crossed over to Gabena Weld Gonfallon, or the River Plain, where Mr. Blanford and Captain Mockler killed a rhinoceros. We returned by the old route to Kokai and Kelamet, and then branched off to Rairo; here we stopped two days collecting. On the 15th of August we moved on again to Mombabarattby, where we killed a lioness, one out of four, the others running away; from this place to Ain (where we re-entered our former route), which we quitted on the 17th of August for Amba and Mai Wallet. Mr. Blanford and I stayed in Amba from the 19th to the 21st, trying to obtain specimens of the “ *Oryx beisa*.” I unfortunately did not even see one; Mr. Blanford procured four specimens. We went from Amba to Massowah, which I left on the 27th for England.

List of collections by Zoologist.

“ I append a list of my collections, full information relative to which will appear at a later date :

Skins of mammals, about	24	Reptiles in spirit, about	6
Skull of an aboriginal	1	Tortoises and lizards about	6
Skull of African elephant	1	Fish, about	30
Skeleton of rhinoceros	1	Crustacea, about	50
Heads of antelope	3	Lepidoptera, about	150
Skeletons of other mammals, about	8	Coleoptera, about	200
Skins of birds, about	750		
Birds and mammals in spirit, about	20	Total number of specimens, about	1,250

The following living specimens were also forwarded to the Zoological Society from Zula.

Young wild cats*	..	..	..	..	2
Jerboa-like land rats..	..	..	..	..	2
Guinea-fowls	..	..	..	..	2

METEOROLOGIST.

Surgeon Cook, M.D., of the Bombay Army, was the officer selected by the Bombay Government as meteorologist. He left Bombay on the 5th January, 1868, and arrived at Zula on the 20th idem, accompanied by a European assistant who had previously been attached to the Observatory at Belgaum. He arrived at Kumayli on the 14th February, at Upper Suru on the 21st idem, and ascended the Senafè Pass on the 17th of the following month, establishing an observatory there.

Proceed-
ings of Me-
teorologist.

Having remained a month at Senafè, he made a rapid journey southward as far as Ashangi.

The following is Dr. Cook's report showing the result of his labours:—

“ *Report on the Meteorology of Abyssinia.* ”

“ Intervening between the shore of Annesley Bay and the highlands of Abyssinia is a tract of sandy plain, at first but a few feet above high-water level, but rising as it extends inwards towards the base of the chain of mountains to a height of about 450 feet at Kumayli. Outlin e
the physical
characters of
the country.

“ This tract varies in width from a mere strip towards the bottom of the bay, to 8 or 10 miles opposite Mulkutto or Zula, the site chosen for the base of operations of the Force.

“ Differing in every material respect from Abyssinia proper, a notice of this country would hardly be required were it not that it was traversed by the whole of the force which entered the country, and formed the residence at the stations of Zula and Kumayli of a considerable portion of that force for the whole period of the occupation.

“ This plain, composed of exceedingly soft and loose sand, sparsely covered with a thin sprinkling of calicornias and acacias, is broken by one or two low hills of trap rock, and a spur from the Gedem Hills which lie further north.

“ At Kumayli the great mountain mass rises abruptly from the plain, and, range behind range, reaches a height of some 10,000 feet in the mountain peaks, which tower above the last few miles of the pass before the table-land is reached at Senafè.

“ The series of ranges, cross cut by the gorges of the pass, are composed of metamorphic rocks, capped by trap and sandstone, near the summit.

“ From Senafè, southward to Mai Wahiz, a distance of 50 miles, the country maintains a height, with some few exceptions, exceeding 8,000 feet, and is composed of trap and sandstone rocks; thence, as far south as Antalo, a distance of 60 miles, the level sinks some 1,000 or 1,200 feet, and a series of limestone strata is met with; succeeded by trap formations, closely resembling those of Western India, attaining a maximum elevation in the Talanta and Wadela plateaus of some 10,500 feet, cross cut by the river gorges of the Jedda and Bashilo to a depth of 3,000 or 4,000 feet,

“ The valleys and hill sides around Senafè are well clothed with forest, chiefly of the juniper, the trachitic strata forming by decomposition a light friable soil; southward to Adigrat and Mai Wahiz, as far as the sandstone extends, the soil forms good arable land, and broad plains with low scrub are frequent, thence for the next 60 miles of the limestone series the country is dry, barren, and stony, and thinly sprinkled with acacia.

* These were the only specimens forwarded by Mr. Jesse that reached the society alive. They were the young of *Felis maniculata*, Rüppell.

Physical
character
influences
climate.

Difference
in the
seasons.

Cold season
of the plains.

" At Antalo, from the decomposition of the nodular basalt, a true 'black soil' like the cotton soil of the Dekkan is met with; further south rise the mountains of Wajerat, densely covered with juniper forests, and having a rich friable soil from the decomposing trap, followed by the broad, elevated, and bleak plains of the Wadela and Talanta, and the succession of flat-topped saddle-backed trap ranges, capped with basalt like those of the plains of India.

" As may be supposed, the climate of the different tracts of country varies with, and is influenced by their physical characteristics, but that of the highlands has the same distinctive features throughout the provinces of Tigrè, Amhara, and Shoa; but differing from that of the plains in every respect; differing, indeed, as much as though separated by wide parallels of latitude or broad expanse of ocean, the one resembling some of the worst portions of the Desert of Sind, the other enjoying an European temperature.

" The variation of the seasons of the two countries (separated by difference of elevation only) is remarkable. The seasons of the highlands resemble, in their arrangement, those of the Dekkan in India, having a well-marked cold or wintry period, a hot or summer, and a monsoon or rainy season; while those of the lowlands can only be divided, like those of Scind, into a hot and a cold season. The heavy rainfall of the highlands, bringing with it coolness and verdure, does not extend into the Habesh, where, at the same period of the year, the heat and drought are most marked and intolerable, and where, if any rain falls at all, it occurs during the cold-weather months.

" Through the kindness of some Medical Officers* who were present at the commencement of the campaign, I have been able to glean some data of the months of October and November: these, with the registers of portions of the months of January and February, will probably give a fair indication of the character of the climate during the cold season of the plains. During the early part of October, at Zula, the mean daily maximum was 98·8°, and the minimum 71·6°, with an extreme maximum of 100°, and minimum of 70°. The mean daily range was thus 27°, and the extreme range 30°. The sky was clear; a slight dew was observed at night; the breeze northerly; the barometer at noon gave a mean of 30·03.†

" For the remainder of the month the register was kept at Hadoda, about 10 miles inland. Here the mean maximum temperature was 96·7°, and mean minimum 65°; the greatest maximum 99°, and least minimum 61°, giving a mean daily range of 31·7°, and an extreme range of 38°. The wind was northerly; sky clear, with a slight dew at night; the mean barometrical pressure at noon was 29·51.

" At sea, on board ship, the mean maximum was registered as 89·6°, and the mean minimum as 85·9°, giving a range only of 3·7°!

" During November the mean daily maximum was 96·4°, and the extreme maximum 105°, while the mean minimum at night was 67·4°, the lowest point reached being 66°. The diurnal range was thus 29°. The air was dry, the mean difference between the dry and wet bulb thermometers being 13°. No rain fell during the month; the sky was generally clear, and the wind northerly. At sea, during this time, the mean maximum was 83·5°, and the mean minimum 81·3°, giving a difference only of 2·2°.

" In January the heat had moderated, and the temperature was more equable. The mean maximum was 90°, mean minimum 69·0°, extreme maximum 96°, extreme

* Surgeon Lumsdaine, Assistant-Surgeon Martin, and Dr. Griffin of the P. and O. steamer "Noona."

† Approximate, by aneroid barometer.

" minimum 66°, mean diurnal range 21°, and extreme range 30°. The maximum temperature in the sun's rays was 142°, the approximate mean temperature of the month 79·5°. The mean barometrical pressure, corrected and reduced, was 29·919; the direction of the wind was north-east and east; the mean amount of ozone was 3 by day and 4 by night.

" The reading for the month of February were as follows:—Mean maximum 85°, mean minimum 71·5°, extreme maximum 93°, extreme minimum 67°, mean diurnal range 13·5°, extreme range 24°, mean temperature of the month 78·2°, mean barometrical pressure 29·907. For the first half of the month the general direction of the wind was northerly, for the remainder westerly and variable. About 1 inch of rain fell.

" The mean temperature of the cold-weather season may perhaps be set down at 81°. The nights and early mornings were cool, sometimes comparatively cold, a light breeze from the land (*i.e.* from the mountainous region) generally prevailing. This died away soon after sunrise, and the air became still and close; and frequently the temperature at 10 A.M. had almost reached its maximum for the day. About 11 A.M. the sea-breeze commenced, with pretty much uniformity, attaining its full force about noon, and continuing to blow steadily until 4 or 5 P.M., when it died away. Its good effect was very marked, and on days when it was comparatively absent the heat became oppressive.

" Dust storms occasionally occurred, and usually mitigated the heat and relieved the oppressive feeling which the peculiar electrical condition of the air excited until its gradual culmination in the storm.

" The barometrical readings were remarkably regular. The two maxima occurred at about 9·30 A.M. and P.M., and the minima at 3·30. The mean difference between these readings was but slightly above 1-10th, while the greatest difference recorded did not exceed 3½-10ths. The rain which fell in February, aided by the cloudy weather which generally prevailed through the month, did very much to mitigate the temperature and render it more agreeable, while it layed the chronic dust-storm which usually prevailed over camp the greater portion of the day, and revived the face of nature generally. The dust-covered salicornias of the plain grew green again, the acacias threw out fresh shoots, and a thin green herbage made its appearance on the loose sandy soil.

" About the latter part of the month of March the hot season commenced, and the heat grew in intensity until, in the beginning of the month of June, the mean daily maximum reached 105·6°, and the mean minimum 84·8°, the temperature never falling below 83° during day or night, and the highest was 108·5°, under the most favourable circumstances of shade and air circulation. Indeed the air was so heated that a stronger gust than usual served only to raise the thermometer a degree or two. The difference between the readings of the dry and wet bulb thermometers varied from 20° to 24° during the day, and 10° to 13° at night, the air being very dry. Hot s
of the plains.

" The mean barometrical pressure at this time was 29·676, corrected and reduced to 32°.

" The land and sea breezes were well marked; the former fortunately blew with still greater force than during the cold weather, or the effects of this extreme heat would have been more disastrous.

" The climate of the 50 miles of the pass varies of course greatly with the difference of elevation, but it assimilates more nearly with that of the lowlands. The rainfall of the cold-weather months extends up as far as Suru or Undel, *i.e.*, to an elevation of Climate of
the pass.

“ about 3,500 feet, while that of the monsoon of the highlands reaches generally to
 “ about the same extent downwards, but its effects in the shape of floods and torrents
 “ are felt throughout the length of the pass.

“ The temperature at Suru (about 2,500 feet above the sea), during the ascent of
 “ the Army in February and first half of March, was moderated by the effects of the rain
 “ on the mountains, and of the mists which hung incessantly about their summits. The
 “ nights were much cooler than those of the plains, and the range of temperature greater.
 “ On clear days, however, when no clouds intervened, it became evident that the confined
 “ air of the pass could become heated equally with that of the plains, though at so con-
 “ siderable an elevation. Thus the mean maximum temperature reached 88°, with an
 “ extreme maximum of 98°; the mean minimum temperature was 65°, and the lowest
 “ 61·5°, giving an extreme range of 36·5°. The heat consequently was at this time but
 “ little inferior to that of the coast, and the extremes greater. The ordinary rule, there-
 “ fore, of the decrease of 1° of temperature for every 300 feet of elevation does not hold
 “ good under circumstances like these.

“ At the end of May or commencement of June, when I descended the pass, the
 “ heat at this spot was intense; the maximum temperature registered was 105° in the
 “ shade, while before sunrise, at 4 A.M., the thermometer stood at 80°.

“ At this season, at Undul (some 1,300 feet higher above sea-level), the maximum
 “ heat registered was 93°, and the minimum 71·5°. At Rahagedi, about 6,500 feet, the
 “ temperature had decreased to a maximum of 86°, and a minimum of 58·5°; the rule of
 “ decrease of temperature with height here applying with greater accuracy.

Climate of
the high-
lands.

