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ACCOUNT OF
ROORKEE COLLEGE,
ESTABLISHED FOR THE INSTRUCTION
OF
CIVIL ENGINEERS,
WITH A SCHEME FOR ITS ENLARGEMENT.

Printed by Order
OF THE
HON'BLE THE LIEUTENANT GOVERNOR
OF THE
NORTH WESTERN PROVINCES.

AGRA:
SECUNDR A ORPHAN PRESS.

1851.

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PLAN
of the
STATION of ROORKEE



1000 900 800 700 600 500 400 300 200 100 0 100 feet

A C C O U N T
O F T H E P R E S E N T S T A T E O F T H E
C O L L E G E F O R C I V I L E N G I N E E R S
A T R O O R K E E,
A N D S C H E M E F O R I T S E N L A R G E M E N T.

1. The object of this brochure is to explain the circumstances which occasioned the institution of a College for Civil Engineers at Roorkee, the progress which has been hitherto made in the accomplishment of the design, and the further measures, which are now proposed for the full attainment of the advantages, which the College is calculated to produce.

2. The necessity has long been felt of some systematic training for Civil Engineers in this country.

3. The Western Jumna Canals were commenced in 1817. Up to May 1st, 1847, the expenditure on the original works alone had amounted to Rs. 12,04,749, whilst the annual expenditure on Establishment was about Rs. 70,000, and on current repairs upwards of Rs. 50,000, the annual direct income being about Rs. 3,00,000.

4. The Eastern Jumna Canal was commenced in 1822. Up to May 1st, 1847, the expenditure on the original works had amounted to Rs. 8,14,492, the annual expenditure on Establishment was Rs. 34,000, and on current repairs about Rs. 35,000, the annual direct income being about Rs. 1,20,000.

5. In the Dehra Dhoon, in Rohilcund, and on the Nujjufgurh Jheel, near Delhi, works for draining and irrigation have long been maintained by the Government. These require skilful superintendence, and the employment of expensive establishments. They yield a considerable revenue to the Government, and add much to the productive powers of the land, and to the wealth of the people.

6. Within the last 20 or 30 years, several fine roads have been constructed by the Government at the public expense. The road from Jubbulpore on the Nerbudda to Mirzapore on the Ganges has been led with much skill across the Kymoor range. The Grand Trunk Road from Calcutta to Delhie is a perfect spe-

cimen of a metalled road, adapted to the rapid transit of Wheel-carriages. The road from Agra to Bombay, though less perfect than the others, was laid out with great engineering skill, and the pass down the Vindhya Range by which the valley of the Nerbuddah is gained, was an arduous and costly undertaking.

7. In 1841, the Government appointed Committees in every district to administer the local Funds. These Funds consist of the surplus collections from the Ferries across the rivers, and of a contribution of one per cent. on the Land Revenue, which the zumeendars agreed at the last Settlement to pay in commutation of the obligation to labor on the roads. The former is called the Ferry Fund, and amounts in all the districts to about Rs. 2,00,000 per annum, the latter is called the Road Fund, and amounts to about Rs. 4,00,000 per annum. The Local Committees are bound to expend the total of Rs. 6,00,000 per annum on Roads, Bridges, &c., for the accommodation of travellers, and for the better development of the resources of the country.

8. From the commencement of 1833, the operations of the Great Trigonometrical Survey have been carried on in the North Western Provinces of Hindoostan, and from that time to the present the Head Quarters of the Department have been chiefly in the Dehra Dhoon and the neighbouring hill station of Mussoorie.

9. The last Land Revenue Settlement of the North Western Provinces, which came to a close about 1842, was founded upon a scientific survey of the whole country. This cost the Government Rs. 23,56,555,* and provided an accurate Map of every village in the whole tract of more than 70,000 square miles. It was the foundation of a complete system of registration of the rights in land. The maintenance of that registration requires constant reference to the Survey Maps, and an acquaintance with both the English and Native modes of survey.

10. It is thus apparent that for many years past there has existed a large demand for skill in every branch of Civil Engineering, over and above that which is always required by the Government for the construction and maintenance of its Civil and Military buildings. To meet this demand, there were Officers of the Army, and educated Europeans who came to the country unconnected with the Services; there were European Non-Commissioned Officers and Soldiers; and there were also natives of the country. To make these efficient Agents, the well educated Europeans, lately arrived in the country, required instruction in the native languages, especially in the Vernacular terms of science, and also in the peculiarities of materials and of construction in this country. The uneducated Europeans required scientific instruction, so that their energy and trustworthiness might be well directed. The natives of the country, from their local expe-

* See Official Return in Rushton's Almanac for 1851, p. 75.

rience, and ability to bear exposure to the climate, were likely to prove efficient instruments, if they were only well instructed, and inspired with a proper sense of the importance of their position.

11. Efforts to supply this want were for some time made by providing the means of special scientific training, in institutions which were then existing.* In January 1845, Lieutenant Baird Smith, of the Engineers, Superintendent of the Eastern Jumna Canal, undertook to conduct at Saharunpoor the education and training of native youths in Civil Engineering. For this purpose certain disbursements were sanctioned, and two of the most advanced scholars in the Agra and Delhie Colleges were placed under Lieutenant Smith's care. Towards the close of the same year,† masters were appointed to the Delhie and Agra Colleges for the special purpose of teaching Architectural Drawing and Surveying.

12. In the same year a very important step was taken by the formation of a class of "Sub-Assistant Executive Engineers," who should have fixed allowances and a recognized standing in the public service. The following Rules constituting this class of Officers were promulgated with the sanction of the Supreme Government on October 9th, 1845.

I.—"A class of Officers shall be appointed, to be denominated 'Sub-Assistant Executive Engineers.'

II.—"The salary of the appointment shall be 100 rupees per mensem, with "travelling allowance, when in the field, to the extent of three-tenths of the "salary, as fixed by the Orders of Government, dated September 19th, 1843.

III.—"The Rules for joining stations and for leave of absence, prescribed "for Sub-Assistant Surgeons shall be held applicable to Sub-Assistant Executive "Engineers.

IV.—"All Candidates for the appointments shall be required to prove, by an "examination, that they possess the following qualifications:—

"Sufficient acquaintance with the English language to enable them to read, "understand and explain works on Civil Engineering.

"A knowledge of Geometry, Algebra, Plane and Spherical Trigonometry, "Conic Sections and Mechanics.

"Acquaintance with the use of the Sextant, Theodolite, Levelling Instru- "ment, and other Instruments commonly used in Surveying, with a practical "knowledge of Land Surveying and Levelling."

"Ability to draw Maps and Plans, including the construction of working "plans from designs, models, or actual existing works.

"Acquaintance with the method of keeping accounts in the Department of "Public Works, and with the mode of preparing estimates."

* Vide Appendix D. to Education Report for the North Western Provinces, 1844-45.

† Vide Appendix E. to Education Report for the North Western Provinces, 1845-46.

V.—“A Committee will be formed, once or oftener in a year, for the purpose of examining Candidates and giving them certificates of qualification. If it be found inconvenient for this Committee to assemble together, they will decide on fit questions to be answered in writing, and will hold the examination at such place or places, and in such manner, as may be found convenient.

VI.—“Candidates for these appointments are desired to submit their applications to the Secretary to the Government of the North Western Provinces, in the General Department, but no applications will be received which are not accompanied with the Survey, (including Map and Field-book), of a tract of country, and

* Superintending Engineer and Executive Officers in the Central and Western Provinces.
 Superintending and Executive Officers of Canals
 Superintendent of Embankments and Water-Courses in Rohilcund.
 Principal of Delhi College.
 Principal of Agra College.
 Principal of Benares College.
 Superintendent of Bareilly School.

“with the plan, section, and estimate of a building, sufficient to show the competency of the Candidate in these branches of Education. These must be accompanied with a Certificate from one of the Officers noted in the margin* that the specimens are, to the best of his belief, the actual performance of the Candidate, and that the Candidate has also studied

“and made progress in the several branches of science noted above. The above-mentioned Officers have been requested to grant such certificates, when they think them merited, and to forward the application under their official cover.”

