

R E P O R T

FROM THE

SELECT COMMITTEE

ON

SCIENTIFIC INSTRUCTION;

TOGETHER WITH THE

PROCEEDINGS OF THE COMMITTEE,

MINUTES OF EVIDENCE,

AND APPENDIX.

*Ordered, by The House of Commons, to be Printed,
15 July 1868.*

R E P O R T.

THE SELECT COMMITTEE appointed to inquire into the Provisions for giving **INSTRUCTION** in Theoretical and Applied **SCIENCE** to the **INDUSTRIAL CLASSES**;— —**HAVE** considered the matters to them referred, and have agreed to the following **REPORT**:—

In order to ascertain the state of scientific instruction amongst the industrial classes, your Committee has called before it witnesses representing the following bodies:—

1st. The Department of Science and Art of South Kensington, the Committee of Council for Education, and the Government Colleges of Science and Naval Architecture.

2nd. The Universities of Oxford, Cambridge, London, and Edinburgh; The Royal College of Science, Dublin; Queen's College, Belfast; King's College and University College, London; and Owens' College, Manchester.

3rd. The few secondary schools in which science has been for some time systematically taught.

4th. The managers and teachers of science classes and mechanics' institutes receiving aid from the State, or supported exclusively by voluntary efforts.

5th. The population engaged in the great staple industries carried on in the principal manufacturing towns and districts.

Their evidence may be included under two heads:—

1st. The state of scientific instruction of,

- (1.) The foremen and workmen engaged in manufactures.
- (2.) The smaller manufacturers and managers.
- (3.) The proprietors and managers-in-chief of large industrial undertakings, and—

2nd. The relation of industrial education to industrial progress.

I.—The STATE of SCIENTIFIC INSTRUCTION of FOREMEN and WORKMEN.

It is stated that the foremen are almost, without exception, persons who have been selected from the class of workmen by reason of their superior natural aptitude, steadiness, and industry. Their education, and that of the workmen, during the school age, has been received in elementary schools; and owing both to the defective character of the instruction in some of those schools, and to the early age at which the children go to work, it is rarely sufficient to enable them to take advantage of scientific instruction at a later period.

In this statement the children educated as half-timers under the Factory Acts must as a rule be included. The evidence of Mr. Mundella and other witnesses tends to show that the primary education received in the factory schools

is insufficient, except where the employment and education are both uninterrupted between the ages of 8 and 13, and where the instruction is given in good schools established or supported by manufacturers who take an active and intelligent interest in the welfare of the children whom they employ.

The little rudimentary knowledge acquired at school is rarely retained after the young people have been at work two or three years, and elementary scientific instruction is thus entirely beyond the reach of a large portion of our industrial population. The series of schools at Halifax, at Oldham, &c. are exceptional instances of fair elementary education to children, followed by elementary instruction in theoretical and applied science to young persons and adults.

It is stated by many witnesses (and on this subject your Committee would direct particular attention to the evidence of the Rev. Thos. Cromwell, Principal of the Training School at Chelsea) that the tendency of the Revised Code has been to diminish the efficiency of elementary education. It is hoped that the recent introduction of a seventh standard of examination may have a contrary and beneficial effect, and it is contended that drawing and elementary knowledge of physical geography, of the properties of matter, and of the laws of health, may be taught to young children in every elementary school.

The existing elementary classes in experimental science are generally held in connection with mechanics' or literary institutions; although their number has increased of late, they are confined chiefly to the Metropolis and its neighbourhood, and to Lancashire, the West Riding of Yorkshire and Cornwall, and to Edinburgh and Glasgow, and Birmingham.

The pupils may present themselves for the examinations of the Society of Arts, and of the Department of Science and Art at South Kensington. When such pupils are of the artizan class, and are successful, payment according to results is made to the teachers by the Department, and Queen's prizes or medals are given to the pupils themselves.

Besides artizans, draughtsmen, clerks, teachers, and other persons of various grades, attend these classes, and the evidence of Professor Tyndall, Professor Huxley, and the other examiners, as well as of many other competent witnesses, concurs to show that the instruction, though elementary, is sound.

Elsewhere these classes scarcely exist. There are no such classes permanently established in the north-eastern, eastern, west midland, or southern counties; and in many parts of England the fact that Government aid is granted to them was unknown until public attention was drawn to it by the recent discussion of the subject of technical education, and by the appointment of this Committee. It is true that the Science and Art Directory shows numerous classes scattered over the country, but they are mostly confined to rudimentary instruction in chemistry, physiology, and botany, in various schools. Though not without value of their own, they have very little, if any, direct influence on the industrial occupations of any class.

In Scotland, where the superior primary instruction of the artizans removes one of the obstacles to their acquiring scientific instruction, the Watt Institution of Edinburgh and the Andersonian University of Glasgow have rendered good service, the former during nearly half a century, the latter for more than 20 years; they can boast amongst their scholars such names as those of Nasmyth, James Young, and many others. Technical objections have hitherto prevented these schools from receiving the grants of the Science and Art Department; but within the last 12 months these have been overcome.

The Mining School of Cornwall, as described by Mr. Robert Hunt, Keeper of Mining Records, is the only one of its kind: the mining population being scattered over a wide area, it is necessary to send a teacher to the villages in order to conduct the classes.

The miners are taught the elements of chemical and physical science with special reference to their occupations; and the school is producing results which are excellent, though limited as to their area by want of funds. The wages of the miners are inadequate to enable them to pay fees sufficiently high to support the school, even with the aid of payment on results from the Department of Science and Art, and the local subscriptions do not enable the promoters to provide instruction for all the villages which require or desire it.

The witnesses from the North of England, representing the coal trade,
Messrs.

Messrs. Daglish and Cochrane, are anxious for the establishment of a similar peripatetic school in the pit villages of Durham and Northumberland. Until their attention was drawn to the Cornish Mining School, they were quite unaware of its existence. They state that the proprietors of collieries would be willing to provide the necessary buildings, and they consider it essential that the Department of Science and Art should give its advice, and the services of its organising master, to the local committees which may be formed to carry out science instruction amongst the mining population of those counties.

At the Working Men's College, Halifax, evening classes for scientific instruction in chemistry, as applied to the manufactures of the locality, and in machine drawing and practical geometry, were opened in August 1867. At Huddersfield special classes are now in course of formation for teaching chemistry, as applied to dyeing, to foremen and apprentices. These classes are supported by the principal manufacturers and merchants of the neighbourhood. At Bradford a subscription list has been opened for the erection of a School of Science and Art, at a cost of 50,000 *l.*, to which one of its citizens has offered a contribution of 5,000 *l.* The munificent gift of 100,000 *l.* by Mr. Whitworth, for the endowment of scholarships in mechanical engineering is offered on conditions that give to the artizans, concurrently with men of other grades, and who have received a more liberal education, an opportunity of acquiring a scientific knowledge of their craft and profession.

The Hulme branch of the Amalgamated Society of Carpenters has been the first trade society to establish an adult school in which carpenters and joiners, whether members of the society or not, may be taught drawing, the principles of building, construction, and other branches of science having special reference to their trade.

The Bristol Trade School, and the Navigation School of Hull, both aided by grants on results from the Science and Art Department, are conspicuous examples of the successful introduction of science teaching into elementary schools of a superior kind for artizans. The Bristol School is fully described in the evidence of Mr. Thomas Comber. The building, formerly used as a national school, is rent free, and receives some 150 boys of the ages of 12 to 15, who are taught elementary mathematics, chemistry, physics, and mechanical drawing. They pay a fee of 3 *l.* per annum, which, together with the grant on results, covers the cost of conducting the school. The principal engineering and chemical establishments of the city accept for their vacant apprenticeships, with marked preference and partiality, the pupils of the Trade School.

A hindrance second only to that of the defective elementary instruction of the pupils is the scarcity of science teachers, and the want of schools for training them. The remuneration of the teachers, arising from pupils' fees and payment on results by the Department of Science and Art, is with few exceptions so scanty that science teaching is scarcely ever followed as a profession, but only as an addition to some more profitable employment. Hence classes are frequently suspended whenever the more important occupations of the teacher demand increased attention, or cause him to remove to other localities.