“ I have mentioned the natural division of the seasons of the highlands into a cold,
 “ a hot, and a rainy season. The cold season may be said to extend from October to
 “ February, the hot from the beginning of March to the middle of June, and the wet or
 “ monsoon period from this to the end of September.

Cold season.

“ The only month of the cold season of which I have been able to collect reliable
 “ data is December, which month may perhaps be accepted as a fair mean of this season,
 “ though colder weather may have occurred during other months of this period.

December.

“ The mean maximum for this month was 73·6°, and the mean minimum 43°, giving
 “ an estimated mean temperature of 58·3°. The extreme maximum was 77°, and the
 “ lowest temperature 39°, showing a mean diurnal range of 30·6°, and an extreme range
 “ of 38°. The mean temperature of evaporation was 54°. Dew was formed at night, the
 “ sky being usually clear, and the wind southerly or south-easterly. The days were very
 “ pleasant, but the nights cold under canvas, at times exceedingly so; and in exposed
 “ and damp situations, as on Goose Plain, near Senafè, in the following month (January)
 “ ice formed inside the tents. Mr. Blanford informed me that hoar-frost occurred at
 “ Tekunda as late as the 28th February. Dr. Kirk states that at Ankober, in Shoa,
 “ lat. 9° 35', E. long. 39° 54', at an elevation of 8,200 (?) feet, ‘ the nights are chilly in
 “ ‘ the colder months; though snow is unknown, a thin sheet of ice is often found on
 “ ‘ the more sheltered pools, whilst a white hoar-frost frequently greets the eye at day-
 “ ‘ break.’

“ The mean temperature at Ankober, for the winter months, was 52·6°, the extreme
 “ maximum 65°, and extreme minimum 41°.

“ At Magdāla, in lat. 11° 30', the mean temperature* of the cold-weather months
 “ was 56·2°; the mean maximum ranged from 70° to 72°; the mean minimum from
 “ 33° to 48°. In the year 1867 there were 12 rainy days in the month of January; in

* Deduced from Meteorological Register made by Dr. Blanc.

“ the following year, on two occasions only rain fell in this month. In February 1867 no rain fell; in the same month, in the following year, rain fell at night on nine occasions. At Ankober, in 1842, the rainfall was more equally distributed through these months of the cold-weather season.

“ The registration for the hot-weather months commenced on the 19th March. It was made under very favourable circumstances, the instruments being hung in a shed constructed to receive them, admitting a perfectly free circulation of air, but excluding all reflected heat; watertight, but not liable to be heated by the sun's rays. I found that the registrations made in the small canvas tents supplied to the Force were most unreliable and incorrect, a thermometer hung in one of them often reading 15° above that of the air in shade. Hot season.
Registration
how made.

“ The instruments were read every two hours, from 5·30 A.M. to 9·30 P.M.; and on the 1st, 11th, and 21st of the month hourly, from 3·30 A.M. to 9·30 P.M. During the months of April and May, a barometrical reading was also taken daily at 3·30 A.M. The readings were made by a mercurial mountain barometer by Newman, carefully compared with the standard at Bombay.

“ The mean maximum temperature, for the portion of the month of March under review, was 81°, the mean minimum 52·5°, the greatest maximum reading 84°, and the lowest reading 48°. The mean diurnal range of temperature was thus 28·5°, and the extreme range 36°; the estimated mean temperature 66·7°. The air was very dry through the day, the difference between the dry and wet bulb thermometer usually being from 15° to 20° at noon, and on one or two occasions reaching 25°.* To this dryness of the atmosphere was due the intensity of the sun's rays, often very marked, the solar radiation thermometer reading on several occasions 138°. The mean average relative humidity, for the 12 hours from 9·30 A.M. to 9·30 P.M., was 53·1°. The air became moister towards evening very rapidly, the difference between the dry and wet thermometers often falling 12°, and on one occasion 20° between the hours of half-past three and half-past five o'clock. The average difference at night, for this month, was 4°. Month of
March.

“ The wind was light at night, usually towards morning from the west (showing a slight inclination to the arrangement of land and sea breezes), east or south-east during the day, strong through the middle of the day, but dying away towards evening, when it frequently veered round to north-east, and brought up masses of vapour and fog from seaward.

“ The nights were generally clear and starlit; clouds, usually cirro-cumuli, gathered about 9 or 10 A.M., reached a maximum amount in the afternoon, and passed away at evening.

“ Rain fell on three occasions during the afternoons, accompanied with thunder and lightning, and on one occasion with hail.

“ The indications of ozone were always present; the mean amount by day was 3, with double that quantity at night.

“ The barometrical readings were very regular. The mean maximum, at 9·30 A.M. (which exceeded slightly the maximum at night), was 22·591; the mean minimum 22·514 (corrected and reduced to 32°); while the mean daily range was thus ·077, the greatest range observed during the month was only ·233.

“ The readings of the thermometer, during the month of April, varied to a remarkably small extent from those of March. The mean maximum was 81·5°, the mean Month of
April.

* The greatest difference yet observed in Great Britain is 18°.

" minimum 53.2° , the greatest maximum 86° , and the least minimum 49° ; the mean diurnal range was 28.3° , and the extreme range for the month 37.5° ; the estimated mean temperature 67.3° , or half a degree only above that of the previous month. The air was somewhat drier, the greatest difference between the dry and wet bulb thermometers observed being 28.5° , giving an estimated relative humidity of .159; the mean daily average for the month, from 9.30 A.M. to 9.30 P.M., being .487. On two occasions, the extreme maximum temperature in the sun's rays reached 141° . The quantity of ozone registered daily gave a mean of 3 by day and 6 by night as before.

" Rain fell on five days; about one inch was measured. There were thunderstorms on the 2nd, 14th, 23rd, and 27th; and distant thunder, with lightning, was observed on fifteen occasions, chiefly occurring in the afternoon or towards evening. Banks of fog on the north-east horizon were observed on the 5th, 6th, 10th, and 11th. The peculiar electrical condition of the air, tending to produce dust-storms and dust-columns, with violent and irregular gusts of wind, prevailed on the 10th, 11th, and 22nd.

" The wind was something more variable, especially during the first half of the month, when a westerly current was frequently noticed during the middle of the day. The general direction of the wind was easterly, rising, as before, in the morning, attaining its maximum force during the heat of the day, and fading away at evening. The nights were clear, and dew was observed on nine occasions.

" The mean reading of the barometer, at the morning maximum, was 22.594, at the afternoon minimum 22.540, the maximum reading of the month 22.641, and the lowest reading 22.493. The mean daily variation was only .054, and the extreme range .148, being even less than that of last month.

Month of
May.

" The month of May had a slightly lower general temperature, and the daily variation and range of temperature were less. The mean maximum was 77° , the mean minimum 54.5° ; the greatest maximum 83.5° , the lowest reading 49° ; the mean diurnal range 22.5° , and extreme range during the month 34.5° . The estimated mean temperature was 65.7° .

" The air was less dry, the mean difference at 9.30 A.M. being 12.8° , at 3.30 P.M. 12.6° , and at 9.30 P.M. 5° ; the maximum difference was 25° , the daily mean relative humidity .581. The average maximum temperature in the sun's rays was 125.3° , and the greatest observed temperature 139° . The quantity of ozone registered was in excess of that of the previous month, viz., 5 by day and 7 by night.

" The weather was unusually cloudy and showery throughout the month, but especially during its latter part, when the skies were frequently overcast. Rain fell on 14 days; a total of 1.86 inches was measured.

" Thunderstorms occurred on the 2nd, 3rd, 4th, 5th, 6th, 11th, 15th, and 26th, generally towards evening, and distant thunder and lightning were observed on ten other occasions. Atmospheric dust was noted on the 13th, 14th, and 24th, and fogs at night on the 8th and 9th. The wind blew more steadily from the east with fewer variations, the mean estimated force at 9.30 A.M. was 2.1, at 3.30 P.M. 3.0, and at 9.30 P.M. 1.8; the maximum force registered was 7.

" The barometrical readings were still more uniform, and showed less diurnal and extreme range than before. The morning maximum (mean average) was 22.613, and afternoon minimum 22.561, evening maximum 22.607, and morning minimum 22.568. The greatest maximum 22.654, and lowest pressure 22.523, the mean diurnal variation .052, and extreme range .131.

Equable
character of
climate.

" The equable character of the climate of these months, and their general similitude,

"are very striking, their means taken together differing to hardly any extent from the means of either. Taken as a whole, the mean diurnal range of temperature is $26\cdot4$, the extreme range 36 , and the estimated mean temperature of the hot season $66\cdot5$.

"From the results obtained by Dr. Blanc at Magdāla, I have calculated the mean temperature of this season at that place to be $65\cdot5$, and from the register kept at Ankober, in 1842, by Dr. Kirk, it is $58\cdot5$; the decrease of temperature thus evidenced towards the south being due probably to greater elevation and a damper atmosphere.

Mean annual temperature of the highlands.

"We may perhaps take the mean temperature of December at Senafè as an approximate mean for the cold season, viz., 58 . At Magdāla the mean was $56\cdot2$, and at Ankober $52\cdot6$. The mean of the rainy season at the latter place was $56\cdot3$, or $2\cdot2$ below the means of the hot season; at Magdāla 60 , or $5\cdot5$ below that of the hot. At Senafè the decrease may perhaps fairly be calculated about the same; this would give a mean temperature of 61 for the rainy season.

"These results would give an approximate mean annual temperature of $61\cdot8$ for the province of Tigré, $60\cdot5$ for Amhara, and $55\cdot8$ for that of Shoa, or a mean annual temperature for the highlands of Abyssinia of $59\cdot3$, closely approximating to that of the South of France. But the equable character of the climate of the highlands, when we contrast its seasons, becomes more remarkable than its low annual temperature, while the mean summer heat of the South of France rises considerably above, and its mean winter temperature falls much below that of the highlands of Abyssinia, the difference between the mean temperature of the summer and of the winter months of the latter country is only 6 in Shoa, and $8\cdot5$ in Tigré (approximately).

"The evenness of the barometrical readings is also very marked, especially so when the latitude of the country is taken into consideration. The mean daily fluctuation for the three months amounted only to $\cdot061$, while at Calcutta, which is 7 of latitude further north, it is nearly double that amount, and at Bombay, lat. $18\cdot58$, the mean daily variation is $\cdot102$.

Variation of atmospheric pressure.

"The extreme range of the barometer between its highest and lowest readings amounted only to $\cdot233$ in March, $\cdot148$ in April, and $\cdot131$ in May. It is to be regretted that observations with the mercurial barometer could not have been extended over a longer period in this country. Dr. Kirk was unable to make any at Ankober, three barometers received by him for the purpose being broken on the journey.

"From observations made on board Her Majesty's ship "Octavia" in Annesley Bay, kindly forwarded to me by Captain Campbell, I have deduced the following means of the barometrical readings (corrected and reduced to 32) for the months of January, February, March, and parts of April and May.

Barometric pressure at sea level.

"The mean maximum pressure for the month of January was $30\cdot006$, and the minimum $29\cdot895$, the greatest maximum $30\cdot117$, and the lowest reading $29\cdot761$, giving a mean diurnal fluctuation of $\cdot111$ and an extreme range of $\cdot356$.

"The mean maximum for February was $29\cdot994$, the mean minimum $29\cdot901$; extreme maximum $30\cdot152$, extreme minimum $29\cdot722$, giving a mean diurnal range of $\cdot093$, and an extreme monthly range of $\cdot430$.

"The mean maximum for March was $29\cdot905$, and the mean minimum $29\cdot805$, the highest reading $30\cdot078$, and the lowest during the month $29\cdot619$, giving a mean diurnal range of $\cdot102$, and an extreme range of $\cdot459$.

"The mean maximum for April was $29\cdot897$, the mean minimum $29\cdot798$, the highest reading $30\cdot039$, and the lowest $29\cdot630$, showing a mean diurnal fluctuation of $\cdot099$, and an extreme range of $\cdot409$.

Monsoon,
or rainy
season.

"In May (from 21st to 31st inclusive) the mean maximum pressure was 29·846, and the mean minimum 29·770, giving a range of ·076.

"Perhaps the most striking characteristic of the climate is the occurrence of a well-marked monsoon, or rainy season, in a climate otherwise strictly temperate. Rainy seasons, such as the well-known south-west monsoon of India, occur also in other parts of the world, as in Guinea, Central America, and elsewhere, but these occur in tropical climates with very high temperatures.