13. The number of Sub-Assistant Executive Engineers was at first limited to 4, but was subsequently (December 22nd, 1846,) increased to 20. One of Lieut. Baird Smith’s pupils named Munnoo Lall was immediately examined, and found qualified for an appointment of this nature. He has since rendered valuable services as a Teacher in the Roorkee College. Three other native youths have since passed the required examination, and obtained appointments as Sub-Assistant Executive Engineers. The chief benefit of the measure has been to hold out definite expectations to the educated youth in the Government Colleges. The standard of mathematical attainments has been designedly fixed high, and there are many who are making great exertions to reach the mark.

14. In 1847, after the conclusion of the first Punjab War, Lord Hardinge, then Governor General, determined on the vigorous prosecution of the Ganges Canal. This great national undertaking was designed to irrigate, by means of the waters of the Ganges, the greatest part of the Doab between the Ganges and Jumna. It was then supposed that it would cost Rs. 1,00,00,000 and might be completed in 6 or 7 years. The undertaking, especially in the first few miles of its course, was beset with great engineering difficulties. Evidently it would tax to the utmost the skill, industry and resources of the people and of the country. The science that was necessary to construct a work of this magnitude, would also be constantly kept in exercise for its maintenance, improvement, and extension. Immediate measures were necessary to meet the emergency, and to provide a constant supply of

well-trained, experienced Civil Engineers, who should be able to face all the difficulties which are involved in the management of large undertakings of this nature. Out of this emergency Roorkee College had its rise.

15. Roorkee is a village situated about half way between Saharunpore and Hurdwar, at the point a little to the south of the Sewalik range of Hills, where the Ganges Canal leaves the low land bordering the river, and enters upon the high land forming the water-shed of the Doab. This level is reached by a large aqueduct across the Solani river, a tributary to the Ganges running under Roorkee, and immediately to its east. The circumstances which caused the selection of this spot as the site of the College, are thus stated in the proposal made to the Governor General on September 23rd 1847. "The Establishment now forming at Roorkee near the Solani aqueduct on the Ganges Canal affords peculiar facilities for instructing Civil Engineers. There are large workshops and extensive and most important structures in course of formation. There are also a library and a model room. Above all a number of scientific and experienced Engineer Officers are constantly assembled on the spot, or occasionally resorting thither.

"These Officers however all have their appropriate and engrossing duties to perform, and cannot give time for that careful and systematic instruction which is necessary for the formation of an expert Civil Engineer.

"On these accounts the Lieutenant Governor would propose the establishment at Roorkee of an Institution for the education of Civil Engineers, which should be immediately under the direction of the Local Government in the Educational Department."

16. The proposal obtained the immediate and cordial support of the Governor General of India. On October 19th 1847, Lieutenant R. Maclagan of the Bengal Engineers, was appointed Principal of the College, and on November 25th of the same year the following Prospectus was issued.

No. 949.

General Department, North Western Provinces.

HEAD QUARTERS, the 25th November 1847.

NOTIFICATION.

"The Lieutenant Governor directs the publication for general information of the following Prospectus of a College for instruction in Civil Engineering which is now established at Roorkee, and of which Lieutenant R. Maclagan, Engineers, has been appointed Principal.

PROSPECTUS OF THE CIVIL ENGINEERING COLLEGE AT ROORKEE.

[1st.] "The College is designed to give theoretical and practical instruction in Civil Engineering to Europeans and Natives, with a view to their employ-

“ment on the public works of the country, according to their several qualifica-
“tions and the requirements of the Service.

[2nd] “The Director of the Ganges Canal will be *ex-officio* Visitor of the
“College.

[3rd.] “There will be three Departments in the College, in each of which
“will be a certain number of Stipendiary Students, for whom quarters will be
“provided.

[4th.] “*First Department.*—Candidates for the appointment of Sub-Assistant
“Civil Engineer, as constituted by the orders of Government dated October 9th
“1845.

[5th.] “Persons admitted into this Department must be under the age of
“22. They must have previously acquired an ability to read and write with
“ease and accuracy in the English language, and a knowledge of Geometry, Alge-
“bra, Mensuration, Plane and Spherical Trigonometry, Conic Sections and Mecha-
“nics.

[6th.] “The number of Stipendiary Students in this Department is restricted
“to eight, who will be admitted only with the sanction of the Government.

[7th.] “Scholars from any of the Government Colleges, if properly qualified,
“may be transferred to this Department, receiving travelling allowance to Roor-
“kee at the established rate. They will there receive, besides free quarters, an
“increase of one-fourth to their Scholarship allowance, to cover extra expences,
“or such increase as will make up their stipend to the amount of Rs. 40 per
“mensem. Properly qualified persons, not attached to any Government College,
“will receive a monthly allowance of Rs. 40 in addition to free quarters.

[8th.] “Candidates for these stipends are desired to submit their applications
“to the Principal of the Roorkee College, accompa-
“nied with certificates of their proficiency in the
“abovenamed subjects and of character from some
“one of the Officers noted in the margin.* The
“Principal having satisfied himself of their profici-
“ency in such manner as he may find to be best, will
“submit his recommendation to the Secretary to the Government, North Western
“Provinces.

[9th.] “*Second Department.*—European Non-Commissioned Officers and Sol-
“diers. They will be required, previous to their admission, to prove by examina-
“tion, conducted in such manner as the Principal may find best, their proficiency
“in Reading, Writing and Arithmetic, Elementary Geometry, Mensuration, and
“Simple Plan Drawing. A certificate of character will also be required from the
“Commanding or Staff Officer of the Regiment, Troop, or Company to which they
“belong.

* Superintending Engineer and Execu-
tive Officers in the Central and North
Western Provinces and Punjab Divi-
sions.
Superintending and Executive Officers
of Canals and Roads.
Principals of Agra, Delhie and Benares
Colleges.

[10th.] "Their instruction at the College will be regulated with a view to their employment as Overseers in the Department of Public Works, to which they will, when qualified, be transferred, to meet the demands of the Service.

[11th.] "Their travelling charges to Roorkee will be paid. They will remain at the College on probation for six months, during which time they will receive, besides free quarters and their Regimental pay, the same advantages as with their Corps, or an equivalent in money. If approved at the end of this period, they will then receive the pay of an Assistant Overseer, and continue under instruction at the College, or be drafted off for the Public Service, as may be found advisable. During the time they remain at Roorkee, they will be under the command of the Officer who fills the post of Principal of the College.

[12th.] "Their number is not at present to exceed ten.

[13th.] "*Third Department.*—Native youths desirous of instruction in Surveying, Levelling and Plan Drawing. A fair acquaintance with Arithmetic in the Native form, and an ability to read and write Oordoo in the Persian character, will be the qualifications required for admission to this Department.

[14th.] "The number of Stipendiary Students in this Department will be limited to sixteen, who will receive a monthly allowance of Rs. 5 for maintenance, besides free quarters.

[15th.] "Properly qualified Candidates who are willing to come to Roorkee and support themselves there at their own cost, will be admitted into all the Departments so far as means may be available for their instruction. Should the number of such applicants be numerous, moderate fees will be hereafter demanded for admission to the benefits of the Institution. Instruction will for the present be gratuitous, and no payments will be demanded without previous notice of one year.

[16th.] "Students who have conducted themselves to the satisfaction of the Principal will, on leaving the College, be furnished with a Certificate of their character and qualifications.

[17th.] "Annual Examinations will be held, when all the Students attached to the College will be classed according to their proficiency. Prizes of Books, Mathematical Instruments, &c., will be given to the most deserving students."