Nearly all the witnesses claim, as a means of augmenting their emoluments, some relaxation of the rule which prevents teachers being paid on the results of instruction given to persons who are not artizans.

As the demand for instruction increases, the incomes of the teachers will doubtless increase likewise, but the want of competent men will still remain. The offer, under a recent Minute of the Department, of sums of 25 *l.* per annum in aid of scholarships to be founded by localities contributing like sums, together with the remission of the fees of the Government Colleges of Science to the holders of such scholarships, will probably induce some young men to prepare themselves for the career of elementary science teachers.

II.—THE SCIENTIFIC INSTRUCTION OF THE SMALLER MANUFACTURERS AND MANAGERS.

Unfortunately, this division may be disposed of in a very few words. Its members have either risen from the rank of foremen and workmen, in which case all that has been stated of the first division will also apply to them; or

else they are an offshoot from the class of smaller tradesmen, clerks, &c., and have been educated in the ordinary secondary endowed, and so-called commercial schools. With some admirable exceptions, the instruction which they afford is certainly not superior to that of the best conducted elementary schools; and even in the better schools of this grade the principles of science are scarcely ever taught. The pupils have, however, generally remained at school till the age of 14 or 15, and they never lose the use of the elementary instruction which they had acquired at school. Hence, where the opportunity for instruction in adult science classes exists, they have not, like the artizans, to contend with the mere clerical obstacles to the acquisition of scientific knowledge.

III.—THE PROPRIETORS AND MANAGERS OF GREAT INDUSTRIAL UNDERTAKINGS.

In those not unfrequent cases where these persons also have risen from the rank of artizans, the same exceptional gifts, including more especially those of unconquerable perseverance and energy which had caused their elevation, have also enabled them generally to correct the deficiencies of their early literary training. Any knowledge of scientific principles which they may have acquired is generally the result of solitary reading, and of observation of the facts with which their pursuits have made them familiar.

More generally, however, the training of the capitalists, and of the managers of their class, has been that of the higher secondary schools; followed in rare, though in more recent years less unfrequent, instances, by a course of more or less systematic scientific instruction in colleges like the Royal School of Mines, the Royal College of Chemistry, University and King's Colleges, London; Owens' College, Manchester; and the Laboratories of the Universities of Edinburgh and Glasgow. The scientific courses of Oxford have been too recently instituted, and have hitherto been devoted too entirely to pure science, to have had any appreciable influence on the scientific instruction of this class; besides which, a feeling exists, to which expression was given by Mr. Chance, the eminent manufacturer of Smethwick, himself a man of great scientific attainments, and a distinguished member of the University of Cambridge, that however suitable the Universities may be or become for the training of professors of science of the higher class, the habits at present acquired there by the sons of wealthy men are not conducive to the successful prosecution of an industrial career.

The Military and Scientific Department of the Proprietary College of Cheltenham, and the City of London Endowed School, are exceptional instances of secondary schools in which instruction in science holds the first place. In the great public schools of Harrow and Rugby, instruction in one scientific subject, in addition to classics and mathematics, has only recently been made compulsory.

Any attempt to analyse briefly the evidence as to the degree of instruction given at King's College and University College, London, and Owens' College, Manchester, would probably fail to convey a correct impression; your Committee would therefore direct attention to the evidence. The same observation applies to the University of Edinburgh, where a Chair of Civil Engineering has recently been founded by Sir David Baxter, to the endowment of which the Government has agreed to contribute.

The engineers of Manchester and the neighbourhood have raised a fund for endowing a similar Chair at Owens' college in that city. To that fund, a single firm of mechanical engineers contributes 3,000 *l.*, besides a subscription of 250 *l.* per annum from one of its partners. The college is full to overflowing, and a proposed building fund of 150,000 *l.* has already received subscriptions amounting to 40,000 *l.*

The Royal School of Mines in Jermyn-street, in addition to its lectures to artizans, delivered by some of the most eminent men of science, has systematic courses of lectures in nearly every subject usually comprised in a higher technical course, with the important exception of mathematics.

The number of its matriculated students is under 20; its metallurgical laboratory, which has room for only 10 students, is always full. The Royal College of Chemistry in Oxford-street, which is connected with it, has about 40 students in its laboratory. It cannot accommodate more.

It

It has been possible, in consequence of the good preparatory teaching of elementary mathematics in the Dockyard Schools from which the pupils are drafted, to make mathematical instruction, which is wanting in Jermyn-street, one of the principal features of the Royal School of Naval Architecture at South Kensington, the only school of naval construction in the kingdom. According to the evidence of Mr. Reed, Chief Constructor to the Navy, this school is rendering most essential service to that department. The pupils are engaged during six months in constructive works in the various dockyards, and undergo a complete course of technical training at South Kensington in all that relates to their art, during the rest of the year.

Your Committee does not consider it desirable to refer in this report to the Royal College of Science in Dublin, or to the Queen's Colleges and science classes in Ireland, as the subject of the institutions for promoting science and art in Ireland is now undergoing separate investigation.

2. *The Relation of Industrial Education to Industrial Progress.*

The industrial system of the present age is based on the substitution of mechanical for animal power; its development is due in this country to its stores of coal and of metallic ores, to our geographical position, and temperate climate, and to the unrivalled energy of our population.

The acquisition of scientific knowledge has been shown by the witnesses to be only one of the elements of an industrial education and of industrial progress. Indeed, there is a preponderance of evidence to show that so far as the workmen, as distinguished from the managers, are concerned, it can be considered an essential element only in certain trades, or, generally, as enlarging the area from which the foremen and managers may be drawn.

In all cases another and an indispensable element of industrial success is the acquisition of practical experience and manipulative skill.

The evidence given before your Committee places beyond all doubt the fact, that these latter acquirements are possessed in a pre-eminent degree by our manufacturing population of every grade, according to their several necessities. They are obtained in our factories, our forges, our workshops, our shipyards, and our mines, which, in their organization and appliances, are the models which, with a few special exceptions, other nations have hitherto imitated and followed, but not surpassed.

Although the pressure of foreign competition, where it exists, is considered by some witnesses to be partly owing to the superior scientific attainments of foreign manufacturers, yet the general result of the evidence proves that it is to be attributed mainly to their artistic taste, to fashion, to lower wages, and to the absence of trade disputes abroad, and to the greater readiness with which handicraftsmen abroad, in some trades, adapt themselves to new requirements.

It is owing to one or more of these favourable conditions, rather than to superior education or technical skill, that the lacemakers of Calais, and the locomotive manufacturers of Creuzot and of Esslingen, are competing with this country in neutral markets, and even at home; and Mr. Cochrane states that the low rate of wages alone enabled the factory at Anzin to furnish him with pumping and winding engines, constructed according to his own design, but of excellent workmanship, for his collieries in Northumberland and Durham.

Only two witnesses from Birmingham, the one an eminent merchant, the other a manufacturing jeweller, and Mr. Gill, a woollen manufacturer, of Innerleithen, in Scotland, attribute the loss of certain trades to the superior skill, appliances, and education of the German, Belgian, and American manufacturers; and the great steel works of Krupp, in Westphalia, have been named as the only instance of a factory which is said to possess an organisation superior to that of any establishment in the same branch of industry in this country.

At the same time, nearly every witness speaks of the extraordinarily rapid progress of Continental nations in manufactures, and attributes that rapidity, not to the model workshops which are met with in some foreign countries, and are but an indifferent substitute for our own great factories, and for those which are rising up in every part of the Continent; but, besides other causes, to the scientific training of the proprietors and managers in France, Switzerland,

Switzerland, Belgium, and Germany, and to the elementary instruction which is universal amongst the working population of Germany and Switzerland. There can be no doubt, from the evidence of Mr. Mundella, of Professor Fleeming Jenkin, Mr. Kitson, and others, and from the numerous reports of competent observers, that the facilities for acquiring a knowledge of theoretical and applied science are incomparably greater on the Continent than in this country, and that such knowledge is based on an advanced state of secondary education.

All the witnesses concur in desiring similar advantages of education for this country, and are satisfied that nothing more is required, and that nothing less will suffice, in order that we may retain the position which we now hold in the van of all industrial nations. All are of opinion that it is of incalculable importance economically that our manufacturers and managers should be thoroughly instructed in the principles of their arts.

