CONSIDERATIONS GOVERNING THE ESTABLISHMENT OF A POWER STATION TO SUPPLY THE VARIOUS BUILDINGS WITHIN THE UNIVERSITY AREA.

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The University of Sydney, with its various Colleges, &c., is unique in being absolutely self-contained within its own grounds which, moreover, are not crossed by any public roads. An examination of the figures given below also shows that the lighting for all the buildings totals up to a considerable amount, and the writer considers that a small Electric Power Station placed centrally with regard to the various University Buildings, Colleges, &c., should be in a position to supply current at a reasonable rate.

Besides the lighting, a fair amount of power would also be required for the various departments, viz., Engineering, Physics, Chemistry, Geology, Medical School, &c. Electric power could also be supplied for any building operations that might be going on, for example, the cranes, mortar mills, &c. The largest power load, however, would be the Engineering School. One objection to the use of large prime movers in the Engineering School itself is that they are liable to make a good deal of noise, and cause vibration, and the latter is especially detrimental to accurate Electrical testing. By having a separate Power Station the larger and more noisy units, especially the gas engines, and the gas producer plant, could be cut off entirely from the Laboratories and Lecture rooms.

One difficulty in teaching Engineering is that the apparatus in the Laboratories must of necessity be smaller than that which is used in regular commercial work, and even when the new Engineering School is equipped it will have this fault. A Power Station would go far to minimise the disadvantage.

If the scheme proposed in this paper can be carried into effect it would immediately place the Engineering side of the University in the forefront. In such a station the various qualities of coal could be tested for calorific value, smokeless, burning, &c.; also the various kinds of oil, methods of removing oil from condensed steam, &c. Incandescent and arc lamps could be tested before being put into use and any novelties in the way of auxiliary station plant, such as feed pumps, steam traps, water meters, besides switch gear, instruments, &c., could be tried under actual commercial conditions.

Another important use for such a station would be the possibility of giving Mechanical and Electrical Engineering students an opportunity of actually running a plant before they leave the University. At this point it may be interesting to refer to the Testing and Training Institution of London, founded in the early days of electrical activity, when trained men were difficult to get hold of.

The course at this Institution is essentially a practical one in that the student goes first to the School, and then to an Engine works, having about six months in each. After a second period at theory he goes to some firm which specialises in Electrical manufacturing and, after another half-year in the School, he finally enters a Central Station. A good many works and central stations are affiliated with the above-mentioned Institution, and the fee for the Course is 100 guineas a year for three years, part of which goes to the works. This "Sandwich" system of training, as it is sometimes called, has been in vogue in the West of Scotland for a good many years, and Professor Cormack has introduced it in connection with the Mechanical and Electrical Engineering Courses at University College, London. The Northampton Institute has also an arrangement of this kind with various works.

After all, the establishment of such a Power Station into which the Electrical Engineering students can be drafted and have practical experience before leaving the University is only carrying out in Engineering what is already done for the Medical Students who benefit very materially by having the Prince Alfred Hospital in which to gain practical experience.

I think everyone will agree that the success of the Medical School is largely due to the fine Hospital within five minutes' walk of, and closely allied to, the School. To obtain their diploma Medical Students must pass examinations at the end of the fourth and fifth year, covering the practical work done in the Hospital. In time something of the kind might be arranged for the Electrical Engineering Students, the course being extended to cover the time spent in the proposed Station. However, without going so far as that, it is self evident that such a station would be a valuable adjunct to the Engineering School.

Some experts consider, and quite rightly, that the instruction given in the Engineering Shops of a Teaching Institution should be mainly in the use of tools, and not so much in the construction of actual apparatus; this latter they think should be learnt in an engine or machine works. The proposal the writer is putting forward, however, is different. It is not to make engines or machines, tools or dynamos, but it is to turn out electric energy for lighting and power, and this can be done as well in the proposed University Station as in any other. The electricity supply at the Hawkesbury Agricultural College is entirely undertaken by the Students, who also carry out wiring, fitting up of motors, etc.

SYSTEM OF SUPPLY.

When first considering the question of establishing a Power Station the writer had in mind working with alternating current, preferably 3-phase, mainly because of the interesting experience such a plant would give.

An examination of the loads and the distances over which power has to be transmitted, showed, however, that an ordinary direct current three-wire system, with 480 volts across the outers, would serve very well, quite moderate-sized conductors giving a drop well below five per cent.