"The rainy season is of importance, not only in equalizing the temperature, increasing the fertility, and keeping up the water supply of the country, but, as Sir S. Baker has so graphically shown, it plays a most important part in the annual overflow of the Nile.

Extent of
Abyssinian
monsoon.

"The extent of country over which this monsoon falls includes the whole of Abyssinia proper, and a large tract of the country lying to the westward, roughly from the 8th to the 16th degree of north latitude, and in breadth from the 40th to the 35th or 34th meridian of east longitude.

Variation in
quantity of
rainfall.

"The amount of rainfall is greatest to the southward and westward, and decreases towards the east and north. I do not think that in the region around Senafè there is a very heavy fall. The evidences of a copious monsoon (such as are met with on the western ghâts of India) are altogether wanting. The houses and churches are flat-roofed, and constructed of materials not suited to withstand excessive wet. The trees are bare of moss and ferns, and there are no large collections of standing water. It is only as we journey southward that these indications of a moderate rainfall are lost. At Adigrat, the houses are still principally flat-roofed, though here and there a circular thatched roof is seen. These rapidly increase in proportion as we go south, and, after passing Antalo, none but circular, high, conical roofs are met with. In the mountainous region of Wojerat, about 13° N. latitude, the forest is dense, and the trees are thickly hung with moss and drooping festoons of ferns, two of which, at least, are identical in species with those found in the forests around Mahableshwur, on the mountains of Western India, where the rainfall averages 250 inches during the monsoon. South of this parallel of latitude are the lakes of Ashangi, Haik, and Dembea, &c., and here also are those wonderful river systems whose streams flow through valleys 3,000 feet below the level of the surrounding country.

Duration
and dates.

"Dr. Kirk estimated the rainfall at Ankober to be about 100 inches, judging from his knowledge of the fall during the monsoon in the Bombay Presidency, with which he was familiar; but I believe that this would be considerably under the mark, if taken as an average even for the south-east portion of the country, and, from Sir S. Baker's description of the deluges of rain which occurred in the western portion of the rainy district, the fall in that direction probably greatly exceeds that amount.

"The rainy season proper commences as a rule about the middle of June, occasionally a little earlier, and ceases about the middle of September. By the 20th June, according to Sir S. Baker, the floods make their appearance in the Blue Nile and Atbara, and disappear about the end of September. These dates, however, vary somewhat, and, as in India, the rains occasionally commence earlier or later. Thus, at Ankobar in the year 1842, there were only eight rainy days in June; at Magdâla, in 1866, there were 13 rainy days in May, while in the following year there were only three wet days in May and six in June. At Senafè rain fell on 15 days in May, and 1·860 inch were gauged.

Causes of
monsoon.

"The wind currents during this season are easterly. Earlier in the year there is a southerly tendency, and later on they blow more from the north, thus pointing toward the tract of country in the centre of the continent, whose vast deserts being heated as the sun passes northward, become the foci of the indrawn masses of atmosphere, and

				Wind.					Rain.				Ozone.		Cloud.		
Maximum Temperature of Air.	Minimum Temperature of the Air.		Extreme Range of Tempera- ture.	General Direction.	Mean Force at			Maximum Force Registered.	Total Fall.	Number of Days on which Rain fell.	Maximum Quantity Regis- tered in 24 Hours.		Mean Amount during		Mean Amount at		
Date.		Date.			9-30 A.M.	3-30 P.M.	9-30 P.M.					Date.	Day.	Night.	9-30 A.M.	3-30 P.M.	9-30 P.M.
	Degrees		Degrees						Inches.		Inches.						
26th	66·0	24th	30·0	N.E. and E.	0·7	2·7	0·4	5	0·000	0	0·000	..	3	4	3	2	1
11th	67·0	3rd	24·0	N.W. and N.E.	1·5	3·7	1·6	9	0·310	8	0·120	8th	5	5	9	9	8
18th	69·0	10th	24·0	W.	0·7	0·8	0·7	2	0·540	5	0·370	16th	6	5	8	9	9
24th	59·0	26th	27·5	W. and N.E.	1·4	1·7	1·2	4	0·370	6	0·190	27th	7	7	8	10	9
6th	61·5	10th	36·5	W.N.E. and E.	0·8	1·2	0·9	4	0·180	3	0·120	9th	3	4	6	6	6
14th	60·0	15th	24·5	E.	0·5	1·5	1·0	6	0·000	0	0·000	..	1	1	0	0	0
21st	48·0	22nd	36·0	E. and S.E.	2·5	3·6	2·8	8	1·020	3	1·000	29th	3	5	2	6	2
23rd	49·0	12th	37·5	E.	1·6	3·5	1·8	6	0·950	5	0·750	23rd	3	6	2	6	3
2nd	49·0	8th	34·5	E.	2·1	3·0	1·8	7	1·860	14	0·760	15th	5	7	5	8	6

SENAFÉ.

(On the Tableland.)

Latitude 14° 20' N. Longitude 39° 27' E. Height above the Sea about 8,000 feet.

March 19th to 31st.

• Minimum temperature on the grass first registered on 24th.
Night generally cold. Also morning and evening cool. Warm during the day, and frequently cloudy. Cool and agreeable on 23rd and 31st. Thunderstorms on the afternoons of the 19th, 21st, 26th, and 29th (heavy on 29th). Distant thunder also on the 30th.

April 1st to 30th.

Observations taken hourly on the 1st, 11th, and 21st. Weather generally cool and agreeable. Frequently cloudy during the day, and clearer at night and morning.
Thunderstorms on the afternoon of the 2nd (heavy), 9th (distant), 14th, 23rd, and 27th. Distant thunder also on the 1st, 16th, 24th, and 28th.

May 1st to 27th.

Observations taken hourly on the 1st, 11th, and 21st. Month for the most part cool and agreeable. Thunderstorms very frequent.
Hailstorm on the 6th.

Table 1. (continued)			
Mean Temperature			
Year	1901	1902	1903
1901	58.4	58.2	58.3
1902	58.5	58.3	58.4
1903	58.6	58.4	58.5
1904	58.7	58.5	58.6
1905	58.8	58.6	58.7
1906	58.9	58.7	58.8
1907	59.0	58.8	58.9
1908	59.1	58.9	59.0
1909	59.2	59.0	59.1
1910	59.3	59.1	59.2
1911	59.4	59.2	59.3
1912	59.5	59.3	59.4
1913	59.6	59.4	59.5
1914	59.7	59.5	59.6
1915	59.8	59.6	59.7
1916	59.9	59.7	59.8
1917	60.0	59.8	59.9
1918	60.1	59.9	60.0
1919	60.2	60.0	60.1
1920	60.3	60.1	60.2
1921	60.4	60.2	60.3
1922	60.5	60.3	60.4
1923	60.6	60.4	60.5
1924	60.7	60.5	60.6
1925	60.8	60.6	60.7
1926	60.9	60.7	60.8
1927	61.0	60.8	60.9
1928	61.1	60.9	61.0
1929	61.2	61.0	61.1
1930	61.3	61.1	61.2
1931	61.4	61.2	61.3
1932	61.5	61.3	61.4
1933	61.6	61.4	61.5
1934	61.7	61.5	61.6
1935	61.8	61.6	61.7
1936	61.9	61.7	61.8
1937	62.0	61.8	61.9
1938	62.1	61.9	62.0
1939	62.2	62.0	62.1
1940	62.3	62.1	62.2
1941	62.4	62.2	62.3
1942	62.5	62.3	62.4
1943	62.6	62.4	62.5
1944	62.7	62.5	62.6
1945	62.8	62.6	62.7
1946	62.9	62.7	62.8
1947	63.0	62.8	62.9
1948	63.1	62.9	63.0
1949	63.2	63.0	63.1
1950	63.3	63.1	63.2
1951	63.4	63.2	63.3
1952	63.5	63.3	63.4
1953	63.6	63.4	63.5
1954	63.7	63.5	63.6
1955	63.8	63.6	63.7
1956	63.9	63.7	63.8
1957	64.0	63.8	63.9
1958	64.1	63.9	64.0
1959	64.2	64.0	64.1
1960	64.3	64.1	64.2
1961	64.4	64.2	64.3
1962	64.5	64.3	64.4
1963	64.6	64.4	64.5
1964	64.7	64.5	64.6
1965	64.8	64.6	64.7
1966	64.9	64.7	64.8
1967	65.0	64.8	64.9
1968	65.1	64.9	65.0
1969	65.2	65.0	65.1
1970	65.3	65.1	65.2
1971	65.4	65.2	65.3
1972	65.5	65.3	65.4
1973	65.6	65.4	65.5
1974	65.7	65.5	65.6
1975	65.8	65.6	65.7
1976	65.9	65.7	65.8
1977	66.0	65.8	65.9
1978	66.1	65.9	66.0
1979	66.2	66.0	66.1
1980	66.3	66.1	66.2
1981	66.4	66.2	66.3
1982	66.5	66.3	66.4
1983	66.6	66.4	66.5
1984	66.7	66.5	66.6
1985	66.8	66.6	66.7
1986	66.9	66.7	66.8
1987	67.0	66.8	66.9
1988	67.1	66.9	67.0
1989	67.2	67.0	67.1
1990	67.3	67.1	67.2
1991	67.4	67.2	67.3
1992	67.5	67.3	67.4
1993	67.6	67.4	67.5
1994	67.7	67.5	67.6
1995	67.8	67.6	67.7
1996	67.9	67.7	67.8
1997	68.0	67.8	67.9
1998	68.1	67.9	68.0
1999	68.2	68.0	68.1
2000	68.3	68.1	68.2
2001	68.4	68.2	68.3
2002	68.5	68.3	68.4
2003	68.6	68.4	68.5
2004	68.7	68.5	68.6
2005	68.8	68.6	68.7
2006	68.9	68.7	68.8
2007	69.0	68.8	68.9
2008	69.1	68.9	69.0
2009	69.2	69.0	69.1
2010	69.3	69.1	69.2
2011	69.4	69.2	69.3
2012	69.5	69.3	69.4
2013	69.6	69.4	69.5
2014	69.7	69.5	69.6
2015	69.8	69.6	69.7
2016	69.9	69.7	69.8
2017	70.0	69.8	69.9
2018	70.1	69.9	70.0
2019	70.2	70.0	70.1
2020	70.3	70.1	70.2
2021	70.4	70.2	70.3
2022	70.5	70.3	70.4
2023	70.6	70.4	70.5
2024	70.7	70.5	70.6
2025	70.8	70.6	70.7
2026	70.9	70.7	70.8
2027	71.0	70.8	70.9
2028	71.1	70.9	71.0
2029	71.2	71.0	71.1
2030	71.3	71.1	71.2
2031	71.4	71.2	71.3
2032	71.5	71.3	71.4
2033	71.6	71.4	71.5
2034	71.7	71.5	71.6
2035	71.8	71.6	71.7
2036	71.9	71.7	71.8
2037	72.0	71.8	71.9
2038	72.1	71.9	72.0
2039	72.2	72.0	72.1
2040	72.3	72.1	72.2
2041	72.4	72.2	72.3
2042	72.5	72.3	72.4
2043	72.6	72.4	72.5
2044	72.7	72.5	72.6
2045	72.8	72.6	72.7
2046	72.9	72.7	72.8
2047	73.0	72.8	72.9
2048	73.1	72.9	73.0
2049	73.2	73.0	73.1
2050	73.3	73.1	73.2
2051	73.4	73.2	73.3
2052	73.5	73.3	73.4
2053	73.6	73.4	73.5
2054	73.7	73.5	73.6
2055	73.8	73.6	73.7
2056	73.9	73.7	73.8
2057	74.0	73.8	73.9
2058	74.1	73.9	74.0
2059	74.2	74.0	74.1
2060	74.3	74.1	74.2
2061	74.4	74.2	74.3
2062	74.5	74.3	74.4
2063	74.6	74.4	74.5
2064	74.7	74.5	74.6
2065	74.8	74.6	74.7
2066	74.9	74.7	74.8
2067	75.0	74.8	74.9
2068	75.1	74.9	75.0
2069	75.2	75.0	75.1
2070	75.3	75.1	75.2
2071	75.4	75.2	75.3
2072	75.5	75.3	75.4
2073	75.6	75.4	75.5
2074	75.7	75.5	75.6
2075	75.8	75.6	75.7
2076	75.9	75.7	75.8
2077	76.0	75.8	75.9
2078	76.1	75.9	76.0
2079	76.2	76.0	76.1
2080	76.3	76.1	76.2
2081	76.4	76.2	76.3
2082	76.5	76.3	76.4
2083	76.6	76.4	76.5
2084	76.7	76.5	76.6
2085	76.8	76.6	76.7
2086	76.9	76.7	76.8
2087	77.0	76.8	76.9
2088	77.1	76.9	77.0
2089	77.2	77.0	77.1
2090	77.3	77.1	77.2
2091	77.4	77.2	77.3
2092	77.5	77.3	77.4
2093	77.6	77.4	77.5
2094	77.7	77.5	77.6
2095	77.8	77.6	77.7
2096	77.9	77.7	77.8
2097	78.0	77.8	77.9
2098	78.1	77.9	78.0
2099	78.2	78.0	78.1
2100	78.3	78.1	78.2

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 2099 78.0
 2100 78.1

"the main-spring of the whole phenomena. The vast column of air thus drawn in over the country comes from the region of the Arabian Sea and Indian Ocean, over which at this season of the year the south-west monsoon, laden with moisture from the equatorial sea, is blowing. Thus Abyssinia, and more indirectly but not less consecutively, Egypt itself participates in the benefit of those climatic phenomena, which originated by the ascending heated air-currents of Central Asia bring fertility and verdure to the plains of Hindostan.