They are convinced that a knowledge of the principles of science on the part of those who occupy the higher industrial ranks, and the possession of elementary instruction by those who hold subordinate positions, would tend to promote industrial progress by stimulating improvement, preventing costly and unphilosophical attempts at impossible inventions, diminishing waste, and obviating in a great measure ignorant opposition to salutary changes.

Whilst all the witnesses concurred in believing that the economical necessity for general and scientific education is not yet fully realised by the country, some of them consider it essential that the Government should interfere much more actively than it has done hitherto, to promote the establishment of scientific schools and colleges in our great industrial centres.

In reference to the sufficiency, or the reverse, of voluntary efforts, it is stated, on the one hand, that premiums of several hundred pounds are paid for the admission into the offices of civil, and the workshops of mechanical engineers, of pupils, many of whom fail to avail themselves fully of the valuable instruction which they would obtain there, owing to the absence on their part of all preliminary instruction in mathematics and physical science. It is reasonably inferred that persons who are willing to pay those large sums, and who do not hesitate to send their sons to expensive schools, will be prepared to pay for instruction in science as soon as they are convinced of its utility. It is argued, on the other hand, that in all countries, and at all times, the offer of education of every kind has preceded the demand, and that any temporary sacrifice on the part of the State, in order to place scientific instruction within the reach of those who would be likely to appreciate it, will be amply and speedily repaid by the increase of the general intelligence and prosperity which it will produce.

A more general opinion on the part of the witnesses than either of these opposite views is, that wherever any locality in which, from its geographical position and industrial importance, it may be presumed that a scientific college or a higher secondary school of science is likely to be successful, is prepared to contribute largely to the creation and maintenance of such an institution, the State may fairly give assistance to such locality by liberal grants for building and apparatus, in addition to the existing payments on results and scholarships.

CONCLUSIONS.

The evidence which has been given before your Committee, and in part summarised in the preceding pages, together with the information which is accessible to them in common with other members of the community, has convinced them :

(1.) That with the view to enable the working class to benefit by scientific instruction it is of the utmost importance that efficient elementary instruction should be within the reach of every child.

(2.) That unless regular attendance of the children for a sufficient period can be obtained, little can be done in the way of their scientific instruction.

(3.) That elementary instruction in drawing, in physical geography, and in the phenomena of nature, should be given in elementary schools.

(4.) That

(4.) That adult science classes, though of great use to artizans, to foremen, and to the smaller manufacturers, cannot provide all the scientific instruction which those should possess who are responsible for the conduct of important industrial undertakings. That all whose necessities do not oblige them to leave school before the age of 14, should receive instruction in the elements of science as part of their general education.

(5.) That the reorganisation of secondary instruction and the introduction of a larger amount of scientific teaching into secondary schools are urgently required, and ought to receive the immediate consideration of Parliament and of the country.

(6.) That it is desirable that certain endowed schools should be selected in favourable situations for the purpose of being reconstituted as science schools, having in view the special requirements of the district; such schools to be rendered available to the surrounding districts, by the establishment of exhibitions open to public competition; so that the children of every grade may be able to rise from the lowest to the highest school.

(7.) That superior colleges of science, and schools for special scientific instruction requiring costly buildings and laboratories, cannot be supported by fees alone, without aid from one or more of the following sources, namely, the State, the localities, and endowments or other benefactions.

(8.) That such colleges and special schools are most likely to be successful if established in centres of industry, because the choice of such centres tends to promote the combination of science with practice on the part both of the professors and of the pupils; and to enable many to attend them to whom the expense of living at a distance from home would otherwise be an insuperable barrier.

(9.) That the provinces of England, especially the agricultural districts, have not received a sufficient proportion of the State grants for scientific education.

(10.) That those provinces of England are entitled to such a modification of the public grants as will afford them increased aid, supplementary to the funds which they may raise in their own localities for the purpose of promoting scientific instruction. That grants of money from the national exchequer for local scientific instruction should be chiefly designed to promote local activity, and a better use of resources otherwise available, and should be regarded as occasional or temporary.

(11.) That some slight addition to the emoluments of science teachers would probably tend materially to promote the establishment and permanence of elementary science classes.

(12.) That the provisions of the Public Libraries and Museums Act should be altered so as to enable public bodies to levy a slightly increased rate for scientific purposes.

(13.) That the managers of training colleges for the teachers of elementary schools should give special attention to the instruction of those teachers in theoretical and applied science, where such instruction does not exist already.

(14.) That teachers in elementary day schools should be paid on results, for teaching science to the older scholars, in the same way as payment is now made for drawing in such schools. That the education of higher science teachers should be encouraged, by the granting of degrees in science at Oxford and Cambridge as at other Universities, and by the opening of a greater number of fellowships to distinction in natural science as well as in literature, and mathematical and moral science.

(15.) That a more intimate connection between the various Government institutions for scientific instruction in London would increase the efficiency of each of those institutions, and that the constitution and management of those institutions and their future relations to each other requires further investigation.

PROCEEDINGS OF THE COMMITTEE.

Thursday, 2nd April 1868.

MEMBERS PRESENT:

Mr. Samuelson.	Mr. Read.
Mr. Akroyd.	Mr. Acland.
Mr. E. Potter.	Mr. Dixon.
Mr. Powell.	Mr. Gregory.
Mr. M'Lagan.	Lord Frederic Cavendish.
Mr. William Lowther.	Mr. Graves.
Mr. Bagnall.	

Mr. *Samuelson* was called to the Chair.

The Committee deliberated.

[Adjourned to Thursday, 23rd April, at Twelve o'clock.]

Thursday, 23rd April 1868.

MEMBERS PRESENT:

Mr. SAMUELSON in the Chair.

Mr. Gregory.	Lord Frederic Cavendish.
Mr. Dixon.	Lord Robert Montagu.
Mr. Potter.	Sir Charles Lanyon.
Mr. Bazley.	Mr. Austin Bruce.
Mr. M'Lagan.	Mr. Bagnall.
Mr. Lowther.	Mr. Graves.

Mr. *Henry Cole*, C.B., and Captain *Donnelly*, R.E., were severally examined.

[Adjourned to Monday next, at Twelve o'clock.]

Monday, 27th April 1868.

MEMBERS PRESENT:

Mr. SAMUELSON in the Chair.

Mr. Akroyd.	Mr. Austin Bruce.
Mr. Bagnall.	Mr. Gregory.
Lord Robert Montagu.	Lord Frederic Cavendish.
Mr. Read.	Sir Charles Lanyon.
Mr. M'Lagan.	Mr. William Lowther.
Mr. Bazley.	Mr. Dixon.
Mr. Potter.	Mr. Acland.

Captain *Donnelly*, R.E., further examined.

Mr. *R. R. W. Lingen* examined.

[Adjourned to Thursday next, at Twelve o'clock.]

Thursday, 30th April 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Akroyd.		Mr. Austin Bruce.
Mr. Read.		Mr. Gregory.
Mr. Potter.		Mr M'Lagan.
Lord Robert Montagu.		Mr. Bazley.
Lord Frederic Cavendish.		Mr. Dixon.
Sir Charles Lanyon.		Mr. Bagnall.
Mr. Acland.		Mr. Lowther.

Mr. *Henry Cole* and Captain *Donnelly*, R.E., further examined.

Dr. *Lyon Playfair* examined.

[Adjourned to Monday next, at Twelve o'clock.]

Monday, 4th May 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Bazley.		Lord Frederic Cavendish.
Mr. Potter.		Lord Robert Montagu.
Mr. Akroyd.		Mr. Dixon.
Mr. Lowther.		Mr. Read.
Mr. Bagnall.		Mr. Austin Bruce.
Mr. Graves.		

Mr. *Trenham Reeks*, Mr. *J. F. Iselin*, and Dr. *J. Percy*, were severally examined.

[Adjourned till Thursday next, at Twelve o'clock.]

Thursday, 7th May 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Bazley.		Lord Frederic Cavendish.
Mr. Potter.		Mr. Austin Bruce.
Mr. Akroyd.		Mr. Graves.
Mr. Dixon.		Mr. M'Lagan.
Mr. Acland.		Mr. Read.
Mr. Lowther.		