The conditions are such that an accumulator battery must necessarily form a large proportion of the station equipment in order to supply current after 12 o'clock midnight and all day Sunday without running any machinery. Such accumulators could, of course, be used with alternating current plant, but it would mean considerable loss in efficiency, in transforming from alternating to direct current and back again.

There was also the question of iron losses in the transformers to be taken into account, for, unless current could be cut off entirely during part of the day, these iron losses would be considerable.

The writer, therefore, decided in favor of a direct current 3-wire system, half the initial plant being driven by gas producer and gas engines, and half by a steam engine. All the figures in the paper, therefore, refer to such a plant. It will be understood that when once the Station is started, various other types of prime movers, as well as electrical machinery could be introduced for the purpose of testing. The Station would indeed be practically an adjunct to the Engineering Laboratories.

With a large amount of current available it would be possible to undertake experimental work in electro-chemistry and electro-metallurgy, both of which are the most promising branches of electrical engineering.

OUTPUT OF STATION.

Resolved into lamps of 16 candle-power each the total lamp connection on the present gas lighting basis is about as follows:—

University Buildings	1765
University Grounds	155
Lamps in Victoria Park	45
Prince Alfred Hospital	450
Ditto, New Building	400
St. Paul's College and house	170
St. Andrew's College and house	190
St. John's College	70
Women's College	80
Moore College and house	75
	3400

The writer considers it a fair thing to assume the usual proportion of two-thirds as being the number alight at any one time, therefore:—

$\frac{2}{3}$ x 3,400 = 2,266 16 c.p. lamps.

And this represents 2,266 x 53 = 120,000 watts.

For the lighting alone we must therefore provide 120 KW. of plant with, of course, the usual spares. It should be noted that this figure has been arrived at on a conservative estimate. For example, the number of lamps in the various colleges has been taken as those actually in use at the present time, but some of the Colleges have not the full complement of students and consequently some gas jets are permanently cut off.

RETURN SHEWING THE LIGHTING BY GAS, AND ELECTRIC FITTINGS OF THE UNIVERSITY DEPARTMENTS.

		Ordinary Gas Jets.	Incandescent Gas.	Electric Lamps.
1.	Main Building, including Great Hall, and Women's and Men's Common Rooms	347	48	0
2.	Medical School	404	5	55
3.	Chemical Department ...	271	1	177
4.	Assaying " ...	68	0	0
5.	School of Mines	138	0	0
6.	Engineering Department ...	134	0	30
7.	Biology " ...	33	1	0
8.	Physical " ...	305	10	225
	Total ...	1,700	65	487

It is admitted that the precincts of the University, and especially Victoria Park, are very inefficiently lighted. To do this properly would considerably raise the output of the Station.

We have, in addition, to consider the question of the motor load. This is a difficult thing to estimate beforehand in any installation, but we do know that current will be required for running the various workshops in the Engineering, Physics, Geology and Chemical Departments, &c., as well as the Medical School practically all day, whilst for testing purposes in the Electrical Engineering and Physics Department it will be wanted part of each day. Then, as regards the Hospital, the laundry runs all day, and the Rontgen Ray, Finsen Light, &c., intermittently. There are also the fans so that a certain amount of overlapping of Light and Power Supply will take place, which should be allowed for.

Finally, there is the question of electric heating. No one can foresee how much current is likely to be used for Electric Radiators to heat rooms, and for boiling water, &c. The writer can only say that as regards himself the sooner he can substitute Electricity for the altogether abominable gas fire, and gas ring, he is going to do it.

It will thus be seen that our moderate Station, capable of turning out 120 KW. may very well grow into one twice the size. In this paper the writer proposes to figure on plant to develop 180 KW. with ample battery power in addition, to run the lighting all night and over the week ends.

STATION EQUIPMENT.

The completed station would contain:—

1 Quick Speed Compound Engine driving two 45 k.w. Dynamos.

1 Water Tube Boiler to supply the above, 120lb. pressure.

2 Gas Engines each driving a 45 k.w. Dynamo by belt.

1 Gas Producer complete for above Gas Engines.

An Accumulator Battery on each side the middle wire.

Boosters to work in conjunction with Battery.

All the necessary piping and auxiliaries.