"Much as the monsoon of Abyssinia resembles that of Western India, it differs in one particular. A large proportion of the rain-fall of the south-west monsoon is precipitated on the conkan, or seaboard of Western India, where the fall amounts to about 80 inches; on the line of the Western Ghâts it reaches 250 inches, but decreases rapidly as it passes eastward, and at Poona is only 24 inches. The reverse of the case is observed in Abyssinia, no fall whatever takes place on the seaboard, and the quantity which is precipitated on the eastern flanks of the mountain ranges is less than that which falls more to westward, while it extends with slowly diminishing force away towards the vast plains which lie to the west of the highlands of Abyssinia.

Difference between the monsoon of India and Abyssinia.

"The monsoon of Abyssinia is termed by the people 'the rains of the Covenant.' There is, especially towards the southward a second, less-marked, rainy season, or rather period of the year in which rain is expected to fall, called by the inhabitants 'the rains of Bounty.'

Rains of Bounty.

"This period comprehends the latter half of February, March, and part of April. The quantity and the period of the rain-fall alike seem, however, very uncertain. At Ankobar, in 1842, there were seven rainy days in February, four only in March, and 14 in April, while at Magdāla, in 1867, rain fell on one day only in February, on 10 in March, and on two in April. At Senafè there were one or two showers in February, three days in which rain fell in March, and four in April, whereas there were 14 rainy days in May and a considerable fall of rain occurred. This fall was still heavier towards the south, and in the mountainous region of Wojerat, between Antalo and Ashangi exceedingly heavy storms occurred, during which several inches of rain must have fallen. It would seem, therefore, that these 'rains of Bounty' are (especially toward the north-east of the highlands) very precarious, both as to quantity and period, and likely in the region around Senafè to be deferred so late as to immediately precede or run into the more exact and determined period of the 'rains of the Covenant.'"

GEOLOGIST.

Mr. Blanford was permitted by the Government of India to accompany the Force as geologist and zoologist. He left Bombay on the 4th December, 1867, landed at Zula on the 22nd, and left for the interior on the 12th February, 1868. In the meantime he explored the immediate vicinity of Zula, visited Hadoda and Wiah, examined the Kumayli Pass, and, in company with Dr. Cook, went to the southern extremity of Annesley Bay. Having examined into the geology of Senafè, and paid a visit to Tekonda, the Koheito Plateau, and Halai, he started for the front on the 17th March and reached Magdāla on the 10th April, having performed the journey in 21 days, which allowed little time for a careful examination of the country.

Proceedings of Geologist.

Mr. Blanford left Magdāla on the 16th April. He remained seven days near the Lake of Ashangi, and was back at Senafè on the 25th May. Previously to leaving Africa he paid a visit to the hot springs of Ailat, and to the country of the Bogos, above

Massowah, accompanied by Mr. Jesse and Mr. Münzinger. He finally left the coast of Africa on the 29th August for Bombay.

Scientific
results.

The scientific results of Mr. Blanford's journey are of much value. He has determined the true succession of the principal rocks constituting the Abyssinian highlands, defining their characters with greater exactness than had been done previously. He has, moreover, collected (with the assistance of officers who took an interest in his labours), 2,019 specimens of vertebrate animals representing 390 species, and about 3,500 specimens of molusca and articulata, representing 500 species.

The results of Mr. Blanford's researches are laid down in an illustrated work published by Messrs. Macmillan, and styled "Observations on the Geology and Zoology of Abyssinia."

List of
Zoological
specimens
collected by
Geologist.

The following is the list of the specimens of Vertebrata collected by Mr. Blanford:—

	No. of Specimens of each Species		No. of Specimens of each Species.
SUB-KINGDOM—VERTEBRATA.*			
I. CLASS—MAMMALIA.			
Order— <i>Quadrumana</i> .			
1. <i>Cynocephalus hamadryas</i> , <i>L.</i> ..	3	10. <i>Herpestes mutigella</i> ? <i>Rüpp.</i> , var 5 complete skins. 1 flat skin (imperfect). 1 skeleton.	7
* 1 skin with skull.		8. <i>Hyæna crocuta</i> , <i>L.</i>	1
* 2 skulls.		* 1 complete skin.	
2. <i>Cercopithecus griseoviridis</i> , <i>Desm.</i> ..	4	6. <i>Canis mesomelas</i> , <i>L.</i>	1
* 1 complete skin.		* 1 complete skin.	
† 1 flat skin.		7. <i>Canis</i> , <i>sp.</i>	3
* 1 skeleton.		3 complete skins (* 1 † 2).	
† 1 skull.		Order— <i>Pachydermata</i> .	
Order— <i>Cheiroptera</i> .			
40. <i>Vespertilio</i> , <i>sp.</i>	1	22. <i>Phacocheirus æliani</i> , <i>Rüpp.</i> ..	3
† 1 specimen in spirit.		* 1 complete skin.	
Order— <i>Carnivora</i> .			
3. <i>Felis maniculata</i> ? <i>Rüpp.</i>	1	* 1 head (skin and skull).	
† 1 complete skin.		* 1 skull.	
4. <i>Felis</i> , <i>sp.</i>	1	23. <i>Rhinoceros Keitloa</i> ? <i>Smith.</i> ..	1
† 1 complete skin.		† 1 head (skin and skull).	
5. <i>Genetta tigrina</i> ? <i>Gray</i>	1	24. <i>Hyrax</i> , <i>n. sp.</i> ?	1
1 flat skin.		† 1 complete skin.	
9. <i>Herpestes gracilis</i> ? <i>Rüpp.</i>	1	25. <i>H. abyssinicus</i> ? <i>Ehr.</i>	20
1 complete skin.		15 complete skins. 2 flat skins (imperfect). 2 skeletons. 1 skull.	

* In the Mammalia when a complete skin is specified a skin with skull and leg-bones is meant. A flat skin is without skull or leg-bones.

The numbers preceding each correspond with similar numbers on the labels affixed to the specimens. In the birds in general the sexes are only noted where they differ ;—(*) indicates male ; (†) female.

	No. of Specimens of each Species.		No. of Specimens of each Species.
25a. <i>Do. var. a.</i> ? <i>H. Brucier, Gray</i> ; or <i>H. alpini, Gray</i> 6 complete skins. 1 flat skin (imperfect). 1 skeleton.	8	18a. <i>Do. rufus, var.</i> 8 complete skins.	8
25b. <i>Do. var. b.</i> 1 complete skin.	1	19. <i>Strepsiceros Kudu</i> * 1 skin with skull; no leg-bones. † 1 flat skin.	2
26. <i>Hyrax, sp. ? nov.</i> 2 complete skins.	2	20. <i>Capra hircus, h. var. (domestic)</i> .. * 1 complete skin of large-horned variety.	1
<i>Order—Proboscidea.</i>		21. <i>Ovis steatopygus, Pallas (domestic)</i> * 1 skull. 1 foetus in spirit.	2
27. <i>Elephas africanus, Cuv., var.</i> .. † 1 skull.	1	<i>Order—Rodentia.</i>	
<i>Order—Ruminantia.</i>		28. <i>Lepus abyssinicus, Ehr.</i> .. . 5 complete skins.	5
11. <i>Gazella soemmerringii, Rüpp.</i> .. * 1 complete skin. † 1 flat skin without head or feet. 2 skulls (* 1 1 †). † 1 frontlet.	5	29. <i>L. aegyptius? Geoffroy</i> 4 complete skins.	4
12. <i>G. dorcas? h</i> † 1 complete skin. 2 heads (skin and skull) * 1 † 1. 2 skulls without lower jaw. (one imperfect) * 1 † 1. * 1 horns of young buck.	6	30. <i>Sciurus annulatus, F. Cuv.</i> .. 3 complete skins.	3
13. <i>G. (perhaps G. Arabica, Ehr.)</i> .. * 1 skull.	1	31. <i>Xerus rutilus, Rüpp.</i> 4 complete skins.	4
14. <i>Oryx Beisa, Rüpp.</i> † 2 complete skins. † 1 skeleton.	3	32. <i>X. leuco-umbrinus, Rüpp.</i> 12 complete skins. 2 flat skins, imperfect. 2 skeletons.	16
15. <i>Oreotragus sultatrix</i> † 1 complete skin. * 1 head.	2	33. <i>Pectinator spekii, Blyth</i> 6 complete skins. 1 „ in spirit. 6 specimens in spirit.	13
16. <i>Scopophorus montanus, Rüpp.</i> .. * 1 complete skin.	1	34. <i>Bathyergus (? Rhizomes) splen-</i> <i>dens, Rüpp.</i> 2 complete skins. 1 specimen in spirit. 1 skeleton.	4
17. <i>Cephalophus Madoqua, Rüpp.</i> .. * 2 skins with skulls, but with- out leg-bones.	2	35. <i>Euryotis, sp.</i> 4 complete skins.	4
18. <i>C. hemprichii, Ehr.</i> 3 complete skins (* 1 † 2). † 1 flat skin. * 1 skeleton.	5	36. <i>Mus, sp.</i> 2 specimens in spirit.	2
		37. <i>Mus, sp.</i> 2 specimens in spirit.	2

			No. of Specimens of each Species.				No. of Specimens of each Species.
38. Mus, <i>sp.</i>	..	..	1	18A. Do. in immature plumage ..	..	..	2
1 specimen in spirit.				19. Gypogerranus serpentarius, <i>L.</i> ..	..	..	1
39. Gerbillus, <i>sp.</i>	..	..	9	1. Gypaëtos meridionalis, <i>Keyser Blas.</i> ..	..	..	2
3 complete skins.				20. Milvus ater, <i>L.</i>	..	..	5
6 specimens in spirit.				21. M. ægyptius, <i>Gmel.</i>	..	..	1
			166	22. Circus æruginosus, <i>L.</i>	..	..	2
				23. Circus cineraceus, <i>Montague</i> ..	..	..	3
						1 *	1 *
				24. C. Swainsoni, <i>A. Smith</i>	..	..	1 *
				<i>Family—Strigidae.</i>			
				25. Bubo (perhaps B. cineraceus, <i>Geu-</i>	..	..	3
				<i>rin</i>)	..	..	1
				26. B. maculosus, <i>Vieill.</i>	..	..	4
				27. Athene meridionalis? <i>Risso</i> ..	..	..	2
				28. Scops vulgaris, <i>Cuv.</i>	..	..	
				ORDER—SCANSORES.			
				<i>Family—Psittacidae.</i>			
				29. Pœocephalus meyeri, <i>Cretzschmar</i> ..	..	..	10
				30. Agapornis tarantæ, <i>Stanley</i> ..	..	..	11
						7 * 4 †	2
				31. Palæornis cubicularis, <i>Hasselquist</i> ..	..	..	
				ORDER—INSESSORES.			
				<i>Family—Bucconidae.</i>			
				32. Pogonorrhynchus saltii, <i>Stanley</i> ..	..	..	2
				33. P. Undatus, <i>Rüpp. var</i>	..	..	6
				34. P. melanocephalus, <i>Rüpp.</i>	..	..	3
				35. Barbatula chrysoconus, <i>Temm.</i> ..	..	..	4
				36. Trachyphonus margaritatus, <i>Rüpp.</i> ..	..	..	9
				<i>Family—Picidae.</i>			
				37. Picus (Campethera) æthiopicus,	..	..	11
				<i>Hemprich</i>	..	..	5 * 5 † 1 ?
				37A. P. do. young (?-P. erythrusus, <i>Swain.</i>)	..	..	1 *
				38. P. (Dendrobates) hemprichii, <i>Ehr.</i> ..	..	..	2
						1 * 1 †	
				<i>Family—Indicatoridae.</i>			
				39. Indicator (probably I. archipelagicus,	..	..	1 *
				<i>Temm</i>)	..	..	1 *
				40. I. minor, <i>Le Vaill</i>	..	..	
				<i>Family—Cuculidae.</i>			
				41. Cuculus canorus, <i>L.</i>	..	..	1
				42. Oxylophus (probably O. afer, <i>Leach</i>)	..	..	3
				43. O. melanoleucos? <i>gm.</i>	..	..	1
				44. Chrysococcyx, <i>sp.</i>	..	..	2
				45. C. <i>sp.</i>	..	..	1
				46. Centropus monachus, <i>Rüpp.</i> ..	..	..	2
				47. C. superciliosus, <i>Rüpp.</i>	..	..	7

RESUMÉ

Orders.