Mr. *Joseph Whitworth* and Mr. *Robert Hunt*, F.R.S., were severally examined.

[Adjourned till Monday next, at Twelve o'clock.]

Monday, 11th May 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Lowther.
Mr. Acland.
Mr. Austin Bruce.
Mr. Akroyd.
Mr. Potter.

Mr. Bazley.
Sir Charles Lanyon.
Mr. M'Lagan.
Lord Frederic Cavendish.
Mr. Read.

Dr. *W. B. Carpenter* and Professor *John Tyndall* were severally examined.

[Adjourned to Thursday next, at Twelve o'clock.]

Thursday, 14th May 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Graves.
Mr. Bazley.
Mr. Potter.
Mr. Dixon.
Mr. Lowther.
Mr. Acland.
Mr. Akroyd.

Lord Frederic Cavendish.
Mr. Read.
Mr. M'Lagan.
Lord Robert Montagu.
Mr. Austin Bruce.
Sir Charles Lanyon.

Room cleared.—The Committee deliberated.

Professor *Fleeming Jenkin* examined.

[Adjourned to Monday next, at Twelve o'clock.]

Monday, 18th May 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Gregory.
Mr. Lowther.
Mr. Acland.
Lord Robert Montagu.
Mr. Akroyd.
Mr. Potter.

Mr. Bazley.
Mr. M'Lagan.
Sir Charles Lanyon.
Mr. Read.
Mr. Powell.
Mr. Dixon.

Professor *R. B. Clifton* and Sir *R. Kane* were severally examined.

[Adjourned till Thursday next, at Twelve o'clock.]

Thursday, 21st May 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Graves.
Mr. Dixon.
Mr. Acland.
Mr. Bagnall.
Mr. Bazley.

Mr. William Lowther.
Mr. Potter.
Mr. Read.
Mr. M'Lagan.

Rev. Dr. *Joseph Woolley* and Mr. *E. J. Reed* were severally examined.

[Adjourned till Monday next, at Twelve o'clock.]

Monday, 25th May 1868.

MEMBERS PRESENT:

Mr. SAMUELSON in the Chair.

Mr. Graves.	Mr. Bazley.
Mr. Gregory.	Mr. Bagnall.
Mr. Potter.	Mr. Acland.
Mr. Dixon.	Mr. M'Lagan.
Mr. Akroyd.	Mr. Read.
Lord Frederic Cavendish.	Sir Charles Lanyon.

Mr. *J. W. Cunningham*, Dr. *W. A. Miller*, and Rev. *E. A. Abbott*, M.A., were severally examined.

[Adjourned till Thursday next, at Twelve o'clock.]

Thursday, 28th May 1868.

MEMBERS PRESENT:

Mr. SAMUELSON in the Chair.

Mr. Gregory.	Mr. Dixon.
Mr. Bazley.	Mr. Acland.
Mr. Potter.	Mr. William Lowther.
Mr. Akroyd.	Mr. Bagnall.

Rev. Canon *Moseley*, Mr. *Thomas Coomber*, and Rev. *John G. Cromwell*, M.A., were severally examined.

[Adjourned till Monday, 8th June, at Twelve o'clock.]

Monday, 8th June 1868.

MEMBERS PRESENT:

Mr. SAMUELSON in the Chair.

Mr. Lowther.	Mr. Read.
Lord Frederic Cavendish.	Mr. M'Lagan.
Mr. Akroyd.	Mr. Dixon.
Mr. Potter.	

Mr. *Henry William Ripley*, Mr. *George Gibb*, Mr. *William Henry Stopford*, and Mr. *George Jarman*, were severally examined.

[Adjourned till Thursday next, at Twelve o'clock.]

Thursday, 11th June 1868.

MEMBERS PRESENT:

Mr. SAMUELSON in the Chair.

Mr. Potter.	Lord Frederic Cavendish.
Mr. Dixon.	Mr. Akroyd.
Mr. Bazley.	Mr. Powell.
Mr. Graves.	Mr. Austin Bruce.
Mr. Lowther.	Sir Charles Lanyon.
Mr. Bagnall.	Mr. Beecroft.

Mr. *Anthony John Mundella*, Mr. *Henry Ashwell*, Mr. *Thomas Isaac Birkin*, Mr. *James Kitson*, jun., and Mr. *Henry H. Sales*, were severally examined.

[Adjourned till Monday next, at Twelve o'clock.]

Monday, 15th June 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Acland.
Mr. Akroyd.
Mr. Lowther.
Mr. Potter.
Mr. Bazley.

Mr. Bagnall.
Mr. M'Lagan.
Mr. Read.
Mr. Dixon.
Mr. Powell.

Dr. *J. Watts*, Mr. *Thomas Lawton*, and Mr. *John Angell*, were severally examined.

Mr. *J. F. Iselin* further examined.

[Adjourned till Thursday next, at Twelve o'clock.]

Thursday, 18th June 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Potter.
Mr. Bazley.
Mr. Akroyd.
Mr. Acland.
Mr. Bagnall.

Mr. Lowther.
Mr. Powell.
Sir Charles Lanyon.
Mr. Dixon.
Mr. M'Lagan.

Professor *Henry E. Roscoe*, F.R.S., and Mr. *John Platt* (a Member of the House) were severally examined.

[Adjourned till To-morrow, at Twelve o'clock.]

Friday, 19th June 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Read.
Mr. Potter.
Mr. Acland.
Mr. Lowther.

Mr. Dixon.
Mr. Powell.
Mr. Bagnall.
Lord Frederic Cavendish.

Mr. *Robert Rumney* examined.

[Adjourned till Monday next, at Twelve o'clock.]

Monday, 22nd June 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Dixon.
Mr. Potter.
Mr. Lowther.
Mr. Akroyd.

Mr. Bagnall.
Mr. Acland.
Lord Frederic Cavendish.
Mr. Powell.

Mr. *John Henry Chamberlain*, Mr. *W. C. Aitken*, Mr. *John Bragg*, and Mr. *C. Hibbs*, were severally examined.

[Adjourned till Thursday next, at Twelve o'clock.]

Thursday, 25th June 1868.

MEMBERS PRESENT:

Mr. SAMUELSON in the Chair.

Lord Robert Montagu.	Mr. Graves.
Mr. Dixon.	Mr. Acland.
Mr. Potter.	Mr. Lowther.
Mr. Powell.	Mr. M'Lagan.
Mr. Akroyd.	Mr. Read.

Captain *Donnelly*, R.E., further examined.

Mr. *James Chance*, Mr. *Alfred Field*, Dr. *George Lloyd*, and Mr. *John Skirrow Wright*, were severally examined.

[Adjourned till Monday next, at Twelve o'clock.]

Monday, 29th June 1868.

MEMBERS PRESENT:

Mr. SAMUELSON in the Chair.

Mr. Akroyd.	Mr. Powell.
Mr. M'Lagan.	Lord Frederic Cavendish.
Mr. Bazley.	Mr. Dixon.
Mr. Potter.	Mr. Read.
Sir Charles Lanyon.	

Sir *C. Lanyon* (a Member of the Committee), Mr. *R. Calvert Clapham*, Mr. *William Cochrane*, Mr. *John Daghish*, and Mr. *Henry Watson*, were severally examined.

[Adjourned till Thursday next, at Twelve o'clock.]

Thursday, 2nd July 1868.

MEMBERS PRESENT:

Mr. SAMUELSON in the Chair.

Mr. Gregory.	Mr. M'Lagan.
Mr. M'Lagan.	Mr. Austin.
Mr. Lowther.	Lord Frederic Cavendish.
Mr. Akroyd.	Mr. Dixon.
Mr. Bazley.	Mr. Graves.
Mr. Powell.	

Dr. *Stevenson Macadam*, Mr. *John Mayer*, F.C.S., Mr. *Robert Gill*, and Mr. *William Bain*, were severally examined.

[Adjourned till To-morrow, at Twelve o'clock.]

Friday, 3rd July 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Lord Robert Montagu. Mr. Dixon. Mr. Potter. Mr. Bazley. Mr. Powell.		Mr. M'Lagan. Mr. Akroyd. Mr. Acland. Mr. Lowther. Lord Frederic Cavendish.
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Captain *Donnelly*, R.E., further examined.