17. The Establishment of the College was fixed on the following scale:

1 Principal, Staff Salary, ..	..	..	..	..	600	0	0
Do., House rent, ..	..	..	..	..	50	0	0
1 Head Master, Salary, ..	..	..	..	..	300	0	0
Do., House rent, ..	..	..	..	..	50	0	0
1 Architectural Drawing Master, Salary,	200	0	0
1 1st Native Teacher,	120	0	0
1 2nd ditto ditto,	50	0	0
					1370 0 0		

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SCHOLARS' STIPENDS.							
8 @ 40 Rs. per mensem,	320	0 0	
16 @ 5 Rs. per mensem,	80	0 0	
						400	0 0
GENERAL ESTABLISHMENT,							
2 Chuprasses, .. .. .	..	..	@ 5 Rs. per mensem,	..	10	0 0
3 Tindals (for surveying parties),	..	..	@ 5 .. .. .	..	15	0 0
18 Khalasees, for ditto,	..	..	@ 4 .. .. .	..	72	0 0
1 Bearer, .. .. .	..	..	@ 5 .. .. .	..	5	0 0
1 Chokeydar, .. .. .	..	..	@ 5 .. .. .	..	5	0 0
1 Sweeper, .. .. .	..	..	@ 4 .. .. .	..	4	0 0
						111	0 0
FOR EUROPEAN BARRACKS.							
1 Khidmutgar, .. .. .	..	..	@ 6, .. .. .	..	6	0 0
2 Cooks, .. .. .	..	..	@ 6, .. .. .	..	12	0 0
2 Dhobees, .. .. .	..	..	@ 6, .. .. .	..	12	0 0
3 Bheestees, .. .. .	..	..	@ 5, .. .. .	..	15	0 0
2 Sweepers, .. .. .	..	..	@ 4, .. .. .	..	8	0 0
1 Chokeydar, .. .. .	..	..	@ 5, .. .. .	..	5	0 0
						58	0 0
Total Co.'s Rs., 1939						0	0

18. On January 1st, 1848, the first pupils were enrolled, by the transfer to the Principal of a few native lads, who had been learning Levelling under Major W. E. Baker, Engineers, then Director of the Ganges Canal, but it was not till the middle of the year that the Establishment was completed, the buildings erected and the classes opened. In August the number of men in the 2nd Department was complete, and they were all lodged in the Barracks, which had been constructed for them.

19. In the cold season of 1848-49, the second Punjab War broke out, and caused a temporary interruption of proceedings. The supply of Students to the 2nd Department was for the time stopped, and the Principal, Head Master, and Military Students marched to the Frontier, and were absent from Roorkee for a little more than two months. The restoration of peace on the annexation of the Punjab in March 1849 permitted the vigorous resumption of operations in the College.

20. Early in 1850, the number of Military Students was increased from 10 to 15, and the period of their stay at the College was prolonged to a year, the first six months being probationary. It was at the same time arranged that admissions to this Department should only take place at the commencement of each year.

21. In 1850, the number of Stipendiary Students in the 3rd Department was increased. In addition to the 16 hitherto on the Establishment drawing Rs. 5

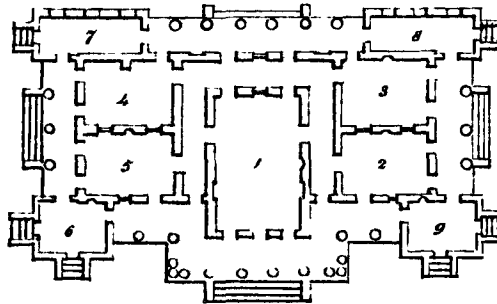
CIVIL ENGINEERING COLLEGE

ROORKEE

Erected, 1848



Scale 1/4" = 1 foot



References

1. Drawing Class room
2. 2nd Department D^o & European non-stipendiary 2nd D^o
3. 3rd " " Senior & Junior Divisions
4. Library - 1st Department - & non-stipendiary 1st D^o
5. Principal's room - part of Library - schoolbook store - Instruments &c
6. Surveying instrument room - Native Office - & Bookbinding room
7. Apparatus and Store room
8. Store room
9. Stationery store

Signed
Rob^t Maclagan Lieut.
Principal C. E. College

Roorkee
June 9th 1851

a month, a Senior Division of 8 was formed, each of whom was allowed 10 Rs. per mensem.

22. Up to July 1850, the expenses on account of buildings stood as follows :

On account expense incurred in the construction of the College building, ..	20,952	15	8
Principal's and Head Master's Bungalows and Out-houses,	10,492	8	10
Expenditure on account of furniture for the College,	1,614	10	9
Ditto on account of pucca well,	579	7	1
Ditto clearing, building sites, &c.,	677	13	5
Ditto constructing College Road and 2-arched drain bridge,	553	1	1
Ditto on account of sundry repairs from completion of work to Oct. 31st 1849,	214	11	6
On account of expense in digging wells in Principal's and Head Master's compound,,	191	14	1
	<u>35,277</u>	<u>2</u>	<u>5</u>

23. At the close of 1850, the erection was sanctioned of three Bungalows at a cost of Rs. 2,600 each, for the accommodation of non-Stipendiary Students. Each Bungalow was designed to accommodate two Students, and a rent of Rs. 12-8, from each Student, or of Rs. 25 for each Bungalow was to be demanded to cover the cost of the buildings.

24. On April 7th 1851, the number of Students attached to the College was fifty, viz.

1st Department,	3
2nd Department,	16
3rd Department, Senior Division,	5
Ditto, Junior Ditto,	16
Non-Stipendiary,	10
Total,	<u>50</u>

25. Up to that time, from the foundation of the College, 42 had left it for the Public Service, of whom there were:

1st Department,	2
2nd Department,	21
3rd Department,	18
Non-Stipendiary,	1
Total,	<u>42</u>

26. The appointments they obtained were these :

- 1 Sub-Assistant Great Trigonometrical Survey.
- 1 Sub-Assistant Civil Engineer, (Ganges Canal).
- 21 Assistant Overseers (Canal, Road and Barrack Departments).

16	Native Surveyors and Levellers.
2	Draftsmen.
1	Superintendent of Roads (European Non-Stipendiary Student).
<hr/>	
42	Total.

27. The present state of the College will be best understood from the following outline of the Course of Study for 1851.

COURSE OF STUDY, 1851.

FIRST DEPARTMENT.

Practical Trigonometry and Mensuration.
Mechanics.
Materials and their Application.
Strength of Materials and stability of Structures.
Construction.
Measuring and Estimating.
Outlines of Architecture.
Moving Powers and Machines.
Interior Communication.
Practical Hydraulics.
Principles of Geography and Geodesy.

TEXT BOOKS.

Weisbach's Mechanics of Machinery and Engineering.
Mahan's Civil Engineering.
Treatises on "Architecture," "Building," "Carpentry," from the
Encyclopædia Britannica.
Tredgold's Carpentry.
Abbott on Bridges, and Cantley on Well Foundations.
Wood on Rail Roads.
Weale's Rudimentary Volumes—"Foundations," "Roads," "Blast-
ing and Quarrying."—"Drainage of Lands."
Hughes' Mathematical and Physical Geography.
Galbraith's Mathematical and Astronomical Tables.

SECOND DEPARTMENT.

Practical Geometry.
Algebra.
Plane Geometry.
Application of Algebra to Geometry.

Plane Trigonometry.
Mensuration.
Mechanics.
Building Materials and Construction.
Measuring and Estimating.
Strength of Materials.
Interior Communication and Drainage.

TEXT BOOKS.

Elliot's Practical Geometry and Mensuration.
Tate's Algebra.
Tate's Principles of Geometry, &c.
Hutton's Geometry.
Abbott on Bridges, and Cautley on Well Foundations.
Civil Engineering College "Papers."
Weale's Rudimentary Volumes—"Mechanics," "Art of Building,"
"Blasting and Quarrying," "Foundations," "Roads," "Railways,"
"Drainage of Lands."

HINDUSTANEE.

Anglo Hindustanee Idiomatic Exercises.
Ram Surun Dass's Acchar Abhiyas and Phailawut.
Nukliat-i-Hindi.
Ballantyne's Interpreter.

THIRD DEPARTMENT.

JUNIOR DIVISION.

Practical Geometry.
Higher Arithmetic.
Mensuration.
Plane Geometry.
Algebra.
Plane Trigonometry.