The writer did at first think of including a Diesel Oil Engine, but at the present time they are very expensive, and it would be better, therefore, to wait and get this later.

A steam turbine was also considered, but they are inefficient for small sizes. As for a condenser, the one in the Engineering School would be available.

It should be noted that by arranging the dynamos as above they are all the same size, and the armatures and field coils, etc., being interchangeable, the number of spares to be carried is minimised.

Usually the gas plant would be employed for generating current, but the plant could be changed about during the day-time according to what was required for testing purposes by the Mechanical or Electrical Students.

IMPORTANCE OF ECONOMY IN RUNNING.—A point of importance when deciding on the type of plant is that it should have a long range of economy. That is to say in the case of a steam driven set the consumption should give as flat a curve as possible. Thus of two generating units which give, say, the following figures:—

		¼-load.	½-load.	¾-load.	Full.	1¼-load.
(*a*)	Steam per k.w. hour ...	28 lb.	23 lb.	22 lb.	21 lb.	22 lb.
(*b*)	,, ,, ...	35 lb.	29 lb.	25 lb.	20 lb.	19 lb.

That marked (*a*) is the best, although its consumption at full load is highest. Economical consumption at low loads has the advantage that it is not then so necessary to install separate units for taking care of the light loads. This, again, reacts favourably on the running of the Station, for there is not so much changing from one machine to another as the load comes on.

Again, having the dynamos all about the same size, means reduced cost of connections, and saving of space.

Importance of Economy of Fuel.—When adjudicating between offers of generating plant there are two important points touching on the finance which must be taken into account. The one is "Prime Cost" and the other "Running Cost." More often than not the Prime Cost is taken as the deciding factor, and the cheapest plant is accepted without full consideration of what increased efficiency of a higher priced plant may signify.

Thus, suppose offers are put in for two 45 Kilowatt generating sets, and there is a difference of 4lbs. of steam per Kilowatt hour between the two offers; then assuming cost of coal at 15/- per ton, and that the boiler evaporates 10lbs. of water per lb. of coal, the following equation represents the saving of coal per annum if the plant runs on an average 4 hours per day for 310 days.

$$\frac{2 \text{ x } 45 \text{ k.w. x } 4 \text{ lbs., steam x } 4 \text{ hours x } 310 \text{ days x } 15/\text{-}}{10 \text{ lbs. x } 2{,}240 \text{ x } 20/\text{-}} = £15.$$

The set with the high steam consumption, therefore, costs £15 more per annum to run, and if this is capitalised at, say, 5 per cent., it represents:—

$$\frac{15 \text{ x } 100}{5} = £300.$$

In other words, unless there is a difference of over £300 between the prices of the two sets, the more expensive but more efficient one will really be the cheapest in the long run.

The writer is assuming, of course, that higher efficiency is not obtained at the expense of good running qualities, and sound mechanical construction.

DISPOSITION OF FEEDERS.

By a coincidence it happens that if the Power Station is placed near the new Engineering School, the distance from it to St. Paul's College, and the Women's College; to Prince Alfred Hospital and St. Andrew's College; and to St. John's College is just about five-eighths of a mile in each case. Again, the distance from the Power Station to tap all the various buildings of the University, including the Medical School, is about the same length, and so also is a feeder to supply the Victoria Park lighting.

The University Buildings' Feeder will run to the Biology Department, thence along the road between the present Engineering School and the Physics Department, and between the Geology Department and Macleay Museum, and the Chemistry and Mining Department, and so along past the Common Room to the Great Hall. It will then go along the back of the Main Building, passing the Ladies' Common Room and Fisher Library until it reaches the Medical School, and from the latter it will return direct to the Power Station. Each of the buildings named will be tapped from this Feeder, which, by the way, is really a distributor, and it will be thus seen that any one of them can be supplied with current from two separate directions.

This feeder will be run underground, and the tap connections to the lamps in front of the Main Building will also be underground.

THE ST. PAUL'S COLLEGE FEEDER will leave the Power Station and make a bee line to St. Paul's College; it will then pass to the Warden's Residence, Moore College, and to the Women's College.

THE FIRST FEEDER FOR PRINCE ALFRED HOSPITAL AND ST. ANDREW'S COLLEGE will run past the main entrance to the Oval to the Warden's Residence and St. Andrew's College, and from thence on to the Prince Alfred Hospital.