	Species.	Specimens.
Quadrumania	2	7
Cheiroptera	1	1
Carnivora	8	16
Pachydermata	5	36
Proboscidea	1	1
Ruminantia	11	38
Rodentia	12	67
	40	166

II. CLASS—AVES.

A. Skins.

ORDER—RAPTORES.

Family—Vulturidae.

3. Gyps Rüppelli, <i>Pr. P. v. Wart.</i> ..	1
2. Neophron percnopterus, <i>L.</i> ..	4
4. N. Pileatus, <i>Burchell</i>	2

Family—Falconidae.

5. Falco, jaggur? <i>Gray</i>	1 *
6. F.	5
	4 * 1 †
7. F.	1 †
8. F.	1 †
9. Tinnunculus alaudarius, <i>Bris</i> ..	5
	2 * 3 †
10. T. Cenchris, <i>Naum</i>	4
	2 * 2 †
	5
11. Melierax polyzonus, <i>Rüpp.</i> ..	1
12. Accipiter unduliventur? <i>Rüpp.</i> ..	2
13. Micronisus niger? <i>Vieill.</i> ..	2
14. M. gubar? <i>Le Vaill.</i>	2
15. M. Sphenurus, <i>Rüpp.</i> (adult) ..	2
15A. M. do., in younger plumage ..	7
16. Aquila nævioides, <i>Cuv.</i>	5
17. Helotarsus ecaudatus, <i>Dand.</i> ..	2
18. Buteo augur, <i>Rüpp.</i>	7

	No. of Specimens of each Species.		No. of Specimens of each Species.
<i>Family—Musophagidae.</i>			
48. <i>Turacus leucotis</i> , Rüpp.	11	84. <i>M.</i> (probably <i>M. lafiesnayii</i> , Guer.)	7
49. <i>Chizcerhis zoucera</i> , Rüpp.	6	85. <i>M.</i> (probably <i>M. erythropterus</i> , Gmel.)	1
<i>Family—Coliidae.</i>			
50. <i>Colius leucotis</i> , Rüpp.	4	<i>Family—Bucerotidae.</i>	
51. <i>C. senegalensis</i> , L.	5	86. <i>Tockus limbatus</i> , Rüpp.	4
<i>C.</i> " (young)	2	87. <i>T. flavirostris</i> , Rüpp.	4
<i>Family—Caprimulgidae.</i>			
52. <i>Caprimulgus</i> , <i>sp.</i>	2	88. <i>T. erythrorhynchus</i> , Lath.	7
53. <i>C. sp.</i>	1 * 1 †	89. <i>T. nasutus</i> ? Lath.	10
54. <i>C. sp.</i> (wing only)	1 * 2 †	90. <i>Tmeterceros abyssinicus</i> , Gmel. ..	7 * 3 †
<i>Family—Cypselidae.</i>			
55. <i>Cypselus æquatorialis</i> , Mull. ..	2	<i>Family—Upupidae.</i>	
56. <i>C. apus</i> , L. <i>var.</i>	4	91. <i>Upupa epops</i> , L.	4
57. <i>C. affinis</i> , Licht.	6	91A. <i>U. epops var. senegalensis</i> , Sw. ..	2
<i>Family—Hirundinidae.</i>			
58. <i>Hirundo melanocirissus</i> , Rüpp. ..	1	<i>Family—Promeropidae.</i>	
59. <i>H. striolata</i> , Rüpp.	1	92. <i>Promerops erythrorhynchus</i> ? Cuv.	10
60. <i>H. riocourii</i> , Sav.	4	93. <i>P. senegalensis</i> ? Vieill.	7 * 2 † 1 ?
61. <i>H.</i> (probably <i>H. filicaudata</i> , Lath.) ..	2	94. <i>P. cyanomelas</i> ? Cuv.	1 †
62. <i>H. rufula</i> ? Temm.	2	<i>Family—Nectarinidae.</i>	
63. <i>H. sp.</i>	1	95. <i>Nectarinia abyssinica</i> ? Ehr. ..	11
64. <i>Hirundo rustica</i> ? L. <i>var.</i>	2	95A. <i>N. do. young</i> (? <i>N. gularis</i> , Rüpp.)	10 * 1 †
65. <i>H. pristoptera</i> , Rüpp.	1	96. <i>N. affinis</i> , Rüpp.	2
66. <i>Chelidon urbica</i> , L.	1	97. <i>N. cruentata</i> , Rüpp.	9
68. <i>Cotyle</i> (probably <i>C. torquata</i> , L.) ..	3	98. <i>N. sp.</i>	7 * 2 †
69. <i>C. rupestris</i> , Scopoli	2	99. <i>N. tacazze</i> , Stanley	5
67. <i>C. riparia</i> , L.	1	100. <i>N. metallica</i> , Licht.	4 * 1 †
<i>Family—Coraciidae.</i>			
70. <i>Coracias abyssinica</i> , L.	12	101. <i>N. pulchella</i> , L.	1 *
71. <i>C.</i> (probably <i>C. levaillantii</i> , Temm.)	11	<i>Family—Muscicapidae.</i>	
72. <i>Eurystomus</i> (probably <i>E. afer</i> , Cuv.)	13	102. <i>Tchitrea ferreti</i> , Guerin	8
<i>Family—Halcyonidae.</i>			
73. <i>Halcyon rufiventer</i> , Swains ..	6	103. <i>Muscicapa chocolatina</i> ? Rüpp. ..	2 adult *
74. <i>H. sp.</i>	2	104. <i>M.</i> (probably <i>M. torquata</i> , L.) ..	6
75. <i>H. cærulea</i> , Kuhl.	7	<i>Family—Laniidae.</i>	
76. <i>Alcedo</i> ? <i>senegalensis</i> ? L. ..	3	105. <i>Lanis excubitor</i> , L.	7
77. <i>A. semitorquata</i> , Swains	1	105A. <i>L. (? do. young)</i>	4 * 3 †
78. <i>Ceryle</i> , <i>sp.</i>	1	106. <i>L. rufus</i> , Brisson	3
<i>Family—Meropidae.</i>			
79. <i>Merops lamarekii</i> , Cuv.	9	107. <i>L. cristatus</i> , L.	2
80. <i>M. apiaster</i> , L.	3	108. <i>L. collaris</i> , Lath.	7
81. <i>M. ægyptius</i> ? Forsk.	2	109. <i>L. sp.</i>	13
82. <i>M. cæruleocephalus</i> , Lath.	2	110. <i>Telephorus æthiopicus</i> , Rüpp. ..	4
83. <i>M. cuvieri</i> , Licht.	9	111. <i>Dryoscopus Cubla</i> , Lath.	11
		112. <i>Nilans Brubru</i> , Lath.	4
			2 * 3 †

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	No. of Specimens of each Species.		No. of Specimens of each Species.
<i>Family—Fringillidæ.</i>		ORDER—GEMITORES.	
190. Hyphantornis larvatus, Rüpp. ..	6	<i>Family—Columbidæ.</i>	
190A. H. do. in winter plumage ..	5 * 1 †	226. Columba guinea, L. ..	6
192. H. guerini, Gray ..	3	227. C. albitorques, Rüpp. ..	3
	12	228. Turtur erythrophrys, Swains. ..	5
193. H. galbula, Rüpp. ..	6 *	229. T. Lugens, Rüpp. ..	6
	18	230. T. (? albiventris, Gray) ..	5
194. H. personata, Cassin ..	7 *	231. T. senegalensis? L. ..	6
195. Euplectes exanthomelas, Rüpp. ..	3 *	232. Peristera chalcospilos, Sw. ..	8
	6	233. Oena capensis, Lath. ..	12
191. E. sp. ..	4 * 2 †		7 * 5 †
196. Quelea sanguinirostris, Sw. var. Orientalis ..	1 *	233A. O. do. young ..	2
	12		1 * 1 †
197. Coliuspasser macrocercus? Licht. ..	7 * 5	234. Treron abyssinica, Lath. ..	6
	5	ORDER—RASORES.	
198. Vidua sphenura, Ver. ..	2 * 3 †	<i>Family—Pteroclidæ.</i>	
199. V. principalis, Cuv. ..	3	235. Pterocoles exustus, Temm. ..	2
200. Amadina (Euroloncha) cantans, Gm. ..	2		1 * 1 †
201. A. (ortygospiza) polyzona, Temm. ..	4	236. P. lichtensteini, Temm. ..	8
202. Estrela frenata, Licht. ..	2		3 * 5 †
203. E. ernesti, Hengl. ..	3	237. P. gutturalis? A. Smith ..	2
204. E. (Lagonosticta) minima, Vieill. ..	2		1 * 1 †
205. E. (phoenicotis) Sw. ..	3	<i>Family—Numididæ.</i>	
	5	238. Numida ptilorhyncha, Licht. ..	7
206. Zonogastris citerior, Strickl. ..	4 * 1 †	<i>Family—Perdicidæ.</i>	
	6	239. Chacura melanocephala, Rüpp. ..	1
207. Emberiza septemstriata, Rüpp. ..	4 * 2 †	240. Francolinus erckelii, Rüpp. ..	7
	9		4 * 3 †
208. E. flavigaster, Rüpp. ..	3 †	241. F. ruppelli, G. R. Gray ..	9
209. Passer Swainsoni, Rüpp. ..	4		4 * 5 †
210. P. (perhaps P. superciliosus, A. Hay) ..	11	242. F. gutturalis, Rüpp. ..	6
211. P. sp. ..	6		5 * 1 †
212. P. ? tristriatus, Rüpp. ..	1	243. Pternistes rubricoleis, Rüpp. ..	8
213. Crithagra xanthopyus, Rüpp. ..	7		4 * 3 † 1?
214. C. nigriceps, Rüpp. ..	2	ORDER—GRALLATOIRES.	
215. C. (perhaps, C. aurifrons, Hengl.) ..	3	<i>Family—Otidae.</i>	
216. C. citrinelloides? Rüpp. ..	2	244. Otis (Eupodotis) Arabs, L. ..	5
217. Serinus striola tus, Rüpp. ..	2		4 * 1 †
	5	245. O. (Sypheotides) melanogaster, Rüpp. ..	2
<i>Family—Alaudidæ.</i>			1 * 1 †
218. Pyrrhuloxia (? crucigera) Temm. ..	17	<i>Family—Charadriidæ.</i>	
219. P. leucotis, Stanley ..	11 * 6 †	246. Oedicnemus crepitans, Temm. ..	2
	2	247. O. affinis, Rüpp. ..	1
220. Ammomanes, sp. ..	1 * 1 †	248. Charadrius melanopterus, Rüpp. ..	4
221. Calendrella brachydactyla, Temm. ..	2	249. Oegialia geoffroyi, Wagler ..	1
222. C. ruficeps, Rüpp. ..	4	249A. O. do? (in summer plumage) ..	1
223. Galerida cristata, L. ..	6	250. O. mangolicus, Pallas ..	2
223A. G. do. ? albino, var. ..	12		
224. Alauda, sp. (near arvensis, L.) ..	1		
224A. A. ? do. dark, var. ..	7		
225. Certhialauda desertorum, Stanley ..	1		
	6		
	3 * 3 †		