Lord *Robert Montagu* (a Member of the Committee), Professor *T. H. Huxley*, F.R.S., Dr. *E. Frankland*, F.R.S., and Mr. *J. C. Buckmaster*, were severally examined.

[Adjourned to Tuesday, 14th, at Twelve o'clock (to consider Report).]

Tuesday, 14th July 1868.

MEMBERS PRESENT :

Mr. SAMUELSON in the Chair.

Mr. Powell. Mr. Potter. Mr. Akroyd. Mr. Bazley. Mr. Dixon.		Sir Charles Lanyon. Lord Robert Montagu. Mr. Acland. Mr. Read.
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DRAFT REPORT proposed by the Chairman, read a first time as follows:—

“ 1. In order to ascertain the state of scientific instruction amongst the industrial classes, your Committee has called before it witnesses representing the following bodies:—

“ 1st. The Department of Science and Art of South Kensington, the Committee of Council for Education, and the Government Colleges of Science and Naval Architecture.

“ 2nd. The University of Oxford, the University of London, and certain institutions unconnected with the State, in which science is taught exclusively, or holds a prominent position.

“ 3rd. The few secondary schools in which science has been for some time systematically taught.

“ 4th. The managers and teachers of science classes and mechanics' institutes receiving aid from the State, or supported exclusively by voluntary efforts.

“ 5th. The population engaged in the great staple industries carried on in the principal manufacturing towns and districts.

“ 2. Their evidence may be included under two heads:—

“ 1st. The state of scientific instruction of,

“ (1.) The foremen and workmen engaged in manufactures.

“ (2.) The smaller manufacturers and managers.

“ (3.) The proprietors and managers-in-chief of large industrial undertakings,
and—

“ 2nd. The relation of industrial education to industrial progress.

“ I.—The STATE OF SCIENTIFIC INSTRUCTION OF FOREMEN and WORKMEN.

“ 3. It is stated that the foremen are almost, without exception, persons who have been selected from the class of workmen by reason of their superior natural aptitude, steadiness, and industry. Their education, and that of the workmen, during the school age, has been received in elementary schools; and owing both to the defective character of the instruction

instruction in those schools, and to the early age at which the children go to work, it is rarely sufficient to enable them to take advantage of scientific instruction at a later period.

“4. In this statement the children educated as half-timers under the Factory Acts must, as a rule, be included. The evidence of Mr. Mundella and other witnesses tends to show, that the primary education received in the factory schools is insufficient, except where the employment and education are both uninterrupted between the ages of eight and 13, and where the instruction is given in good schools established or supported by manufacturers who take an active and intelligent interest in the welfare of the children whom they employ.

“5. As a rule, the little rudimentary knowledge acquired at school is rarely retained after the young people have been at work two or three years, and elementary scientific instruction is thus entirely beyond the reach of a large portion of our industrial population. The series of schools at Halifax, at Oldham, &c., are exceptional instances of fair elementary education to children, followed by elementary instruction in theoretical and applied science to young persons and adults.

“6. It is stated by nearly every witness (and on this subject your Committee would direct particular attention to the evidence of the Rev. Thos. Cromwell, principal of the training school at Chelsea) that the tendency of the Revised Code has been to diminish the efficiency of elementary education. It is hoped that the recent introduction of a seventh standard of examination may have a contrary and beneficial effect; and it is contended that physical geography, the elements of drawing, of the properties of matter, and of the laws of health, may be taught to young children in every elementary school.

“7. The existing elementary classes in experimental science are generally held in connection with mechanics' or literary institutions; although their number has increased of late, they are confined chiefly to the Metropolis and its neighbourhood, and to Lancashire, the West Riding of Yorkshire and Cornwall, and to Edinburgh and Glasgow.

“The pupils may present themselves for the examinations of the Society of Arts, and of the Department of Science and Art at South Kensington. When such pupils are of the artizan class, and are successful, payment according to results is made to the teachers by the Department, and Queen's prizes or medals are given to the pupils themselves.

“Besides artizans, draughtsmen, clerks, teachers, and other persons of various grades, attend these classes; and the evidence of Professor Tyndall, Professor Huxley, and the other examiners, as well as of many other competent witnesses, concurs to show that the instruction, though elementary, is sound.

“8. Elsewhere than in the districts named, these classes scarcely exist. In the midland counties, the Midland Institution of Birmingham is the only one in which experimental science is systematically taught. There are no such classes permanently established in the north-eastern, eastern, west midland, or southern counties; and in many parts of England, the fact that Government aid is granted to them was unknown, until public attention was drawn to it by the recent discussion on the subject of technical education, and by the appointment of this Committee. It is true that the Science and Art Directory shows numerous classes scattered over the country, but they are mostly confined to rudimentary instruction in chemistry, physiology, and botany, in various schools. Though not without value of their own, they have very little, if any, direct influence on the industrial occupations of any class.

“9. In Scotland, where the superior primary instruction of the artizans removes one of the obstacles to their acquiring scientific instruction, the Watt Institution of Edinburgh, and the Andersonian University of Glasgow have rendered good service, the former during nearly half a century, the latter for more than 20 years; they can boast amongst their scholars such names as those of Nasmyth, James Young, and many others. Technical objections have hitherto prevented these schools from receiving the grants of the Science and Art Department; but within the last 12 months these have been overcome.

“10. The Mining School of Cornwall, as described by Mr. Robert Hunt, Keeper of Mining Records, is the only one of its kind; the mining population being scattered over a wide area, it is necessary to send a teacher to the villages in order to conduct the classes.

“The miners are taught the elements of chemical and physical science with special reference to their occupations; and the school is producing results which are excellent, though limited as to their area by want of funds. The wages of the miners are inadequate to enable them to pay fees sufficiently high to support the school, even with the aid of payment on results from the Department of Science and Art, and the local subscriptions do not enable the promoters to provide instruction for all the villages which require or desire it.

“11. The witnesses from the north of England, representing the coal trade, Messrs. Dalglish & Cochrane, are anxious for the establishment of a similar peripatetic school in the

pit villages of Durham and Northumberland. Until their attention was drawn to the Cornish Mining School, they were quite unaware of its existence. They state that the proprietors of collieries would be willing to provide the necessary buildings, and they consider it essential that the Department of Science and Art should give its advice, and the services of its organising master, to the local matter which may be formed to carry out science instruction amongst the mining population of those counties.

“ 12. At Huddersfield special classes are now in course of formation for teaching chemistry, as applied to dyeing, to foremen and apprentices. These classes are supported by the principal manufacturers and merchants of the neighbourhood. At Bradford a subscription list has been opened for the erection of a school of Science and Art, at a cost of 50,000 *l.*, to which one of its citizens has offered a contribution of 5,000 *l.*; and the munificent gift of 10,000 *l.* by Mr. Whitworth, for the endowment of scholarships in mechanical engineering, is offered on conditions that give to the artizans, concurrently with men of other grades, and who have received a more liberal education, an opportunity of acquiring a scientific knowledge of their craft and profession.

“ 13. The Hulme branch of the Amalgamated Society of Carpenters has been the first trade society to establish an adult school in which carpenters and joiners, whether members of the society or not, may be taught drawing, the principles of building, construction, and other branches of science having special reference to their trade.

“ 14. The Bristol Trade School, and the Navigation School of Hull, both aided by grants on results from the Science and Art Department, are conspicuous examples of the successful introduction of science teaching into elementary schools of a superior kind for artizans. The Bristol school is fully described in the evidence of Mr. Thomas Comber. The building, formerly used as a national school, is rent free, and receives some 150 boys of the ages of 12 to 15, who are taught elementary mathematics, chemistry, physics, and mechanical drawing. They pay a fee of 3 *l.* per annum, which, together with the grant on results, covers the cost of conducting the school.

“ 15. A hindrance second only to that of the defective elementary instruction of the pupils is the scarcity of science teachers, and the want of schools for training them. The remuneration of the teachers, arising from pupils' fees and payment on results by the Department of Science and Art, is, with few exceptions, so scanty that science teaching is scarcely ever followed as a profession, but only as an addition to some more profitable employment. Hence, classes are frequently suspended whenever the more important occupations of the teacher demand increased attention, or cause him to remove to other localities.