THE SECOND FEEDER FOR THE HOSPITAL AND ST. JOHN'S COLLEGE will run along the other side of the Oval to St. John's College, and from thence on to the Hospital. Of course, if the Authorities are agreeable, the Oval itself could be brilliantly lighted for use in the evenings.

The total lengths of these Feeder lines would be about as follows:—

Round the University Buildings $\frac{5}{8}$ mile underground.
Power Station to Hospital and St. Andrew's $\frac{5}{8}$ mile overhead.
Power Station to Hospital and St. John's $\frac{5}{8}$ mile overhead.
Power Station to St. Paul's and Moore College $\frac{5}{8}$ mile overhead.
Power Station to Victoria Park $\frac{5}{8}$ mile overhead.

That is to say, even including Victoria Park lighting, $2\frac{1}{2}$ miles of overhead Feeder and $\frac{5}{8}$th of underground feeder are outside figures. It is safe to say that there are very few Electricity Stations which are so favourably situated.

As will be seen below the cost of the overhead feeder line with three bare copper wires is all about £350 per mile; but to be on the safe side, the writer proposes to allow a total of £1,500 for feeders and distributors, including arresters and telephones.

As will be seen below under the heading Finance. This amount is under 13 per cent. of the total expenditure, whereas in most public electric supply installations the percentage is nearer 50 per cent.

SIZE OF FEEDERS.

An examination of the data of transmission lines shows that, although the length of a line may vary considerably (even up to 142 miles in the case of the Colgate to Oakland, and 154 miles in the Electra to San Francisco, in California) and although the voltages may vary up to the 60,000 employed on the Electra to San Francisco transmission, yet the actual section of the Copper Conductors is usually one-third of an inch in diameter, that is to say about the size of ordinary trolley wire. On the Continent the almost universal size for overhead wires is 9 m/m — .354-in. diameter. One reason for this is that such wire is a stock size, made in large quantities, and can therefore be bought a little cheaper than either a smaller or larger size. Another reason is that a wire larger than, say, $\frac{1}{3}$-inch becomes practically a rod of copper, and is therefore difficult to erect. Therefore, when deciding on the size of wire to use for the Feeders, one naturally first sees how a standard size, such as .36-in. diameter will suit the load and voltage. In this case the writer proposes to use 480 volts between the outers.

As an example we will make a calculation for the size of Copper Wires necessary for say, the $\frac{5}{8}$ of a mile (3,300 feet) overhead feeder to the Hospital and St. Andrew's College. The load is approximately:—

Existing Hospital Buildings	450 lights.
St. Andrew's Coll. & Warden's House	190 „
	640 „

Of this number we may assume about two-thirds, or, say 425 as being alight at any one time, therefore—

$$425 \text{ lamps} \times 53 \text{ watts} = 2{,}250 \text{ watts.}$$

A three-wire system, with 480 volts between outers, and five per cent. drop in the Feeders will give, for five-eighths of a mile, the following size of conductor:—

$$\frac{2{,}160 \times 3{,}300 \text{ ft.} \times 2{,}250 \text{ watts}}{5\% \times 480^2} = 138{,}000 \text{ circ. mils.}$$

and the nearest size wire to this is .36-in. diameter. There would, therefore, be two outers of .36-in. diameter, and the middle wire of the system would be about one-third area or, say, .22-in. diam.

The St. John's College Feeder would be the same size, and it would take care of St. John's College and the two new Pavilions at the Hospital, which total up to 480 lamps. As this Feeder does not carry so many lights its drop, worked out independently, would be only about 3½ per cent. As a matter of fact, however, the two Feeders would be connected together at the Hospital, and therefore, 5 per cent. may be taken as being well on the outside for drop in pressure.

Underground Feeder.—The only underground feeder which the writer would propose to lay down would serve the University Buildings. It would make a complete ring and consist of, say, two 37/15 cables with a middle cable of 19/16.

Aluminium Wire.—Of recent years a large amount of Aluminium has been used for transmission lines; amongst them may be mentioned the Shawinigan Falls to Montreal, 85 miles long at 55,000 volts, in which there are three conductors of 7 strands, each .162-in. in diameter, and also one of the lines from Colgate to Oakland, 142 miles long at 40,000 volts, which consists of three solid Aluminium conductors, each .46-in. in diameter.

Of course, for the same conductivity, the Aluminium wire has to be of larger diameter than Copper. The relationship between the two being about as shown in the following table.