SENIOR DIVISION.

Conic Sections.
Mechanics and Hydrostatics.
Materials and Construction.
Measuring and Estimating.
Analytical Geometry.
Spherical Trigonometry.
Principles of Geography and Astronomy.
Outlines of Optics, Heat, Electricity.

TEXT BOOKS.

- Adjoodhia Pershad's Practical Geometry.
Ilm-i-Hisab.
Mumlook Ali's Euclid.
Thomason's Ditto.
Elliot's Mensuration, (translated by Beharee Loll).
Ramchunder's Algebra.
Ramchunder's Trigonometry and Conic Sections.
Elements of Natural Philosophy, (translated by Adjoodhia Pershad
and Dhurm Narain).
Webster's Hydrostatics.
Abbott on Bridges, and Cautley on Well Foundations, (translated by
Munoo Loll).
Civil Engineering College Papers, (ditto ditto).
Hughes' Principles of Geography, (ditto ditto).

SURVEYING COURSE.

- I.—Application of Practical Geometry in the Field.
II.—Surveying and Measuring.
1. Without instruments for observing Angles.
Chain measurements of Fields and calculation of Areas.
Preparation of Ground Plans from measurements of Buildings.
Laying down measurements of Buildings from Plans.
2. With instruments for observing Angles.
Prismatic Compass.
Protraction by Bearings.
Theodolite.
Protraction by Traverses.
Areas by Universal Theorem.
III.—Levelling.
Construction of Sections.
Contouring.
Construction and Adjustment of Instruments.
IV.—Laying out Lines, Curves, and Cuttings.
V.—Route Surveying and Field Sketching.

BOOKS OF REFERENCE.

- Adam's Geometrical Essays.
William's Geodesy.
Gibson's Surveying.

Simms' Mathematical Instruments.

„ Drawing Instruments.

Boileau's Traverse Tables.

Simms' Field Engineer.

Bourn's Surveying.

Baker's Surveying.

3RD DEPARTMENT.

Ramsurn Dass' Map Toke.

„ Putwaree ki Kitab.

Hurdeo Singh's Land Surveying.

Settlement Misl.

OUTLINE OF DRAWING COURSE.

I.—Elementary.

Outline Pen Work.

Light and Shade.

II.—Simple Architectural Plans.

III.—Topographical Drawing.

Practice in Enlarging and Reducing.

IV.—Carpentry and Masonry Details.

V.—Engineering and Architectural Drawings.

VI.—Implements and Machinery.

A separate class once a week for Isometrical Projection, Perspective and Landscape Drawing.

28. It will thus be seen that though little more than three years have passed since the first opening of the College, and that though during part of that time the exigencies of the Public Service in the Punjab War caused a temporary suspension of operations, yet a considerable number of well-trained men have been furnished to the service of the State, and the Institution has obtained a standing and organization, which affords promise of much future usefulness.

29. Some idea may be formed of the estimation in which the College is held, by those who desire an education in Civil Engineering, from the fact that though five Students only have been admitted into the first Department of the College since its institution, there have been 17 applications for admission. In the 2nd Department, 41 have been hitherto admitted, but there have been 81 applications. The number of applications in the 3rd Department has been very great, but they have not been registered.

30. There has also been a great demand for men educated in the College, on the part of those who require the services of such men. The Principal has been compelled to decline compliance with many applications made to him, from the

absence of properly qualified Candidates, and he has been only able to comply with a few such applications, by sending out the most promising of his pupils before they had obtained that complete training, which it was desirable they should receive.

31. Those also who are best qualified to form an opinion respecting such an Institution, have expressed themselves favorably as to its efficiency. In the commencement of 1851, a Commission was appointed for enquiring into the superintendence and execution of Public Works in the Bengal Presidency. This Commission consisted of Major W. E. Baker, Bengal Engineers, Major J. P. Kennedy, formerly of the Royal Engineers, and Mr. C. Allen, of the Bengal Civil Service. The following passage occurs in their Report, dated March 5th 1851.

“ The new College at Roorkee has already afforded valuable aid to the Department, and on its present footing is calculated to supply annually

“ 4 Sub-Assistant Engineers,	|	“ 6 Senior Native Agents or Surveyors,
“ 15 Assistant Overseers,	|	“ 16 Junior ditto ditto.

“ The course of instruction imparted to these men, and the opportunities they enjoy on the Ganges Canal Works, of forming a practical acquaintance with almost every description of Engineering duties, give promise of a high standard of qualification for the Public Service.

“ To test the sufficiency of the Roorkee College as now limited, to supply the Department generally with European Overseers, a casualty list has been obtained from the Military Board.

“ The average of vacancies for the last four years has been about 22 per annum, but the strength of the establishment is far below the wants of the Service, and should be increased. The proportion between the Senior and Junior Classes, which has been disturbed by the appointment of an unlimited number of Assistant Overseers, should also be restored. The following scale is recommended, and would not be found excessive.

“ Conductors,	..	..	..	..	..	15
“ Sub-Conductors,	..	..	..	..	..	20
“ Overseers,	..	..	..	..	..	65
“ Assistant Overseers,	..	..	..	..	..	200

Total, .. 300

“ According to the present ratio of casualties, there would, under the proposed organization, be thirty-three vacancies per annum; but this might be slightly reduced, as ‘dismissals’ will be less frequent, as the preliminary qualification improves. The second Class in the Roorkee College might with advantage be doubled, and would then supply thirty Overseers per annum, which would probably suffice.”

32. But during the short period that has elapsed since the foundation of the College, events have occurred, which occasion a greatly increased demand for the scientific skill which it is designed to produce, and therefore add to its importance as an instrument well calculated to supply the want.

33. Early in 1849, the second Punjab War was terminated by the annexation of the whole Territory, which remained to the Seikh Durbar, after the Treaty of 1846. A tract of country containing about 78,000 square miles, and immediately adjoining to the North Western Provinces was then added to the British Empire in Hindoostan. Throughout the whole of this Territory the work of improvement has been commenced with much energy.

34. Already plans are matured and in progress for the accurate survey of all this extensive area. The Trigonometrical Surveyor is casting his net work of triangles over its whole surface, and determining with mathematical precision the true site of every important point. The Revenue Surveyor is laying down the boundaries of every village, and determining the size and productiveness of every field. The Marine Surveyor is ascertaining the capacity of its rivers for navigation, and the means by which their beds may be enlarged and deepened. *

35. The country is intersected by numerous large rivers which flow from north to south. The main lines of communication run east and west. Along those lines Military stores must pass, and Troops must march from Hindoostan to Peshawur. Along those lines the qaflahs must find their way from Cabul and Central Asia to Hindoostan, and take back the manufactures of Great Britain, in return for the products of their own country. Difficult as it may be, roads must be constructed across the whole drainage of the country. Many and costly bridges must be built. The utmost exertions of science are necessary for the maintenance of the ordinary means of intercommunication.

36. These large and numerous rivers take their rise in the perpetual snow of the Himalayas, and pour never-failing streams of water over the dry and thirsty country which lies to the south. But in order that the water may fertilize the earth, it must be drawn from the deep beds of rivers, in which it naturally runs, and be led in artificial Canals along the high lands, whence it may be directed at pleasure, wherever it is most needed. Whilst the Punjab was still the battle field of the armies, which were struggling for the rich possession, an experienced Engineer, Lieutenant R. Baird Smith, scanned the country with his practised eye, and called attention to the ease with which it might be brought under irrigation by Canals. His views were developed in a pamphlet published in 1849 on the "Agricultural Resources of the Punjab; being a Memorandum on the application of the waste waters of the Punjab to purposes of irrigation." The Government was not slow in taking the hint, and already has a Canal been surveyed, lined out and commenced, which, at an expense of Rs. 50,00,000, is to spread the waters of the Ravee over the Barea Dooab between the Beas and the Ravee.

37. Cantonments have to be formed, stations have to be laid out, Civil and Military Buildings of all descriptions have to be built. For these purposes expert designers, skilful architects, and clever artificers are urgently required.