	No. of Specimens of each Species.		No. of Specimens of each Species.
251. <i>Ce. sp.</i>	4	<i>Family—Podicipidae.</i>	
252. <i>Ce. sp.</i>	2	287. <i>Podiceps cristatus, L.</i>	3
253. <i>Ce. sp.</i>	4		2 * 1 †
254. <i>Sarciophorus pileatus? L.</i> ..	4	288. <i>P. philipensis, Gur.</i>	1 †
255. <i>Lobwanellus melanocephalus, Rüpp.</i>	1	289. <i>P. auritus, L. var.</i>	1 †
256. <i>L. senegalensis, L.</i>	3	<i>Family—Laridae.</i>	
257. <i>Hoplopterus spinosus, L.</i> ..	4	290. <i>Larus, sp.</i>	2
258. <i>Glareola limbata, Rüpp.</i> ..	2	291. <i>Xema, sp.</i>	6
259. <i>Dromas ardeola, Paykull</i> ..	2	292. <i>X. sp.</i>	1
<i>Family—Scolopacidae.</i>		293. <i>X. sp.</i>	3
260. <i>Numenius arquata, L.</i>	4	294. <i>Thalasseus bengalensis, Less.</i> ..	3
261. <i>N. phaeopus, L.</i>	1	295. <i>Onychoprion, sp.</i>	4
262. <i>Scolopax gallinago, L.</i>	1	<i>Family—Phaetonidae.</i>	
263. <i>Rhynchos bengalensis, L.</i> ..	1	296. <i>Phaeton rubricanda, Bodd.</i> ..	1
264. <i>Terekia cinerea, Gmel.</i>	1	<i>Family—Graculidae.</i>	
265. <i>Actitis hypoleucos, L.</i>	2	297. <i>Graculus africanus? Gm.</i> ..	2
267. <i>A. Ochropus, L.</i>	1	<i>Family—Pelicanidae.</i>	
266. <i>Totanus calidris, L.</i>	1	298. <i>Pelicanus rufescens, Lath.</i> ..	2
268. <i>Tringa cinctus, L.</i>	1	299. <i>P. philipensis, Gm.</i>	1
269. <i>T. minuta, Bechstein</i>	1		1,316
<i>Family—Rallidae.</i>		RESUMÉ.	
270. <i>Rallus abyssinicus, Rüpp.</i> ..	3	<i>Orders..</i>	
271. <i>Gallinula chloropus, L.</i>	1		
272. <i>Fulica cristata, L.</i>	3		
<i>Family—Ardeidae.</i>			
273. <i>Ardea atricollis? Wagl.</i>	1	Raptores	28 84
274. <i>Herodias garzatta, L. var.</i> ..	3	Scansores	3 23
274A. <i>H. (? do. var.)</i>	1	Insessores	194 970
275. <i>Demi-egretta asha, Sykes</i>	1	Gemitores	9 59
276. <i>Ardeola, sp.</i>	1	Rasores	9 50
277. <i>Butorides, sp.</i>	1	Grallatores	38 86
277A. <i>B. (? in summer plumage)</i> ..	1	Natatores	18 44
<i>Family—Ciconidae.</i>		Total	299 1,316
278. <i>Scopus umbretta, L.</i>	4	<i>C—Eggs.</i>	
279. <i>Ciconia abdimii, Ehr.</i>	3	30. <i>Agapornis taranta</i>	1
<i>Family—Tantalidae.</i>		83. <i>Merops cuvieri</i>	1
280. <i>Ibis (geronticus) comata, Ehr.</i> ..	2	42. <i>Oxylophus afer?</i>	1
291. <i>I. (Harpiprion carunculata) Rüpp.</i>	3		identified.
ORDER—NATORES.		108. <i>Lanius collaris</i>	1
<i>Family—Anatidae.</i>			identified.
283. <i>Anas flavirostris, Smith</i>	4	159 or 160 ? <i>Pratincola? sp.? ..</i>	2
284. <i>Fuligula cristata, Ray</i>	2 †	194. <i>Hyphantornis personata</i>	1
285. <i>Querquedula crecca, L.</i>	1 *		identified.
286. <i>Chenlaopex Egyptiaca, L.</i>	6	238. <i>Numida phlorhyncha</i>	1
287. <i>Bernicla cyanoptera, Rüpp.</i> ..	1		identified.
			8

	No. of Specimens of each Species.		No. of Specimens of each Species.
<i>C—Skeletons.</i>			
29. <i>Pœocephalus meyeri</i>	1	37. <i>Picus æthiopicus</i>	1
35. <i>Barbatula chrysocoma</i> (imperfect) ..	1	38. <i>P. hemprichii</i>	1
36. <i>Trachophonus margaritatus</i> (1 perfect, 1 imperfect)	2	39. <i>Indicator, sp.</i>	1
48. <i>Turacus leucotis</i> (imperfect)	1	41. <i>Cuculus canorus</i>	1
49. <i>Chizaerhis zonurus</i>	1	42. <i>Oxylophus afer</i> ?	3
70. <i>Coracias abyssinica</i> (imperfect) ..	1	43. <i>O. melanoleucos</i>	1
71. <i>C. Levallantii</i> (do.)	1	44. <i>Chrysococcyx, sp.</i>	2
72. <i>Eurystomus afer</i> (do.)	1	45. <i>C. sp.</i>	1
83. <i>Merops cuvieri</i> (do.)	1	46. <i>Centropus monachus</i>	1
88. <i>Tockus erythrorhynchus</i>	1	47. <i>C. superciliosus</i>	2
90. <i>Tmetoceros abyssinicus</i>	1	48. <i>Turacus leucotis</i>	3
92. <i>Promerops erythrorhynchus</i>	1	49. <i>Chizaerhis zonurus</i>	2
188. <i>Textor alecto</i> (imperfect)	1	50. <i>Calius leucotis</i>	3
240. <i>Francolinus erkelii</i>	1	51. <i>C. senegalensis</i>	4
243. <i>Pternestis rubricollis</i>	2	52. <i>Caprimulgus, sp.</i>	1
	17	53. <i>C. sp.</i>	2
<i>D—Sterna.</i>			
<i>RAPTORES.</i>			
3. <i>Gyps Rüppelli</i>	1	55. <i>Cypselus æquatorialis</i>	2
2. <i>Neophron percuopectus</i>	2	56. <i>C. apus</i>	2
4. <i>N. pileatus</i>	1	57. <i>C. affinis</i>	1
5. <i>Falco juggur</i> ?	1	58. <i>Hirundo melanocrissus</i>	1
6. <i>F. sp.</i>	1	61. <i>H. filicaudata</i> ?	1
9. <i>Tinnunculus alandarius</i>	2	<i>H. rustica, L. var</i>	1
10. <i>T. cenchris</i>	1	68. <i>Cotyle torquata</i> ?	2
12. <i>Accipiter unduliventer</i>	1	69. <i>C. rupestris</i>	1
13. <i>Micronisus niger</i>	2	70. <i>Coracias abyssinica</i>	5
15A. <i>Micronisus sphenurus</i>	1	71. <i>C. levallantii</i> ?	2
16. <i>Aquila noovioides</i>	5	72. <i>Eurystomus afer</i> ?	4
17. <i>Helotarsus ecaudatus</i>	1	73. <i>Halcyon rufigaster</i>	1
18. <i>Buteo augur</i>	3	74. <i>H. sp.</i>	2
19. <i>Gypogeranus serpentarius</i>	1	75. <i>H. cœrulea</i>	1
1. <i>Gypætos meridionalis</i>	2	76. <i>Alcedo senegalensis</i>	3
21. <i>Milvus ægyptius</i>	1	78. <i>Ceryle, sp.</i>	1
22. <i>Circus æruginosus</i>	1	79. <i>Merops lamarekii</i>	2
23. <i>C. cineraceus</i>	2	82. <i>M. cœruleocephalus</i>	2
25. <i>Bubo cinerascens</i> ?	2	84. <i>M. lafresnayii</i>	3
26. <i>B. maculosus</i>	1	86. <i>Tockus limbatus</i>	1
27. <i>Athene meridionalis</i>	2	87. <i>T. flavirostris</i>	2
28. <i>Scops vulgaris</i>	4	88. <i>T. erythrorhynchus</i>	3
	42	89. <i>T. nasutus</i>	5
<i>Scansores.</i>			
29. <i>Pœocephalus meyeri</i>	4	90. <i>Tmetoceros abyssinicus</i>	2
30. <i>Agaporius taranta</i>	3	91. <i>Upupa epops</i>	3
		92. <i>Promerops erythrorhynchus</i> ?	3
<i>Insectores.</i>			
32. <i>Pogonorrhynchus saltii</i>	1	94. <i>P. cyanomelas</i>	2
34. <i>P. melanocephalus</i>	1	95. <i>Nectarinia abyssinica</i>	4
35. <i>Barbatula chrysocoma</i>	1	97. <i>N. cruentata</i>	2
56. <i>Trachyphonus margaritatus</i>	3	99. <i>N. Tacazze</i>	1
		101. <i>N. pulchella</i>	2
		102. <i>Tchitrea ferreti</i>	2
		104. <i>Muscicapa torquata, L.</i>	3
		106. <i>Lanius rufus</i>	1
		107. <i>L. cristatus</i>	3
		108. <i>L. collaris</i>	2
		110. <i>Telephorus æthiopicus</i>	1
		111. <i>Dryoscopus cubla</i>	1
		112. <i>Nilans Brubu</i>	2
		113. <i>Laniarius erythropterus</i> ?	3
		114. <i>L. cruentatus</i>	4