Copper and Aluminium Conductors.

	Relative conductivity.	Relative area for equal conductivity.	Relative diameter for equal conductivity.	Relative weight for equal conductivity.	Relative tensile strength for equal conductivity.	Weight of one mile of wire in pounds for equal conductivity.	Say price per pound.	Total price one mile of wire to give equal conductivity.
Copper ...	100	100	100	100	100	·1 in. dia. 163·2 lbs.	10¼d.	£6·93
Aluminium	61	164	128	48·5	75	·128 in. dia. 79·5 lbs.	15d.	£4·97 (28 °/o saving)

Note.—For Aluminium wire in quantity, quotations for £140 per ton are given, which is equivalent to 15d per lb., but for very large quantities still lower prices have been offered. For small quantities the prices are higher, but even at 18¼d. per lb. the price per mile is only £5·96.

It will be seen that for equal conductivity the relative diameters are as 100 : 128, so that to be equal to a .36-in. diameter Copper wire the Aluminium must be .46-in. diameter. This happens to be exactly the relationship of the Copper and the Aluminium transmission lines from Colgate to Oakland.

For the sake of the experience the writer would propose to have one of the Feeder lines to the Colleges of Aluminium wire, the most convenient for the purpose being, perhaps, the one serving St. Paul's College, etc.

POLES.

As regards poles, one naturally thinks first of wood, but the writer is doubtful whether in the long run wood is really the best. True, it is cheap in first cost, but there is much to be said in favor of steel, especially in countries where there are white ants to contend with. Whoever sets out to build a line on sound economical lines, however, must not only bear in mind the initial expense of construction, but also the cost of upkeep. Of course, if the wood and the steel poles were to be spaced out at the same distance apart, say at 50 to the mile (that is 105 feet apart), which is a usual distance, then the wooden pole line would be cheapest. With steel poles the span can be longer, without greatly increasing the height. Indeed, on recent transmission lines in Italy, that of Brembo, for example, steel lattice poles are used, which are only 39 feet long, of which 5½ feet is in the ground, and they are arranged at distances of 100 metres (330 feet) apart, or about 16 to the mile.

By having fewer supports a less number of insulators are required, and there is less chance of current leakage, whilst the appearance of the line is improved.

Below is an estimate of two pole lines, one with Wooden and the other with Steel poles, and it will be seen that the initial expense is about the same in each case.

COMPARISON OF COST PER MILE FOR POLE LINES CARRYING TWO COPPER CONDUCTORS, EACH .36-in. DIAMETER, AND ONE .22-in. DIAMETER.

With Wooden Poles Spaced at 50 to the Mile.

50	Poles, fixed	at £2 10s. ...	£125
150	Insulators, with iron stalk	at 3s. say	22
	Fixing Line, and sundry		40
2	Copper Wires, each ·36 in. dia., with ·02 deflection $\frac{2 \times 36^2 \times \cdot 78 \times 105\cdot 712 \text{ ft.} \times 50 \times 12 \times \cdot 32}{2{,}240} =$	1·84 tons at £75 ...	140
1	Copper Wire ·22 in. dia.		26
		Total	£353

With Steel Poles Arranged at 16 to the Mile.

16	Steel poles with foundations and fixing	at £9 10s. ...	£152
48	Insulators with iron stalk	at 4s. say	10
	Fixing line and sundry		30
2	Copper Wires, each ·36 in. dia.		140
1	Copper Wire „ ·22 in. dia.		26
		Total	£358

The steel poles will give a more solid and lasting, besides a better looking job. The copper is the same in each case, because although the sag between poles is greater, yet there are fewer sags to the mile, so the total length is about the same. When it comes to erecting the Feeders some may have smaller sized wires.

It will be noticed that the writer has allowed for stronger insulators costing 4s. each for the longer spans. As the Feeders run in almost straight lines no special poles would be required; but, if thought necessary, the Steel poles could each be fitted with a bracket for an arc lamp.

On the Canvery Falls transmission in Southern India, composite poles, consisting of iron sockets in the ground and wooden poles let into them were employed. Mr. H. P. Gibbs. the Engineer in charge, has stated that high steel lattice poles spaced at longer intervals would have been much better. The wooden poles, he says, are a constant source of trouble from warping, sun cracking, dry-rot, as well as being subject to destruction by insects.