“ Nearly all the witnesses claim, as a means of augmenting their emoluments, some relaxation of the rule which prevents teachers being paid on the results of instruction given to persons who are not artizans.

“ 16. As the demand for instruction increases, the incomes of the teachers will doubtless increase likewise, but the want of competent men will still remain. The offer, under a recent Minute of the Department, of sums of 25 *l.* per annum in aid of scholarships to be founded by localities contributing like sums, together with the remission of the fees of the Government Colleges of Science, to the holders of such scholarships, will probably induce some young men to prepare themselves for the career of elementary science teachers.

“ II. THE SCIENTIFIC INSTRUCTION OF THE SMALLER MANUFACTURERS AND MANAGERS.

“ 17. Unfortunately, this division may be disposed of in a very few words. Its members have either risen from the rank of foremen and workmen, in which case all that has been stated of the first division will also apply to them; or else they are an offshoot from the class of smaller tradesmen, clerks, &c., and have been educated in the ordinary secondary endowed, and so-called commercial schools. With some admirable exceptions, the instruction which they afford is certainly not superior to that of the best conducted elementary schools; and even in the better schools of this grade the principles of science are scarcely ever taught. The pupils have, however, generally remained at school till the age of 14 or 15, and they never lose the use of the elementary instruction which they had acquired at school. Hence, where the opportunity for instruction in adult science classes exist, they have not, like the artizans, to contend with the mere clerical obstacles to the acquisition of scientific knowledge.

“ III.—THE PROPRIETORS AND MANAGERS OF GREAT INDUSTRIAL UNDERTAKINGS.

“ 18. In those not unfrequent cases where these persons also have risen from the rank of artizans, the same exceptional gifts, including more especially those of unconquerable perseverance and energy which had caused their elevation, have also enabled them generally to correct the deficiencies of their early literary training. Any knowledge of scientific

scientific principles which they may have acquired is generally the result of solitary reading, and of synthetical observation of the facts with which their pursuits have made them familiar.

“ 19. More generally, however, the training of the capitalists, and of the managers of their class, has been that of the higher, secondary, or public schools; followed in rare, though in more recent years less unfrequent, instances, by a course of more or less systematic scientific instruction in colleges like the Royal School of Mines, the Royal College of Chemistry, University and King's Colleges, London; Owens' College, Manchester; and the laboratories of the Universities of Edinburgh and Glasgow. The scientific courses of Oxford have been too recently instituted, and have hitherto been devoted too entirely to pure science, to have had any appreciable influence on the scientific instruction of this class; besides which, a feeling exists, to which expression was given by Mr. Chance, the eminent manufacturer of Smethwick, himself a man of great scientific attainments, and a distinguished member of the University of Cambridge, that however suitable the universities may be or become for the training of professors of science of the higher class, the habits at present acquired there by the sons of wealthy men are not conducive to the successful prosecution of an industrial career.

“ 20. The Military and Scientific Department of the Proprietary College of Cheltenham, and the City of London Endowed School, are exceptional instances of secondary schools in which instruction in science holds the first place. In the great public schools of Harrow and Rugby, instruction in one scientific subject, in addition to classics and mathematics, has only recently been made compulsory.

“ 21. Any attempt to analyse briefly the evidence as to the degree of instruction given at King's College and University College, London, and Owens' College, Manchester, would probably fail to convey a correct impression: your Committee would therefore direct attention to the evidence *in extenso*. The same observation applies to the University of Edinburgh, where a Chair of Civil Engineering has recently been founded by Sir David Baxter, to the endowment of which the Government has agreed to contribute.

“ 22. The inhabitants of Manchester have raised a fund for endowing a similar Chair at Owens' College in that city. To that fund, a single firm of mechanical engineers contributes 3,000 *l.*, besides a subscription of 250 *l.* per annum from one of its partners. The college is full to overflowing, and a proposed building fund of 150,000 *l.* has already received subscriptions amounting to 40,000 *l.*

“ 23. The Royal School of Mines, in addition to its lectures to artizans delivered by some of the most eminent men of science, has systematic courses of lectures in nearly every subject usually comprised in a higher technical course, with the important exception of mathematics.

“ The number of its matriculated students is under 20; its metallurgical laboratory, which has room for only 10 students, is always full. The Royal College of Chemistry in Oxford-street, which is connected with it, has about 40 students in its laboratory. It cannot accommodate more.

“ 24. It has been possible, thanks to the good preparatory teaching of elementary mathematics in the Dockyard schools from which the pupils are drafted, to make mathematical instruction, which is wanting in Jermyn-street, one of the principal features of the Royal School of Naval Architecture at South Kensington, the only school of naval construction in the kingdom. According to the evidence of Mr. Reed, Chief Constructor to the Navy, this school is rendering most essential service to that department. The pupils are engaged during six months in constructive works in the various dockyards, and undergo a complete course of technical training at South Kensington in all that relates to their art, during the rest of the year.

“ 25. Your Committee does not consider it desirable to refer in this Report to the Royal College of Science in Dublin, or to the Queen's Colleges and science classes in Ireland, as the subject of the institutions for promoting science and art in Ireland is now undergoing separate investigation.

“ 26. The following abstracted statement of the cost of instruction in some of the preceding schools or institutions, though only approximate, may be of service:—

“ Royal School of Mines, 30 *l.* for three years, exclusive of laboratory fees, which are from to per annum.

“ Royal College of Chemistry, 6 *l.* per annum, exclusive of laboratory fees, which are

“ King's College Scientific Department, .

“ University College, .

“ Owens' College, Manchester; evening classes to working men, at per course.

“ Cheltenham College Military Department, 28 *l.* per annum; books, laboratory, &c., 8 *l.* per annum.

“ City of London School, 9 *l.* per annum.

“ Bristol Diocesan Trade School, 3 *l.* per annum.

“ *Note.*—King’s College is self-supporting; the ground having been contributed by the State, and the building, for all departments, having cost *l.*

“ Owens’ College is endowed by very large benefactions of the late Mr. Owens and others.

“ The City of London School, according to the evidence of the head master, the Rev. E. Abbott, would be compelled to raise the fees from 9 *l.* to 13 *l.*, if it had to pay rent for its buildings, and received no aid from endowments; and the masters are said to be inadequately remunerated.

“ The Bristol Trade School has no endowment, except the free use of the buildings.

“ The fees in the adult science classes usually vary from 5 *s.* to 10 *s.* per course; the State contributes to the maintenance of the teachers by payments on the results of the May examination of artizan pupils, in addition to which there is in nearly all cases considerable aid from local subscriptions, and from the general funds of mechanics’ and other similar institutions.

“ 2. *The Relation of Industrial Education to Industrial Progress:*

“ 27. The industrial system of the present age is based on the substitution of mechanical for animal power; its development is due in this country to its stores of coal and of metallic ores, to our geographical position and temperate climate, and to the unrivalled energy of our population.

“ 28. The acquisition of scientific knowledge has been shown by the witnesses to be only one of the elements of an industrial education and of industrial progress. Indeed there is a preponderance of evidence to show that, so far as the workmen, as distinguished from the managers, are concerned, it can be considered an essential element only in certain exceptional trades, or, generally, as enlarging the area from which the foremen and managers may be drawn.

“ 29. In all cases another and an indispensable element of industrial success is the acquisition of practical experience and manipulative skill.

“ 30. The evidence given before your Committee places beyond all doubt the fact, that these latter acquirements are possessed in a pre-eminent degree by our manufacturing population of every grade, according to their several necessities. They are obtained in our factories, our forges, our workshops, our shipyards, and our mines, which, in their organization and appliances, are the models which, with a few special exceptions, other nations have hitherto imitated and followed, but not surpassed.

“ 31. The pressure of foreign competition, where it exists, is attributed mainly to the artistic taste of foreign nations, to fashion, to lower wages, and to the absence of trade disputes abroad.

“ 32. It is owing to one or more of these favourable conditions, rather than to superior education or technical skill, that the lacemakers of Calais, and the locomotive manufacturers of Creuzot and of Esslingen; are competing with this country in neutral markets, and even at home; and Mr. Cochrane states that the low rate of wages alone enabled the factory at Anzin to furnish him with pumping and winding engines, constructed according to his own design, but of excellent workmanship, which he has erected at his collieries in Northumberland and Durham.