	No. of Specimens of each Species.		No. of Specimens of each Species.
115. <i>Dicrurus lugubris</i>	2		
116. <i>Turdus olivaceus</i>	3		
117. <i>T. simensis</i>	3		
118. <i>Petrocineta cyaneus</i>	3		
121. <i>Pycnonotus arisnoë</i>	4		
122. <i>Oriolus moloxita</i>	1		
123. <i>Crateropus leucopygius</i>	1		
125. <i>Chatarrhoea, sp.</i>	1		
133. <i>Drymoica, sp.</i>	1		
135. <i>Oligura micrura</i>	1		
136. <i>Phylloscopus natareri</i>	1		
142. <i>Acrocephalus, sp.</i>	3		
143. <i>Ruticilla, sp.</i>	2		
144. <i>R. phoenicura</i>	1		
145. <i>Aëdon galactodes</i>	1		
146. <i>Cercotrichas erythropterus</i>	2		
147. <i>Thamnolea albiscapulata</i>	3		
174. <i>Lamprotornis? leucogaster</i>	2		
148. <i>Mamnobia melæna</i>	3		
149. <i>Saxicola lugubris</i>	3		
150. <i>S. isabellina</i>	4		
151. <i>S. deserti</i>	2		
153. <i>S. œnunthe</i>	1		
158. <i>Cercomela melanura</i>	1		
164. <i>Budytes melanocephala</i>	1		
772. <i>Anthus cervinus</i>	2		
176. <i>Zosterops abyssinica</i>	1		
178. <i>Parus dorsatus</i>	2		
179. <i>Corvus affinis</i>	4		
181. <i>Corvultur crassirostris</i>	1		
182. <i>Ptilorhinus albirostris</i>	4		
183. <i>Amydius rüppelli</i>	4		
184. <i>Lamprotornis acuens?</i>	2		
186. <i>L. cyaniventris</i>	2		
188. <i>Textor alecto</i>	3		
189. <i>Buphaga erythrorhyncha</i>	2		
190. <i>Hyphantornis larvatus</i>	4		
192. <i>H. guerini</i>	3		
193. <i>H. galbula</i>	1		
195. <i>Euplectes xanthomelas</i>	2		
196. <i>Quelea sanguinirostris</i>	2		
197. <i>Colinus passer macrocercus</i>	1		
198. <i>Vidua sphenura</i>	2		
199. <i>V. principalis</i>	1		
202. <i>Estrela zonata</i>	1		
203. <i>E. ernesti</i>	1		
205. <i>E. phœnicotis</i>	1		
206. <i>Zonogastris citerior</i>	1		
208. <i>Emberiza flavigaster</i>	3		
209. <i>Passer swainsoni</i>	2		
212. <i>P.? tristriatus</i>	1		
217. <i>Serinus striolatus</i>	1		
218. <i>Pyrrhulauda crucigera</i>	3		
221. <i>Calendrella brachydactyla</i>	2		
223. <i>Galerida cristata</i>	2		
224A. <i>Alauda, sp.</i>	1		
225. <i>Certhalauda desertorum</i>	2		
		<i>Gemitores.</i>	
		226. <i>Columba guinea</i>	2
		227. <i>C. albitorques</i>	1
		229. <i>Turtur lugens</i>	1
		230. <i>T. albiventris?</i>	1
		231. <i>T. senegalensis?</i>	1
		233. <i>Cena capensis</i>	3
		<i>Rasores.</i>	
		238. <i>Numida ptilorhyncha</i>	2
		240. <i>Francolinus erckelii</i>	5
		241. <i>F. Rüppelli</i>	2
		242. <i>F. gutturalis</i>	2
		243. <i>Pternestis rubricollis</i>	2
		<i>Grallatores.</i>	
		244. <i>Otis Arabs</i>	2
		245. <i>O. melanogaster</i>	2
		246. <i>Œdicnemus crepitans</i>	1
		248. <i>Charadrius melanopterus</i>	3
		249A. <i>Œgiatilis Geoffroyi</i>	1
		257. <i>Œ., sp.</i>	2
		253. <i>Œ., sp.</i>	1
		254. <i>Sarciophorus pileatus</i>	1
		256. <i>Labivanellus senegalensis</i>	1
		257. <i>Hoplopterus spinosus</i>	1
		258. <i>Glaucula limbata</i>	2
		259. <i>Dromas ardeola</i>	2
		260. <i>Numenius arquata</i>	1
		266. <i>Totanus calidris</i>	1
		268. <i>Tringa cinctus</i>	1
		269. <i>T. minuta</i>	1
		270. <i>Rallus abyssinicus</i>	3
		271. <i>Gallinula chloropus</i>	1
		272. <i>Fulica cristata</i>	2
		274. <i>Herodias garzetta?</i>	3
		276. <i>Ardeola, sp.</i>	1
		277. <i>Butorides, sp.</i>	1
		278. <i>Scopus umbretta</i>	3
		279. <i>Ciconia abdimii</i>	1
		280. <i>Ibis comata</i>	2
		281. <i>I. carunculata</i>	3
		<i>Natatores.</i>	
		283. <i>Anas flavirostris</i>	1
		284. <i>Fulegula cristata</i>	1
		286. <i>Chenalopex ægyptiaca</i>	2
		282. <i>Bernicla cyanoptera</i>	1
		287. <i>Podiceps cristatus</i>	3
		288. <i>P. philipensis</i>	1
		289. <i>P. auritus</i>	1
		291. <i>Xema, sp.</i>	3
		295. <i>Onychoprion, sp.</i>	2
		296. <i>Phaëton rubricanda</i>	1
		297. <i>Grambus africanus?</i>	1
		298. <i>Pelicanus rufescens</i>	2
		299. <i>P. philipensis</i>	1

			No. of Specimens of each Species.				No. of Specimens of each Species.
	Species.	Specimens.					
Sterna of Raptores ..	22	35		7. <i>S. sp.</i>	..	..	2 in spirits.
„ Scansores ..	2	7		6. <i>Agama, sp.</i>	..	..	1 in spirits.
„ Insessores ..	118	238		8. <i>A., sp.</i>	..	..	1 in spirits.
„ Gemitores ..	6	9		<i>Family—Lacertidæ.</i>			
„ Rasores ..	5	13		9. <i>Acanthodactylus, sp.</i> ..	..	..	2 in spirits.
„ Grallatores ..	26	43		10. <i>A. sp.</i>	..	..	2 in spirits.
„ Natatores ..	13	20		11. <i>Eremias, sp.</i>	..	..	1 in spirits.
Total of Sterna ..	192	365		12. <i>E., sp.</i>	..	..	1
RESUMÉ—CLASS AVES.				<i>Family—Scincidæ.</i>			
	Species.	Specimens.		13. <i>Euprepis, sp.</i>	..	..	1 in spirits.
Skins	299	1,316		14. <i>E., sp.</i>	..	..	1 in spirits.
Eggs	7	8		15. <i>E., sp.</i>	..	..	5 in spirits.
Skeletons	15	17					51
Sterna	192	365		16. <i>Eumeces ? sp.</i>	..	..	1 in spirits.
Total ..	299	1,706		ORDER—OPHIDIA.			
III. CLASS.—REPTILIA.				<i>Family—Typhlopidae.</i>			
ORDER—CHELONIA.				17. <i>Ophthalmidion, sp.</i>	..	..	1 in spirits.
<i>Family—Testudinidæ.</i>				<i>Family—Viperidæ.</i>			
1. <i>Cimixys belliana, Gray</i>			5 dried specimens.	18. <i>Echis arenicola ? Boie</i>	..	..	2 in spirits.
<i>Family—Emydidæ.</i>				<i>Family—Dasypeltidæ ?</i>			
2. <i>Pelomedusa gehaffiæ, Gray</i> ..			6 3 dried specimens. 3 in spirits.	19. ? <i>Dasypeltis, sp.</i>	..	..	2 in spirits.
ORDER—SAURIA.				<i>Family—Colubridæ.</i>			
<i>Family—Chamæsonidæ.</i>				20. <i>Zamensis, sp.</i>	..	..	2 in spirits.
3. <i>Chamæleo lævigatus ? Gray</i> ..			1 in spirits.	22. <i>Geophis, or an allied genus</i> ..	..	..	1 in spirits.
<i>Family—Varanidæ.</i>				<i>Family—Dryiophidæ.</i>			
4. <i>Varanus ocellatus ? Rüpp.</i> ..			1 in spirits.	21. <i>Dipsas, sp.</i>	..	..	2 in spirits.
<i>Family—Agamidæ.</i>				23. ? <i>Tragops, sp.</i>	..	..	1 in spirits.
5. <i>Stellio cyanogaster, Rüpp.</i> ..			21 in spirits.				

				No. of Specimens of each Species.					No. of Specimens of each Species.	
ORDER—BATRACHIA.										
Family— <i>Ranidæ</i> .										
24.	<i>Rana</i> , <i>sp.</i>	..	..	..	1	2. ? Genus and <i>sp.</i> 1 skin dried. Stream on high-lands.				1.
25.	<i>R.</i>	..	..	..	4	3. ? Genus and <i>sp.</i> 10 specimens in spirits, Stream Suru.				10
25A.	<i>R.</i> ? <i>do. var.</i>	..	..	..	4	4. ? Same genus, another <i>sp.</i> 11 specimens in spirits, stream north of Massowah.				11
26.	<i>Ranidæ</i> (genus ?) <i>sp.</i>	..	..	..	2	5. A small collection of minute plagic fish taken in the towing net off the S.E. coast of Arabia; several species about 12, and about 30 specimens. A few in bad condition. Another similar small collection from the Red Sea. 4 or 5 species, 8 specimens				33
Family— <i>Bufonidæ</i>										
27.	<i>Bufo</i> , <i>sp.</i>	..	..	..	6					
28.	<i>B.</i>	..	..	..	2					
29.	<i>B.</i>	..	..	..	1					
30.	<i>B.</i>	..	..	..	1					
31.	<i>B.</i>	..	..	..	2					

and in the hope that some light might be thrown by them, through the labours of the learned men of Europe, on the ancient history of Ethiopia, and on the records of Christianity.

These manuscripts were carefully examined by M. Münzinger, its title written in each volume, and the books were handed over to the British Museum.

The following is the report of Dr. Wright, of the British Museum, on the manuscripts :—

“ The collection of manuscripts deposited in the British Museum by the order of Sir S. Northcote consists of 359 volumes, one of which is a paper manuscript, in Coptic and Arabic. The remainder are Æthiopic, with the exception of about half-a-dozen, which are written in the modern Amharic dialect. Report by
Dr. Wright.

“ Of these manuscripts, four or five are paper, the rest vellum. They are mostly well bound, and in good preservation, and some of them contain pictures, representing the state of art in Abyssinia during the last two or three centuries. The oldest among them Dr. Wright finds to be of the fifteenth and sixteenth centuries, but the great bulk of the collection belongs to the seventeenth and eighteenth, and some were written during the present century, even in the reign of the late King Theodore. The following are some of the more important classes :—

“ 1. Manuscripts of the Holy Scriptures, comprising the whole of the canonical books of the Old and New Testaments, as well as the Apocrypha, among the latter may be specified the Book of Enoch, the Rufate (‘ Liber Jubilaeorum ’ or ‘ Parva Genesis ’), and the Ascension of Isaiah.

“ 2. A Lectionary, several missals and other office books, psalters, antiphonaries, Hymn-books, and Prayer-books.

“ 3. Collections of homilies and discourses for festivals, saints’ days, &c. Here may be mentioned the Gebra Hemamal or services for Passion week, the Nagara and Manjane Dersana Mikail, Dersana Gabriel, and Dersana Rufail, besides the Miracles of the Virgin Mary, and the ‘ Miracles of Jesus.’

“ 4. The Patristic literature is represented by various translations from the Greek and Arabic, such as the Ancoratus of Epiphanies, some works of Cyril of Alexandria, the Commentary of Chrysostom on the Epistle to the Hebrews, and the works Mar Isaac. Other ecclesiastical works of importance are the Dedas Calia Apostolorium, the sinodos or collection of Canons of the Councils, the treatises ascribed to Clement the Haimanota Abau, or ‘ Faith of the Fathers ’; the Lena Abau, ‘ History or Paradise of the Fathers,’ Tilekseyus or Philoxenus, Aragani Maufasawi, Faus Maufasawi, the huge compilations called Hawiand Talmid, and the Fetha Nagast, or ‘ Laws of the Kings.’

“ 5. The department of history is not so well supplied, but the collection comprises copies of the Jewish history of Joseph ben Gorwon, or Joseppon, the Kebra Nagast or ‘ Glory of the Kings ’; the Universal History of George Walda Amid, the Chronology of Abu Shaker, and two Æthiopian chronicles of considerable value. The History of Alexander the Great is rather to be regarded as a romance.

“ 6. Finally may be mentioned the Seukesor, or Synascarium, of which there are several copies; the Gadla Hawareyat, or acts of the Apostles and Disciples, and numerous lives of Saints.

“ Looking to the number and intrinsic value of these manuscripts, this seems to be the largest and finest collection of Æthiopic literature in Europe. Certainly it far surpasses in extent that of the French traveller, M. Antoine D’Abbadie, the printed catalogue of which comprises 234 numbers, and if it were added by the Trustees to

"their present collection of about 115 manuscripts, the British Museum would probably be placed in the first rank in another department of Oriental literature besides the Syriac.

"Dr. Wright has set apart sixteen of the finest manuscripts with pictures, from which a selection may be made for the Royal Library at Windsor Castle."

Towards the conclusion of the campaign the Commander-in-Chief directed Captain W. Goodfellow, R.E., to make some excavations among the ruins of the ancient Adulis. The following is the report of that officer addressed to the Assistant Quartermaster-General of the Force, and dated the 9th June, 1868:—

Excavations
among ruins
of Adulis.

Captain
Goodfellow's
Report.

"I HAVE the honour to report that in accordance with the wishes of his Excellency the Commander-in-Chief, as communicated to me at Antalo on the 14th ultimo, I lost no time in coming on to Zula, arriving here on the 24th ultimo.

"2. On informing the Commanding Engineer that I had been directed to apply to him for a working party to enable me to make excavations with a view to discovering some remains of ruins of the Ancient Adulis, I was told that owing to the amount of work in hand just at that time I could not have more than 25 men of the Madras Sappers and Miners; with this small party, however, I at once made a commencement. Three narrow trenches being cut into some of the tumuli the walls and foundations of old buildings were discovered. At one spot some cut stone columns were found, and this induced me to remove more of the débris in the immediate vicinity, when the outline of a building, as shown in the accompanying plan, was discernible. I also ascertained by excavation that the foundations of this building, in which the bases of the cut stone columns were found in true position, were 13 feet deep.