LIGHTNING ARRESTERS.—Each Feeder line would, of course, be protected against lightning by Siemen's horn arresters, and Garton Daniel arresters. The earth connection would be well grounded by sheet copper plates, 4ft. square, laid in moist ground; if necessary, to improve the contact, fine coke would be used.

The writer would propose to have a Garton Daniel arrester at each end of each Feeder line, with a Siemen's horn arrester midway. Other types would be used if available, simply for the sake of experience with them; but the writer looks to the Garton Daniel arresters at each end as a complete protection to the lines.

ELECTRIC WIRING OF BUILDINGS.

OUTSIDE LIGHTING.—The front of the University building would be lighted by arc lamps, and there would be arc lamps at each of the main entrances, besides at various points where there are gas lamps now.

Victoria Park might have, say, five 1000 c.-p. arc lamps in place of the ten 60 c.-p. gas jets now in use.

INTERIOR LIGHTING.—The lighting of the various rooms of the University Buildings will, of course, vary with the purpose for which the rooms are used and also as to whether existing fittings can be adapted. The writer is inclined to use small arc lamps mercury vapour and tantrellum lamps wherever possible, because of their low Watts per candle power.

All Corridors in the University buildings would be lighted by Lilliput arc lamps and in some cases, as in the Medical School, the existing lanterns could be adapted for these.

Lecture Rooms would be fitted with mercury vapour tubes and a roof reflector to throw a good light direct on the blackboard and diagrams, without the lamps being visible to the students. The room itself, if small, would be lighted by pendant incandescents, or where brackets exist, by incandescents attached to same. In large lecture rooms, such as those in the Geological and Chemical Departments, arc lamps would be used. Anyone who has seen the trouble and danger involved in turning out and relighting gas jets when lantern slides are being shown will appreciate the great advantage of electric light for Lecture Rooms.

In the Reading Rooms of the Library and other departments mercury vapour lamps could be employed. There would also be a few table lamps so that the eyes of the student could be shaded from direct contact with the light.

In the Museums and rooms where books, etc., are stored, arc lamps would probably be the most effective method of lighting.

The Draughting Room in the new Engineering School would have inverted arc lamps to light by reflection; in Laboratories and Demonstrating Rooms there would be a counterweight pendant to each pair of desks.

Small Rooms and Offices would be lighted by pendants or by lamps adapted to existing brackets, special lamps being provided for the writing tables, roll-top desks, etc.

The Large Hall is a little difficult to light. Arc lamps would be the cheapest method, but as loose cables might be objected to, probably the best way would be to have brackets with large candle-power incandescents, such as the Meridian lamps, arranged round the Hall, and alternating with the present five light gas brackets.

It should be noted that the Medical School, Chemical, Engineering, and Physical Departments already have electric light fittings installed, so that it is merely a case of connecting them up to the new supply. Regarding the remainder of the University Buildings the saving on the gas bills, together with reduced cost of cleaning and decorating and the improved conditions of lighting will more than justify the expense of wiring. This also applies to the Colleges, etc.

Lighting of Colleges.—Each Dining Hall could be lighted with Lilliput arc lamps, and the Common Room, Chapel, Library, &c., with pendant incandescents.

Each Students' Rooms would have a 16 c.-p. pendant incandescent and also a wall plug, so that those who wished to do so could make connection for a table lamp, an electric fan, water heater and, perhaps, an electric radiator.

Lighting of the Hospital.—Regarding the lighting of the Hospital, the writer is unable to call to mind any Hospital of importance in England which is not electrically lighted. Health is the thing which has to be considered most in Hospitals, and surely a light which does not vitiate the atmosphere is ideal.

The electric light would be most valuable for the Operating Theatre of the Hospital, because very serious calls have frequently to be tackled at any hour of the night, and electricity is much cleaner than gas. Small electric glow lamps for giving light in difficult positions are a great help.

An Electric supply would be most useful for the Rontgen Ray apparatus, the Finsen light, and for electric baths, etc. For boiling water, electric kettles could take the place of the unhealthy and dangerous gas rings.

In summer, electric fans would be exceedingly useful, and this may be said also of the University and the Colleges generally. These fans would require current at a time when there is not much lighting.

WORKING OF THE STATION.

The writer would personally supervise the station, see about extensions, alterations, and the work usually done by a Consulting Engineer.