38. It is hence apparent that both in the North Western Provinces and in the Punjab, great national undertakings have been commenced, and are in progress, and that a large and a steady demand for all classes of Civil Engineers may be confidently anticipated. It is therefore necessary for the Government carefully to consider how this exigency can best be met. In Roorkee College they have the germ of an Institution well fitted to supply the want, but it must be greatly enlarged to render it really efficient for the required purpose.

39. The College with its present establishment and present means of accommodation is barely adequate for the instruction of those who now resort to it. It is utterly inadequate, as at present constituted, to meet the exigencies of the occasion. If it is desired to enlarge its sphere of usefulness, very great additions must be made to it, and several other important objects, which do not fall within the scope of its present organization, may at the same time be advantageously accomplished.

40. The measures, which are now proposed for the further development of the scheme, which was contemplated in the first design of the Institution, may be thus enumerated.

FIRST.—The admission of Officers both of the Royal and East India Company's Armies to study at Roorkee College.

SECONDLY.—The improvement and superintendence of the Village Schools in a circle of 40 or 50 miles round Roorkee.

THIRDLY.—The establishment in connection with the College of a *Depôt* of Mathematical and Scientific Instruments, and of a Workshop for their manufacture and repair.

FOURTHLY.—The formation of a Museum of Economic Geology.

FIFTHLY.—The erection of an Observatory for Instruction.

SIXTHLY.—The maintenance of Metal and Stone Printing-presses, with a Book-binder's Establishment, and all that is necessary for the publication of Scientific Works, with appropriate drawings and illustrations.

SEVENTHLY.—The enlargement of the College building and Establishment to meet all these purposes.

Each of these measures requires to be separately noticed.

41. *First.* The admission of Officers of both the Royal and East India Company's Armies, to study at Roorkee College. It has been already stated that the Indian Army is one of the sources whence scientific agency is most easily supplied. Besides the Officers of the scientific Corps, properly so called, there are in the Indian Army many well informed and highly educated men, who have much taste and capacity for Civil Engineering. It is only necessary that the persons

possessed of this talent should be known, and that they should be provided with the means of improving themselves, and of perfecting their knowledge. It was on the suggestion of His Excellency Sir C. J. Napier, G.C.B., then Commander-in-Chief of the Indian Army, that the plan was brought forward, and it was by his assistance that it was matured. The scheme closely resembles that on which the Senior Department in the Royal Military College at Sandhurst has been formed.

42. The following are the Rules by which it is proposed to give effect to this measure.

RULES FOR THE ADMISSION OF OFFICERS TO ROORKEE COLLEGE.

1. European Commissioned Officers of the Army under the rank of a Field Officer, will be permitted to study at the Civil Engineering College at Roorkee on the following terms.

2. The Candidate for admission must be qualified, by acquaintance with his Military duties, and by having passed the examination in the Vernacular Languages, to have charge of a Company.

3. His application is to be addressed through his Commanding Officer to the Principal of the College, who after satisfying himself that the Candidate is likely to profit by the course of study, will forward the application for the approval of His Excellency the Commander-in-Chief.

4. Admissions to the College will take place from the commencement of March to the end of June. Applications should be forwarded so as to permit of the Candidates joining not later than June 30th, after leave formally granted in General Orders.

5. The duration of the first permission to study at the College, will be till November 1st of the same year, but if the progress of the Student is satisfactory, and his conduct otherwise exemplary, the Principal will be at liberty to forward his application to Head Quarters for permission to remain another year at the College. No Student will be allowed to remain longer than the November year after his first admission unless on special sanction granted under peculiar circumstances.

6. The Principal of the College may at any time recommend to His Excellency the Commander-in-Chief, that an Officer be remanded to his Regiment.

7. Officers studying at Roorkee under these Rules will be required to pay Rs. 10 a month to the College Library Fund.

8. Officers who obtain permission to study at Roorkee College will be considered "absent on duty," and will be so reported in the Regimental Returns.

43. These Rules have been approved by the Most Noble the Governor General, and have been recommended for sanction to the Hon'ble the Court of Directors.

44. *Secondly.* The superintendence and improvement of the Village Schools within a circle of 40 or 50 miles round Roorkee. The preceding measure is

intended to provide the highest class of educated scientific men for the design and superintendence of public works. This is calculated to raise up a cheap and effective subordinate agency. In the neighbourhood of Roorkee there are some large and thriving native towns, amongst which may be mentioned, Kunkhul, Jowallahpoor, Munglour and Deobund. In some of these towns handicrafts have long been practised, and in all of them the proximity of the Ganges Canal Works has stirred up a spirit of industry and enterprise. The object of the Government must be to stimulate this spirit and to give it a right direction.

45. The pupils in the 3rd Department of the College, who study science through the medium of the vernacular languages are drawn from the class of the people, whose condition it is intended by this measure to improve. In fact, it was from observing that several of the native Students came from villages in the neighbourhood, that the idea of this scheme of operations arose. It is intended to proceed on the plan at present pursued in some of the Districts in the North Western Provinces, under the Resolution of February 9th, 1850. The plan is to have a few model Village Schools and an establishment of Visitors, whose duty it will be to go round the villages in the tract assigned to them, examining the state of the Indigenous Schools, and advising and assisting the School Masters by instruction, books, and rewards.

46. A commencement has already been made in this work. Two Pergunnah Visitors have been appointed for the last few months, and their researches afford abundant proof of the low state of education at present, and of the great readiness of the people to receive instruction.

47. If an agency were organized in the district of Saharunpoor, similar to that employed in the other Districts under the Resolution of February 9th, 1850, the cost would be

1 Zillah Visitor,	..	..	..	150
4 Pergunnah Visitors, @ 30,	..	..	..	120
4 Tehseeldaree Schools, @ 15,	..	..	..	60
				<hr/>
Total per mensem,	..	..	..	330
				<hr/>
Or per annum,	..	..	..	3960
Add for Prizes,	..	..	..	500
				<hr/>
Total per annum,	..	..	..	4460
				<hr/>

48. *Thirdly.* The formation of a Depôt for the safe custody, and of a workshop for the manufacture and repair, of Mathematical Instruments. When scientific agents have been trained and are ready for work, it is evident that they must be adequately furnished with instruments. Many of these instruments

must be obtained from England, some can be manufactured in this country. All are liable to derangement, and will require occasional repair. This involves the maintenance of a *Depôt* for the safe custody of a sufficient store of instruments, and also of a workshop for their manufacture and repair. These should be placed in the immediate vicinity of each other, where appropriate Superintendents and artificers can be found, and as near as may be possible to the place where they will be used. All these conditions are to be found at Roorkee. The *Depôt* can be formed in the College, where the instruments will be well cared for, and open to the constant inspection of the Students. The workshop will be in the Ganges Canal Yard, close to the College, where are now to be found a large store of material, abundance of clever workmen, and all the appliances necessary for the rougher parts of the work. To these it will only be necessary to add a few artificers of the highest order, machines and instruments for the execution of the finer parts of the work, and a small Office establishment.

49. Roorkee is not only itself the Head Quarters of the establishment on one of the greatest Engineering works of the day, but it is also centrally situated with respect to other works. It easily communicates with Calcutta, it has Rohilcund and its works on one side, the Jumna with its Canals on the other, Dehra Dhoon and Mussoorie immediately to the north; it is more accessible from the Punjab than any other place, where such an institution now exists, or is likely to be formed. Much stress may also be laid on the advantage the Students of the College will derive from being able at any time to see the mode in which instruments are constructed, and to become acquainted with the capabilities of the country both for the manufacture and repair of instruments. They will in their future course know what instruments will be best suited for their purposes, and how and where they can be obtained.

50. One most interesting and useful branch of the workshop will consist in the invention and manufacture of cheap substitutes for expensive instruments. The natives of the country are generally poor, and can ill afford to purchase costly articles, but simple instruments, adequate for all ordinary purposes, can be easily made up at a small price, so as to be within the reach of their means. Surveying compasses, plane tables, levelling instruments, and protractors, can all be furnished at a trifling cost, and can be sufficiently well constructed to answer all the ordinary purposes of village life.