"The columns, judging from the portions lying about, were apparently in their original state built up, clamped with iron and run with lead.

"4. I have been unable to discover any capitals to suit the stone columns, nor is there any trace of how the roof of this building was supported.

"As shown on the plan, the building was erected east and west; at the last end there are the remains of what may once have been an altar, and the masonry exposed leads to the supposition that the last end was shaped in the form of an apex.

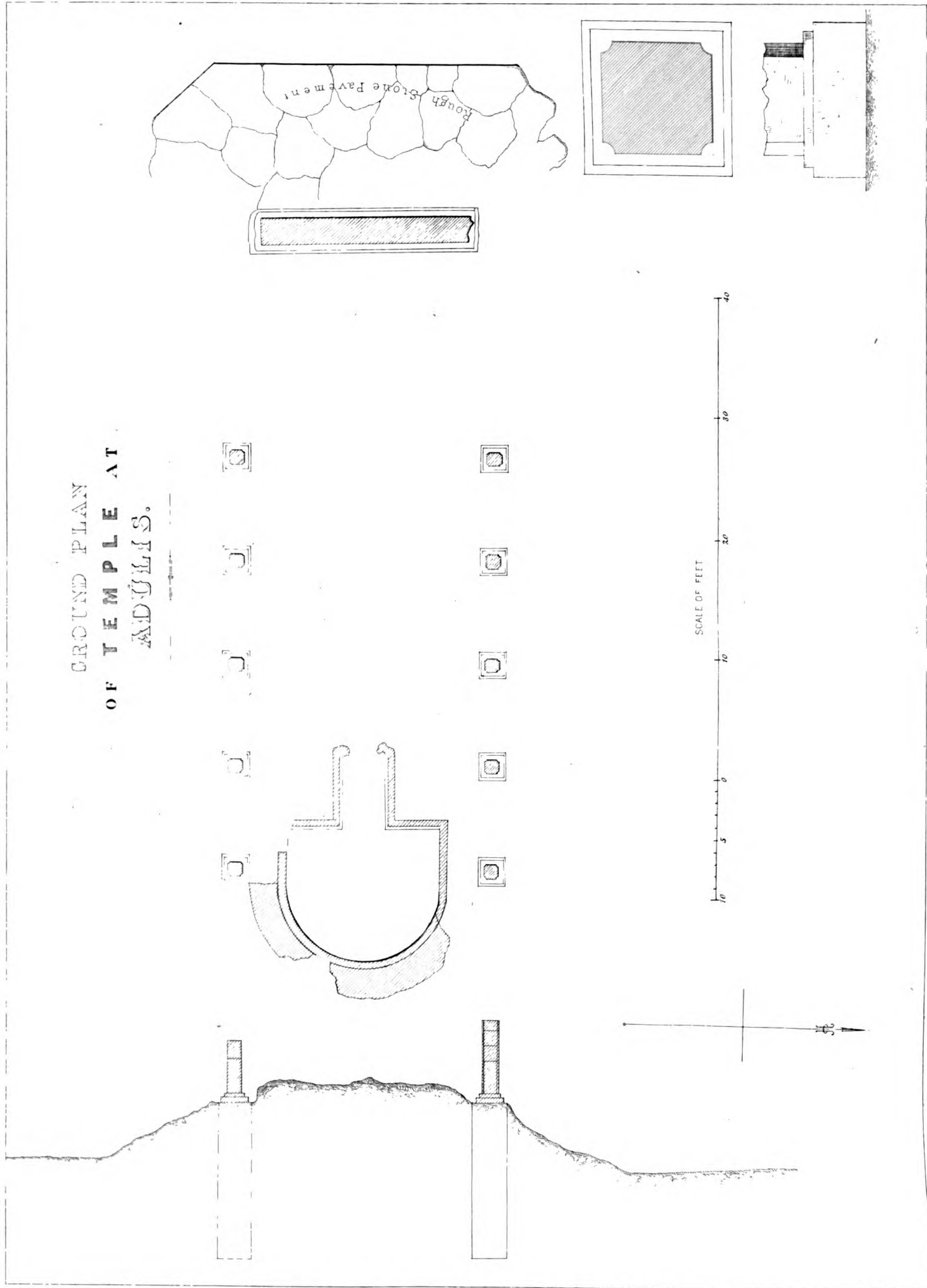
"5. During the progress of the excavation fragments of carved marble, flat pieces of alabaster, having one side well polished, were dug up, and some fragments of marble shafts; also one carved capital in marble, which may be referable to Byzantine architecture. Rough drawings of all these fragments are herewith submitted, and may prove interesting to those possessing more archæological knowledge than I can lay claim to.

"6. On one of the last slabs found there is a carved cross, which lends strength to the supposition that the building now exposed was one of the early Christian Churches, but whether it stands on the débris of still older buildings or not I have been unable to determine, as the excavations have scarcely been carried deep enough.

"7. Besides the marble fragments, shreds of different descriptions of pottery have been found in the débris, but I regret to add only one coin, which it is just possible that those possessing the requisite knowledge in such matters may be able to decipher.

"8. The Madras Sappers and Miners, being under orders to embark for India, the detachment at Adulis was withdrawn on the 5th instant, and on the 7th instant I was

GROUND PLAN OF TEMPLE AT ADULLIS.



"permitted to avail myself of the services of one company of Bombay Sappers and Miners (80 men). Notwithstanding the great heat and difficulties about supplying the men with such an allowance of water as would satisfy them, I have had most willing and industrious excavators, and it is much to be regretted that there is not time, now that the campaign is over and all the arrangements for evacuating the country complete, to continue this work, so as to throw light on the history of some of the hidden things of the past."

The following is the report by the officer in charge of the Department of Antiquities of the British Museum, on the articles found at Adulis, which were presented to that institution :—

Report by
Mr. Franks,
on articles
found at
Adulis.

"Mr. Franks has the honour to report that two cases have been received from the India Office, containing various fragments of marble excavated by the British troops in Abyssinia. They appear to have been chiefly found amid the ruins of a church at Adulis, near Annesley Bay, a view of which has been published in the 'Illustrated London News' for September 5, 1868.

"The most important of the specimens are the following :—

- "1. A white marble capital.
- "2. and 3. Two portions of marble shafts.
- "4. Part of a bas-relief representing a cross.
- "5. Part of another similar.
- "6. Various fragments of marble and alabaster vessels.
- "7. The fragments of an earthen vessel.

"These objects are not of great archaeological value, but considering the distant spot on which they were found, and the light which they throw on the state of the decorative arts in Abyssinia in early times, they are well worthy of a place in the Museum.

"Mr. Franks has likewise received from the same source nine wooden altar slabs, of which some have Ethiopic inscriptions.

The following Table shews the ALTITUDES of Places in Abyssinia, as described by different observers.

	1. Trigo- nometrical Survey.	2. Quarter- Master- General's Department.	3. Dr. Cook.	4. Mr. Markham.	5. Mr. Rohlfs.	Altitudes of places in Abyssinia. Other Authorities.†
<i>Hadas Valley, &c.</i>	Feet.	Feet.	Feet.	Feet.	Feet.	
Mount Gedem	2,750	..	..	..	..	Wiah, 549 Lef., 623 F. and G.
Hadoda	..	480	..	..	..	1,580 F. and G.
Illalia	..	1,377	..	..	..	3,145 Lef.
Tebo	..	2,740	..	..	..	4,674 F. and G.
Mahio	..	3,510	..	..	..	
Mederto	..	5,223	..	..	..	
Dinda Plain	..	6,772	..	..	..	
Tekunda, King's Camp	..	6,600	..	..	..	
Mount Tsaro	9,048*	7,974	..	..	..	9,407 d'Ab.
" Assawut	8,380	7,711	..	..	..	8,397 d'Ab.
" Urug (Habesha Melaysha)	7,940*	..	..	..	..	9,046 d'Ab.
" Sa'asa	8,712	..	..	..	..	8,623 d'Ab., 8,248 Lef.
Halai	8,412	..	..	..	..	8,520 Rüp.

† d'Ab. means d'Abadie; F. and G. mean Feret and Galinier; Rüp. means Ruppel; Lef. means Lefebore.

ALTITUDES of Places in Abyssinia—continued.

	1.	2.	3.	4.	5.	Other Authorities.
	Trigo- nometrical Survey.	Quarter- Master- General's Department.	Dr. Cook.	Mr. Markham.	Mr. Rohlf.	
	Feet.	Feet.	Feet.	Feet.	Feet.	
Da'ara village	8,680	..	..	..	..	
Mount Intokoko	8,170	..	..	..	..	
Hadas, source	7,240	..	..	..	..	
Mount Aroma	7,497	..	..	..	..	
„ Tahulla	6,285*	..	..	..	..	6,729 d'Ab.
<i>Kumayli Pass, &c.</i>						
Kumayli, Railway Terminus ..	..	..	..	..	..	
„ Camp	1,060*	418	..	..	..	
„ Hill	1,490	..	..	..	..	
Mount Abalu	7,610*	..	..	..	..	
Alumta	2,803*	..	..	..	..	
Suru, Lower	1,440*	1,110	..	..	..	
„ Upper	2,600*	2,070	..	3,321	..	
Maian or Undul Wells	3,947	..	..	..	..	
Mount Farum	8,085*	..	..	..	..	
Hadim	3,380	..	..	..	..	
Pass east of Hadim	4,150	..	..	..	..	
Imfahagu	1,260	..	..	..	..	
Barutgedi	..	2,621	..	..	..	
Sonakti	..	3,152	..	..	..	
Rahagedi	6,374	5,288	..	7,418	..	
Senafe, Camp	7,690	7,464	8,175	8,897	..	{ Matara Hill above Senafe 8,843 d'Ab. 9,480 d'Ab.
Akub Terika	9,047	..	..	10,063	..	
Marara Heights	8,208	..	..	..	..	
Mashal Heights	8,340	..	..	..	..	8,735 d'Ab.
Shimazana Heights	8,635	..	..	..	..	
Mount Kishat	8,680	..	..	..	..	9,266 d'Ab.
Mount Seora	9,550	9,281	..	10,700	..	10,433 d'Ab.
Ad-Hazu	8,976*	..	..	..	..	
<i>Senafe to Magdala</i>						
Gunaguna Camp	6,860	7,354	7,510	8,737	..	
Mount Gondegonta (Ziban sifran or Senafe)	10,314*	..	..	..	..	10,917 d'Ab.
Focada Camp	7,890	..	..	..	..	
Mount Sargen	9,204*	..	..	..	..	9,771 d'Ab.
Adigrat	7,740	7,518	8,300	9,440	..	{ 8,290 d'Ab., 8,088 F. and G., 8,180 Rüp.
Mount Alequa, No. 1	10,392*	..	..	..	..	{ 11,035 d'Ab., 10,150 F. and G.
„ No. 2	10,191*	..	..	..	..	10,729 Lef.
Mai Wahez	7,940	7,957	8,679	..	..	
Argotti	..	..	..	9,530	..	
Adabaga	7,753	7,600	8,050	9,140	..	
Dongolo	..	..	6,736	..	..	
Agula	6,355	6,356	6,700	7,645	..	
Dolo	6,832	6,595	7,207	7,957	..	
Eikullet	..	..	7,359	..	..	
Chelikot	..	6,144	6,800	7,600	..	{ 6,693 F. and G., 6,279 Lef.
Antalo	..	7,356	..	..	..	
Buya	6,497	6,144	6,905	7,600	..	
Amba Aradom	..	..	..	..	9,335	
Garajam Height	8,652	..	..	..	..	
Mai Masgah	6,610	6,300	6,700	..	..	
Fingalat Height	8,010*	..	..	..	..	
Gatba Hairat (Muja)	9,199*	9,225	..	10,814	..	
Mashik	7,624	7,800	7,992	..	..	
Alaji Pass	9,875	9,700	10,420	..	9,630	
„ Amba	10,798*	11,200	..	..	..	
Atsala	7,982	7,200	8,361	8,790	7,089	11,380 Lef.
Mesno	..	..	..	..	7,530	
Duggeduka Amba	..	..	..	..	10,950	