“ 33. Only two witnesses from Birmingham, the one an eminent merchant, the other a manufacturing jeweller; and Mr. Gill, a woollen manufacturer, of Innerleithen, in Scotland, attribute the loss of certain trades to the superior skill, appliances, and education of the German, Belgian, and American manufacturers; and the great steel works of Krupp, in Westphalia, have been named as the only instance of a factory which is said to possess an organization superior to that of any establishment in the same branch of industry in this country.

“ 34. At the same time, nearly every witness speaks of the extraordinarily rapid progress of Continental nations in manufactures, and attributes that rapidity, not to the model workshops which are met with in some foreign countries, and are but an indifferent substitute for our own great factories, and those which are rising up in every part of the Continent; but, besides other causes, to the scientific training of the proprietors and managers in France, Switzerland, Belgium, and Germany, and to the elementary instruction which is universal amongst the working population of Germany and Switzerland. There can be no doubt, from the evidence of Mr. Mundella, of Professor Fleeming Jenkin, Mr. Kitson, and others, and from the numerous reports of competent observers, that the facilities for acquiring a knowledge of theoretical and applied science are incomparably greater on the Continent than in this country, and that such knowledge is based on an advanced state of secondary education.

“ 35. All

"35. All the witnesses concur in desiring similar advantages of education for this country, and are satisfied that nothing more is required, and that nothing less will suffice, in order that we may retain the position which we now hold in the van of all industrial nations. All are of opinion that it is of incalculably greater importance economically that our manufacturers and managers should be thoroughly instructed in the principles of their arts than that the artizans themselves should possess the elements of such knowledge; and all are agreed that good primary instruction is what is to be chiefly desired for the working class.

"36. They are convinced that a knowledge of the principles of science on the part of those who occupy the higher industrial ranks, and the possession of elementary instruction by those who hold subordinate positions, would tend to promote industrial progress by stimulating improvement, preventing costly and unphilosophical attempts at impossible inventions, diminishing waste, and obviating in a great measure ignorant opposition to salutary changes.

"37. At the same time, the witnesses are far from believing that the economical necessity for general and scientific education is as yet fully realised by the country, and some of them consider it essential that the Government should interfere much more actively than it has done hitherto, to promote the establishment of scientific schools and colleges in our great industrial centres.

"38. In reference to the sufficiency, or the reverse, of voluntary efforts, it is stated, on the one hand, that premiums of several hundred pounds are paid for the admission into the offices of civil, and the workshops of mechanical engineers, of pupils, many of whom fail to avail themselves fully of the valuable instruction which they would obtain there, owing to the absence on their part of all preliminary instruction in mathematics and physical science; and it is reasonably inferred that persons who are willing to pay those large sums, and who do not hesitate to send their sons to expensive schools, will be prepared to pay for instruction in science as soon as they are convinced of its utility; whilst it is argued, on the other hand, that in all countries, and at all times, the offer of education of every kind has preceded the demand, and that any temporary sacrifice on the part of the State, in order to place scientific instruction within the reach of those who would be likely to appreciate it, will be amply and speedily repaid by the increase of the general intelligence and prosperity which it will produce.

"39. A more general opinion on the part of the witnesses than either of these extreme views is, that wherever any locality in which, from its geographical position and industrial importance, it may be presumed that a scientific college or a higher secondary school of science is likely to be successful, is prepared to contribute largely to the creation and maintenance of such an institution, the State may fairly give assistance to such locality by moderate grants, and by testing the results of the school.

CONCLUSIONS.

"40. The evidence which has been given before your Committee, and in part summarised in the preceding pages, together with the information which is accessible to them in common with other members of the community, has convinced them:—

"(1.) That it is of the most vital importance that increased efforts should be made to place efficient elementary instruction within the reach of every child.

"(2.) That whilst every assistance should be afforded by parochial aid, or otherwise, to enable poor parents to send their children to school, the cupidity or indifference of those who are placed above want should not be permitted to interfere with the claims of every child to receive such instruction.

"(3.) That elementary instruction in drawing, in physical geography, and in the phenomena of nature, should be given in all the larger elementary schools.

"(4.) That adult science classes, though of great use to artizans, to foremen, and to the smaller manufacturers, cannot be deemed a substitute for the scientific instruction which those should possess who are responsible for the conduct of important industrial undertakings. That these, in common with all whose necessities do not oblige them to leave school before the age of 16, should receive instruction in the elements of science as part of their general education.

"(5.) That the reorganization of secondary instruction is urgently required, and that the elaborate reports of the Schools Inquiry Commission, which prove the instruction in those schools to be lamentably defective, whilst abundant funds for efficient education are shown to exist, together with the recommendations of that Commission, ought to receive the immediate consideration of Parliament and of the country.

"(6.) That superior primary schools, and secondary schools of various grades, in which science would more or less take the place of classics as an instrument of culture as well as of direct instruction, can be established, and would be self-supporting, if the fees are equal to those paid for literary instruction in good proprietary or adventure schools of similar grade.

“(7.) That superior colleges of science, and special schools for technical instruction requiring costly buildings and laboratories, cannot be supported by fees alone, but must receive aid from one or more of the following sources—from the State, from the localities, and from benefactions.

“(8.) That such colleges and special schools are, for various reasons, most likely to be successful if established in large centres of industry; and more especially for the reason that the choice of such centres tends to promote the combination of science with practice on the part both of the professors and of the pupils.

“(9.) That the taxpayers of the provinces of England have not received a full share of the benefit of their contributions to the common fund, out of which the large grants to South Kensington, to Jermyn-street, to the Scottish and Irish Universities, and to the Irish Colleges, have been made.

“(10.) That, therefore, if the principal of sustaining Government Colleges of Science and Museums, and of giving aid to Scottish Universities and Irish Colleges be maintained, the large manufacturing and mining centres of England may fairly ask for such a redistribution of the public grants as will afford them increased aid supplementary to the funds which they may raise in their own localities for the purpose of promoting scientific instruction.

“(11.) That some slight addition to the emoluments of science teachers would probably tend materially to promote the establishment and permanence of elementary science classes. It will be for the department to consider whether such addition, if made, should be by increased payment on results in all or some of the subjects taught, or in other ways which may not appear to be open to abuse.

“(12.) That the provisions of the Public Libraries' and Museums' Act should be altered so as to enable public bodies to levy a slightly increased rate for scientific purposes.

“(13.) That the managers of training colleges for the teachers of elementary schools be invited to give special attention to the instruction of those teachers in theoretical and applied science, where such instruction does not exist already.

“(14.) That teachers in elementary day schools should be paid on results, for teaching science to the older scholars, in the same way as payment is now made for drawing in such schools.

“(15.) That a more intimate connection between the various Government institutions for scientific instruction in London would increase the efficiency of each of those institutions; but that, having considered the plan of a central college of science at South Kensington, proposed by the Science and Art Department, your Committee would not recommend its adoption until Parliament shall have referred it to the consideration of competent persons.”

DRAFT REPORT, proposed by Mr. *Acland*, read as follows:

“ I.—IMPORTANCE OF SCIENTIFIC INSTRUCTION TO THE INDUSTRIAL COMMUNITY.

“(1.) *To Firms and Managers.*—Scientific instruction is important to the heads and principal managers of manufacturing firms, *generally*, as one among other branches of a liberal education; and, *in particular cases*, as supplying information necessary for the economical conduct of business.

“(2.) *To the Artizans.*—As regards artizans, scientific instruction is desirable, firstly, as a means of cultivating intelligent habits of observation; secondly, as tending to set trades free from obstinate adherence to traditional rules of practice inapplicable to modern requirements; thirdly, scientific instruction is important to the artizan, who has the practical and moral qualities which might fit him to rise to the post of foreman or manager, because the absence of such knowledge might operate as an obstacle to the progress of a man otherwise well qualified for promotion.

“ II.—SCIENTIFIC INSTRUCTION, HOW CONNECTED WITH GENERAL EDUCATION, AND TECHNICAL PRACTICE.