51. Lieutenant A. Allen, 55th N. I. Engineer of the Ganges Canal Workshop, has already made a most successful commencement in the organization of an establishment of the contemplated kind. He has been able to repair in a superior style instruments which had been accidentally injured, and he has constructed at a very trifling cost many ingenious substitutes for the more costly instruments. The capacity of the workmen, and the feasibility of the scheme, have been proved. The means of effectually working it out are alone required.

52. If the scheme be fully carried out, the following are the establishments necessary for its organization:—

Depôt,	..	..	..	..	216	per mensem.
Workshop,	..	..	..	..	658	” ”
					874	per mensem.
						or 10,488 per annum.

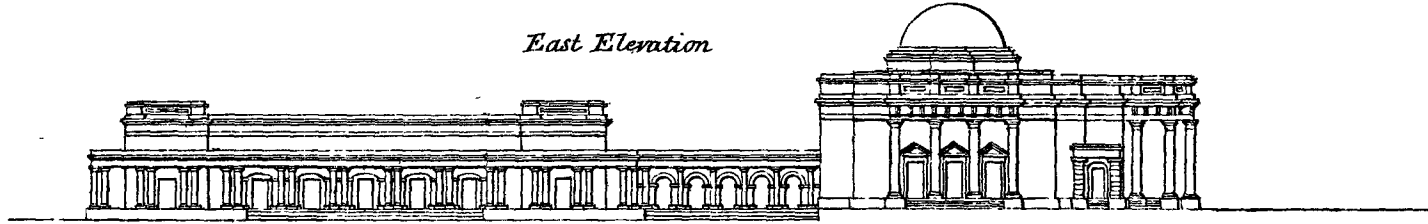
53. It may be added that this project has obtained the warm support of the Military Board, of the Surveyor General of India, of the Deputy Surveyor General; and of Lieutenant Colonel Cautley, and that its adoption has been strongly recommended by the Most Noble the Governor General of India, to the Honorable Court of Directors.

54. *Fourthly.* The formation of a Museum of Economic Geology. The importance of a good Museum of this kind to Students in Civil Engineering is too obvious to need much comment. Here they will find specimens of building material from all parts of the country. Building stones, clays for bricks or potteries, limestones, materials for metalling roads, &c., may all be arranged here according to the localities in which they are found, or their adaptation to the uses for which they are designed. Here also the Students may learn in what positions, the substances of which they are in search may probably be found, or by what indications their search for certain substances may be directed. Some collection of this kind, which should be as it were an Index of the mineral resources of the country in which the Students will be employed, is almost a necessary appendage to the Institution. The maintenance of the Museum will involve but little expence, beyond the building necessary for its reception, unless hereafter it attain to a size and importance which it is unnecessary at present to contemplate. Room has been assigned for the Museum in the proposed additions to the College buildings.

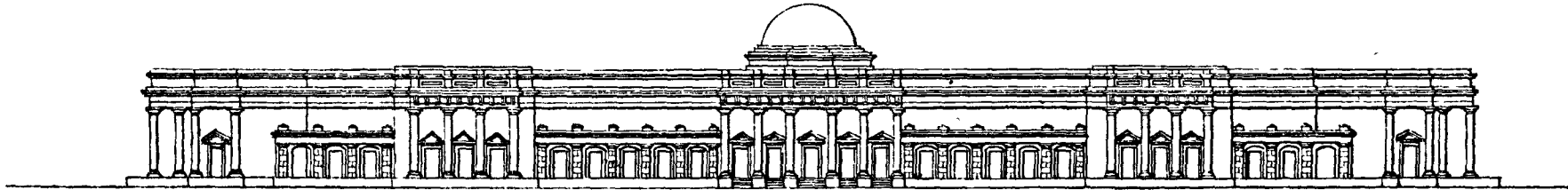
55. *Fifthly.* The erection of an Observatory for Instruction. This will be of great use in familiarizing the Students with the use of Astronomical and Meteorological Instruments, and in teaching them how to conduct the ordinary observations in Astronomy and Meteorology. The importance of good training in the former science, for all those destined for employment in the Survey Department, is evident. The observations in Meteorology which have lately been conducted with so much care, and at a large expence, in the Magnetic Observatory at Simla, and in many other similar Observatories, which have been established at different places on the surface of the earth, show what great importance is now attached to the cultivation of that science. This Observatory when once established will cost little in its maintenance. The charge will consist in the expence of the building and of the Instruments. The Observatory will be detached from the College, and is estimated to cost Rs. 2,500; the Instruments need not be of great value, and it is probable that many can be supplied from the Trigon-

PROPOSED DESIGN for the CIVIL ENGINEERS COLLEGE at ROORKEE

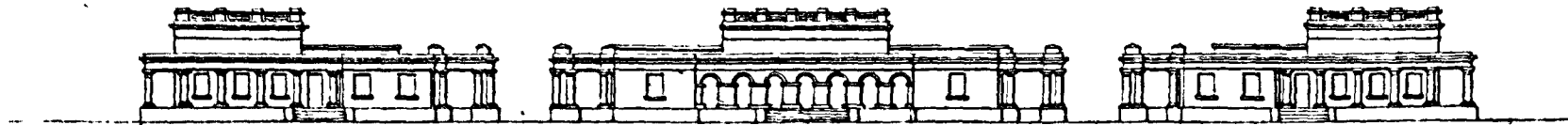
East Elevation



Front, or North Elevation



South Elevation



References

GROUND PLAN.

Reference

1. Drawing Class Room
- 2 & 2 Side Vestibules
- 3 College Stationery Store
4. Geological Museum
- 5 5 Centre Corridor
- 6 Class Room
- 7 7 D^o - D^o -
- 8 8 Entrance Corridor
- 9 Class Room
- 10 D^o - D^o -
11. Closet
- 12 - D^o -
13. Office
14. Library
15. Laboratory
- 16 Lecture Room
- 17 17 Porticos
- 18 18 Verandahs
- 19 Entrance Portico
- 20 Private Closet
- 21 Surveying Instt Room
- 22 Mathem^l Instt Room
- 23 Committee Room
- 24 Principals' Room

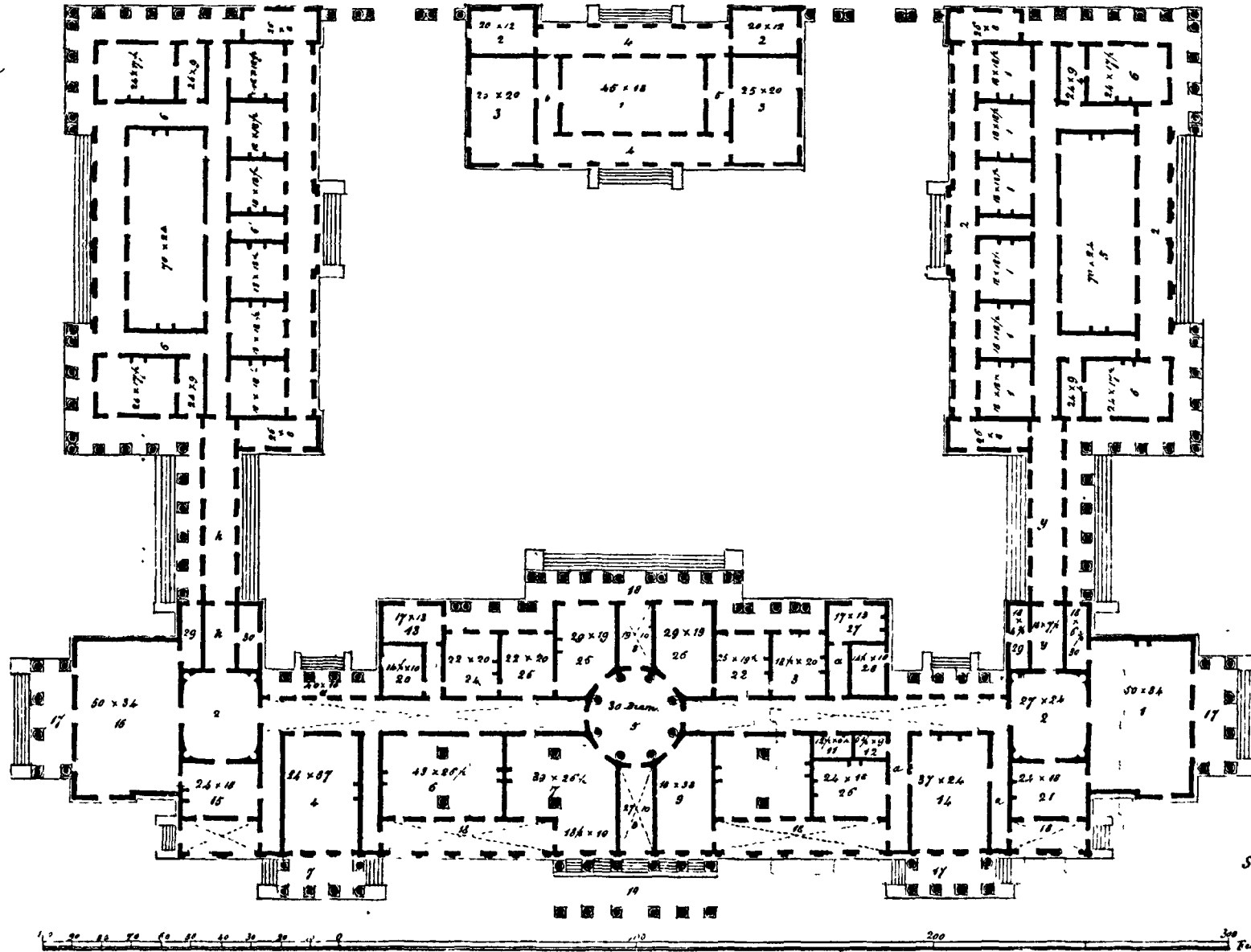
- 25 Apparatus Room
26. Extra Room
- 27 27 Small store Rooms
- 28 Private Closet
- 29 30. Closets
- a a a Sundry Passages
- h. g Open Corridors

Typographic Press

- 1 1 1 1 Drying Rooms
- 2 2 2. Verandahs
- 3 3 3 Passages
- 4 4 Store Room
- 5 Press Room
- 6 6. Composing Rooms

Book Binding

- 1 Press Room
- 2 2 Store Rooms
3. 3 Stitching rooms &c
- 4 4 Verandahs
- 5 5 Passages



Signed

George Prue Inutt

metrical Survey, and from the Simla Magnetic Observatory. The sum of Rs. 6,000 may be supposed sufficient to meet this charge for Instruments.

56. *Sixthly.* The maintenance of Metal and Stone Printing-presses, with a Book-binder's Establishment, and all that is necessary for the publication of Scientific Works, with appropriate drawings and illustrations. It is impossible to attach too much importance to this branch of the project. Civil Engineers in India conduct their operations over a large extent of country. They work often alone, tied down to particular spots, and debarred from those rapid means of communication, which would enable them freely to interchange their ideas with others, and add to the value of their own labors by the experience of their fellow workmen in other parts of the country. Printing and publication are the best means by which the profession can be made acquainted with what is doing beyond their own sphere, the mode in which it is done, and the cost at which it is accomplished.

57. Again, works of instruction are much wanted, both in English, suited to the peculiarities of the country, and in the Native languages, embracing the very rudiments of the science. Already has a most important commencement been made in this branch of operations. Treatises have been drawn up and published both in English and Oordoo, on some of the most important processes of Engineering or Architecture in this country, and many Translations into Oordoo of the most useful and popular English works on the science are now in hand.

58. But the establishment must be complete in all its branches. Lithography affords facilities for the multiplication of Diagrams, of Plans, and of Maps. Wood-cutting will probably be attempted for the greater facility of showing Diagrams in the midst of letter-press. Book-binding is necessary for the preservation of the works which may be printed. All these appliances must be provided on the spot, so that the work may proceed without interruption.

59. A commencement has already been made in this Department. The Printing presses which were attached to the Simlah Magnetic Establishment have been transferred to Roorkee College, with an Establishment costing Rs. 268 per mensem. Lithographic Presses and Stones are now being procured, and the

General Superintendence, ..	365	Rs.	. whole Department when fully established at Roor- kee will involve a monthly charge of Rs. 1,346. A building sufficient for the present requirements of the Press, which will form part of the new pro- posed College Edifice, is now nearly completed. The
Typographic Department, ..	462	"	
Lithographic Ditto,	340	"	
Book-binding,	179	"	
	<hr/>		
per mensem, ..	1346	Rs.	
or per annum, ..	16152	"	

cost of this will be included in the estimated charge for the new College building which is given hereafter.

60. *Seventhly.* The enlargement of the College building and Establishment to meet all the above purposes. A fine design for the new College has been furnished by Lieutenant G. Price, 1st Bengal E. F., an Assistant Engineer in the 1st Division of the Ganges Canal Works. The estimate for this building is Rs. 86,500,

to which must be added Rs. 5,000 for book-shelves and furniture, making in all Rs. 91,500. The arrangement and the various purposes to which the different parts of the building are to be appropriated will be learned by a reference to the plan, where the shaded part on the right hand side of the main building shows the site and extent of the present College.

61. The number of Scholars in the first Department need not be increased; for the number of persons, who can reach the high standard required for admission, is never likely to be large. The Military Students of the 2nd Department, ought certainly to be doubled, as has been recommended by the Commission on Public Works (*vide* para: 31). The number of Stipendiary Students in both Divisions of the 3rd Department may also well be doubled, as the demand for such men is great.

62. It will be necessary to provide additional Bungalows for the Officers of the Army, who may resort to Roorkee, for the purposes of study; but as the expense of these buildings will be covered by the rent, which the occupants will be required to pay, no separate account of the charge need be taken. Barracks however must be provided for the additional number of Military Students in the 2nd Department, and as Roorkee is itself an inconsiderable village, suitable accommodation must be found for the Scholars in the 3rd Department, and for other Natives, who may of their own accord resort to the College for the purposes of study and instruction. The cost will be :—

For the barracks and furniture,	Rs. 13,740
For the native houses,	„ 7,200
	<u>Total Rs. 20,940</u>

63. The present Establishment of Teachers is inadequate for the instruction of more than the present number of Students. If the number of Students is increased, the number of Teachers must be so likewise. It may be assumed, that excluding the Principal, the greatest part of the establishment must be doubled. The present establishment is somewhat increased from what is shown in para 17 as that which was sanctioned on the first formation of the College. It may now be stated thus:

Principal (Staff Salary),	Rs. 600
Under Masters,	„ 670
8 Scholars in the 1st Department @ 40,	„ 320
8 Ditto 1st Division, 3rd Department @ 10,	„ 80
16 Ditto 2nd Division, 3rd Department @ 5,	„ 80
Writers, Servants, &c.,	„ 185
Servants for 2nd Department,	„ 74
	<u>Per mensem, 2,009</u>

No allowance need be made for the increased expense, consequent on the proposed increase of Students in the 2nd Department to double the present amount, beyond that which is necessary for servants, under which head are included Cooks, Washermen, &c. The charge then on the proposed enlarged scale would stand thus:—

Principal, (Staff Salary)	Rs.	600
Under Masters,	„	1,340
8 Scholars in first Department @ 40,	„	320
16 Ditto 1st Division, 3rd Department @ 10,	„	160
32 Ditto 2nd Division, 3rd Department @ 5,	„	160
Writers, Servants, &c.,	„	370
Servants, &c. for 2nd Department,	„	148
		<hr/>
	Total per mensem,	3,098
		<hr/>
	Or per annum,	37,176
		<hr/>

64. It remains now to collect together the several items of charge, and to show what will be the total expense to the Government of the scheme now proposed. The original cost of the buildings, furniture, &c., may be thus stated:—

Buildings already erected as given, (in para: 22),	Rs.	35,277
Estimated cost of new College, including Depôt for Instruments, Museum, Printing-presses, &c., (v. para: 60),	„	91,500
Observatory building and Instruments, (v. para: 55),	„	8,500
Barracks and Accommodation for the 2nd and 3rd Departments, (v. para: 62),	„	20,940
		<hr/>
		156,217
		<hr/>

65. The above original outlay may be represented by an annual charge of 10 per cent. to cover interest and repairs. The annual charge will then stand thus:—

Ten per cent. on original outlay for interest and repair,	Rs.	15,622
College Establishment, (v. para: 63) per annum,	„	37,176
Depôt for Instruments and Workshop, (v. para: 52),	„	10,488
Press Establishment, (v. para: 59),	„	16,152
Village Schools and Inspectors, (v. para: 47),	„	4,460
Probable Contingencies, including Books for Library,	„	6,000
		<hr/>
	Total per annum,	83,898
		<hr/>

66. In seeking to justify the expenditure of so large a sum on an establishment for the purposes of education, there is no desire to undervalue science on its own account, or for the social and industrial improvement which it may effect

amongst the people of the country. It is evidently impossible that an agency, such as it is designed to connect with Roorkee College, should be brought into exercise in the midst of the dense population of the Northern Doab, without materially improving the social condition of the inhabitants. The certain discoveries of modern science would be substituted for the crude and mistaken notions which now prevail on all subjects connected with Natural Philosophy. The people would have daily before their eyes some of the greatest achievements of scientific skill, and they would be taught the steps, by which that skill is acquired, and the means by which it is brought into operation. A stimulus will be given to the native mind, which cannot fail to be highly beneficial. This is in itself an object worthy of the aim of a great Government. It is a purpose for which the State has appropriated large sums of money in all parts of the country.

67. But this project addresses itself yet more directly to the material interests of the Government. The welfare of all Governments is intimately bound up with the prosperity of the people, but the financial system which prevails in the North Western Provinces and in the Punjab, renders the interest of the Governors and the governed more than elsewhere identical. The State income consists mainly of the Land Revenue, and whatever adds to the value of the land, tends directly to increase the income. The Revenues of the North Western Provinces and of the Punjab stood thus in 1849-50:

	<i>Land Revenue.</i>	<i>Revenue from other Sources.</i>	<i>Total.</i>
North Western Provinces,	Rs. 4,46,15,335	Rs. 1,23,72,630	Rs. 5,69,87,965
Punjab and Dependencies,	Rs. 1,46,51,090	Rs. 48,38,590	Rs. 1,94,89,680
Total,	Rs. 5,92,66,425	Rs. 1,72,11,220	Rs. 7,64,77,645

68. A private proprietor or landlord, when he counted the cost of a measure, which was calculated to exercise a material influence on the value of his property, would look not to its actual amount, but to the proportion which it bore to the property affected. If the British Government were to argue thus, it would find that this attempt to train up an agency, necessary for the preservation and improvement of the country, would cost only 1-7th per cent. of the annual income derived directly from the land. It would be equivalent to asking the owner of an estate in England worth £10,000 per annum, to expend less than £ 15 in instructing some of his tenantry how to thorough drain his lands, when he could not otherwise procure skilful men for the work.

69. But the case is much stronger than this. The Government has embarked with all the energies it can command in the noble work of improving the

condition of the people and developing the resources of the country. It has made a commencement, from which it is impossible to draw back, without damage to the national character, and without the sacrifice both of income and of power. Public buildings once made must be kept in repair, and increased to meet the wants of a rapidly augmenting population. Roads once constructed must be maintained and extended as new markets open. Canals which have been once excavated must be kept efficient, lest a people fed by artificial means should be exposed to the horrors of artificial famine. When landed property has once been made to rest on the basis of an accurate and scientific Survey, the means must be provided of appealing to the record of the Survey, and repeating its operations. It is not easy to estimate with any exactness the amounts which will be annually expended on these objects. But a minimum sum may be assumed. Supposing the progress of further improvement to be stayed, and that the Government were to content itself with doing nothing more than it has already determined to do, the probable annual outlay on public works, for which engineering skill would be required in the North-Western Provinces and the Punjab, may be stated as follows for some years to come:—

Civil and Military buildings in the North Western Provinces, (amount in 1849-50),	Rs. 10,00,000
Surplus Ferry Funds, (v. para: 7),	„ 2,00,000
One per cent. Road Fund, (v. para: 7),	„ 4,00,000
Surveys, (including Grand Trigonometrical Survey),	„ 2,00,000
Grand Trunk, Deccan and Agra and Bombay Roads,	„ 2,50,000
Existing Canals, Jumna, Dhoon, Rohilcund, Nujjufgurh,	„ 2,50,000
Probable annual expense of the Ganges Canal,	„ 5,00,000
Public Works in the Punjab (say),	„ 10,00,000
Civil and Military buildings in the Punjab, (say),	„ 20,00,000
Total,	Rs. 58,00,000

70. The problem then for the Government to solve is, how they can most economically manage this large expenditure. Many Civil Engineers, artificers and laborers must be employed in the disbursement. Whatever will increase the science, skill, and character of these agents will cause a material saving in the expenditure. Whatever tends to multiply the number of well-qualified agents will facilitate the operations, and cheapen the supply. It cannot be an unthrifty course which appropriates less than one and a half per cent. of the whole estimated minimum expenditure, to training up an efficient agency and sending them forth with all the appliances which may make them intelligent and trustworthy servants of the State.

71. But the public expenditure on works of this class will certainly be much greater than has been assumed above. There are many schemes awaiting

only the funds and the agency for their execution. In all these vast and rich countries, not a sod has yet been turned for a rail-road. Canal irrigation even in the older provinces is but yet in its earliest infancy. There are 50,000 villages in the districts lying near the Ganges and Jumna, from Allahabad westward, and not more than 2,000 of these obtain water for artificial irrigation from Government works. The generality of the roads are very imperfect, and no bridge of any large dimensions has yet been constructed. The day cannot be far distant when the Jumna at Agra and at Delhi will be crossed by permanent instead of floating bridges. The swamps of the Rohilcund Terai must be perfectly drained, and the copious streams brought down to fertilize the drier but rich lands that lie to the south of the Terai. The waters of the Sursooty and Cuggur and Sutlej must be made to fertilize the arid tract lying to the East and South of the last named river. The Dehra Dhoon must be turned into what there is every prospect of its eventually becoming, an extensive tea garden. Lieutenant Baird Smith has sufficiently set forth "the Agricultural Resources of the Punjab." All these are paying and remunerating undertakings, the value of which will be more and more acknowledged as each year passes. They are the future triumphs of the period of peace, which we may hope has now commenced. All members of the Government* have shown themselves anxious to enter upon this course of improvement. No time should be lost in making ready for the effort, and in preparing the means and appliances which must be in existence to allow of its being put forth.

72. Whether therefore we look to the improvement of the moral and social condition of the people, or to the material interests of the country, and whether we regard the disbursement in its relations to the value of the property, which is to be improved, or to the extent of the operations which are now actually in progress, or which in all probability will shortly be undertaken, there are ample grounds to warrant the proposed expenditure of Rs. 83,898 per annum upon a College for Civil Engineers at Roorkee.

* Lieutenant Colonel Sykes in a paper read before the Statistical Society of London on March 19th 1850, no doubt speaks the sentiments of the body, of which he is a member. "On the whole, although less may have been spent upon public works than India, with its area, population and revenue, might fairly demand, and the governing bodies certainly desired, yet considering the untoward, although successful wars, and the consequent necessity for an annual increase to the public debt, a good deal has nevertheless been done with borrowed money; and the time is fast approaching when continued peace will leave a surplus revenue to be annually devoted to the extension of lines of communication whether canal, rail, or road, and to other purposes for the further development of the acknowledged resources of India."