“ The practical course to be taken in making systematic provision for scientific instruction cannot be decided without taking into account the existing arrangements for *general education*, and for the acquirement of the *technical information* commonly required for the practice of particular professions and branches of business.

“ These arrangements are in part dependent on certain legal restrictions affecting public endowed institutions (such as the grammar schools), and partly on *social, professional,*

sional, and commercial usages, which have created a demand for instruction in private establishments.

“ Very large sums are expended in England on *general education*; these sums are derived in part from ancient endowments, in part from modern contributions to proprietary and other schools, and to a very large extent from the payments of parents in the upper and middle classes.

“ *Technical instruction* in England exists chiefly in the form of apprenticeship and pupilage; and for the advantage supposed to be derived from seeing practice in those forms, very large sums are paid, in the form of premiums, by persons who desire their sons to enter upon professional, manufacturing, commercial, or agricultural pursuits.

“ For *scientific instruction*, either as a part of *general education* or as introduction to *technical training*, the expenditure at present is very small. It is obvious that the success of any course to be pursued with a view to make provision for scientific instruction must depend in great measure on the co-operation of parents; and that such co-operation must be founded on a general conviction of the practical advantage of the means offered. It is probable that, when such conviction shall have been established, private resources may be relied upon for supplying a considerable portion of the necessary expenses.

“ It has, however, been frequently asserted that the higher branches of learning, which may not seem to the public at large to produce immediate results, require the sustentation of public funds in order to place the highest talent at the service of the nation. The same statement is probably not less true of many branches of science, the ultimate results of which to the nation, though most beneficial, may not be obvious or generally recognised.

“ III.—PRACTICAL FORMS IN WHICH SCIENTIFIC INSTRUCTION IS NEEDED.

“ 1. The universal establishment of primary schools, in which some of the elements of natural history may form a part of the instruction, accompanied by measures tending to prevent the rising generation from suffering from the neglect or ignorance of their parents or guardians.

“ 2. The establishment in all towns of secondary schools for artisans and tradesmen willing to keep their children at school to the age of 14 or 15. Drawing, and the elements of mathematics and natural science to be taught in such schools, and the school fees not to exceed 1 l. per quarter.

“ 3. The further extension and encouragement of evening classes, and the appointment of circulating or organising teachers.

“ 4. The introduction of the elements of natural science into all endowed secondary schools in which scholars continue their education up to the age of 16 or 18.

“ 5. The selection of certain endowed schools, in favourable situations in the manufacturing districts, as special science schools, having in view the special requirements of the district; such schools to be rendered available as boarding schools to the surrounding towns, by the establishment of Exhibitions open to public competition; so that the children of the artizan may be promoted from the lowest to the highest school.

“ 6. The establishment of a small number of colleges for adults more or less corresponding to Owen's College, Manchester, in which advanced science teaching may be given on a scale parallel to that of the Universities, but in more direct relation to the industry of the particular district in which each college is situated. The annual cost of such instruction is estimated at about 30 l. per head; it being presumed that there are 200 pupils, and that good buildings are provided.

“ 7. The encouragement and certification of trained science teachers by the recognition of natural science as one element in the curriculum of the training colleges or normal schools aided and inspected by Government. It deserves also to be considered whether teachers of secondary schools should be admitted into the training schools on payment of the expense of their instruction.

“ 8. The encouragement by examination and certificate of self-taught science teachers among the industrial classes.

“ The encouragement of higher science teachers by the granting of degrees in science at Oxford and Cambridge, and opening fellowships to distinction in natural science as well as in literature, and mathematical and moral science.

“ 9. The organisation, by the State, of the secondary education of the country, as a whole, as regards the government and inspection of all publicly-endowed institutions, and the establishment of a recognised standard of attainment for teachers, whether public or private.

“ IV.—SOURCES FROM WHICH THE FUNDS MAY BE DERIVED FOR THE EXPENSE OF SCIENTIFIC INSTRUCTION.

“ The expenses are of three kinds :—

“ *a. Current Expenses.*—Salaries, text-books, materials, chemicals, &c. ; repair of apparatus.

“ *b. Permanent Objects.*—Buildings, new apparatus, museums, libraries of reference.

“ *c. Official Expenses.*—Inspection ; organizing staff for stimulating local action and diffusing information.

“ These expenses may be met by funds derived from the following sources :—

“ The sources of income are as follows :—

“ 1. Fees paid by pupils.

“ 2. Endowments devoted to education.

“ 3. Other public funds, such as obsolete charities, and others of doubtful or mischievous tendency.

“ 4. Voluntary contributions.

“ 5. Local rates.

“ 6. Grants from the public exchequer, or loans advanced on local or personal security.

“ V.—GENERAL PRINCIPLES.

“ It is submitted that it is premature to lay down, as applicable to all places, the proportions in which the expenses of scientific instruction may be provided from the above-named sources, but the following general principles are suggested for discussion :—

“ (1.) That while moral and economic considerations may justify the expenditure from the national exchequer of considerable sums on general, and especially on primary education, with a view to the diminution of crime, pauperism, and disease, the payment, in whole or in part, of the expense of instruction in science for particular classes is open to *prima facie* objection, and requires some special justification.

“ (2.) That such justification for temporary grants from the national funds may to a certain limited extent be sought in present circumstances, which suggest the expediency of measures tending to awaken local activity, and to promote a better use of existing resources.

“ (3.) That on this ground some extension of the action of the Department of Science and Art may be deserving of consideration as a temporary measure.

“ (4.) That in any extended action of the Government the following principles should be borne in mind :—

“ *a.* That expenditure on scientific instruction on the part of the Government is useless without local co-operation, and therefore that the initiative should be taken on the spot, the Government aiding in providing the means, and testing the results.

“ *b.* That endowments for the annual expense of instruction are more effectual when used to stimulate and reward exertion than when they are expended on fixed salaries with a view to make instruction cheap. Therefore, that any portion of existing endowments which may be rightly applicable to scientific instruction should be applied to that object, in the form of exhibitions tenable at good schools or colleges giving scientific instruction.

“ *c.* That the administration of local funds for scientific instruction should be vested in responsible bodies, representing a sufficiently wide area, with a view to guard against undue local influence, and to secure the free action of enlightened public opinion.

“ *d.* That while the evidence before the Committee shows that there is in some quarters great indifference to the importance of scientific instruction, it proves, at the same time, that enlightened individuals and communities, when they are convinced of its necessity, have shown a disposition and ability to make contributions as great as, if not greater than, any which a Government could venture to propose to Parliament to sanction, and therefore that it is more expedient to awaken and direct local exertion than to supersede the necessity for its exercise.

“ *e.* That

"e. That all classes of pupils seeking scientific instruction should be called upon to contribute, according to their means, to the expense of such instruction.

"f. That as regards the special interests of manufacturers, the nation has no more interest in providing for the technical instruction of artizans, and foremen, and managers, than it has in providing agricultural instruction for farm labourers, and hinds, and land agents, with a view to the increase of the production of food.

CONCLUSION.

"The general conclusion to be drawn from the inquiries of the Committee is, that Parliament should be urged to proceed without delay—

- " 1. To organise secondary education.
- " 2. To recognise instruction in natural science as an indispensable element in such education.
- " 3. To provide for the central, provincial, and local administration of existing funds, with due regard to the wants and capabilities of each branch of industry.
- " 4. To press forward further measures for primary education."

Draft Report, proposed by the Chairman, read a second time, paragraph by paragraph.

Motion made, and Question put, That paragraphs 1 to 39 inclusive, be postponed.—The Committee divided :

Ayes, 5.	Noes, 2.
Mr. Acland.	Mr. Akroyd.
Mr. Bazley.	Lord R. Montagu.
Mr. Dixon.	
Sir C. Lanyon.	
Mr. Powell.	

Paragraph 40.—Section 1; Amendments made. Another Amendment proposed, at the end of the section, to add the words, "And that greater regularity of attendance at school, and a lengthened duration of school life should be secured"—(Mr. Dixon).—Question, That those words be there added—put, and *negatived*.

Section 1, as amended, *agreed to*.

Section 2.—Amendments made.

Another Amendment proposed, by leaving out the words, "by parochial aid"—(Mr. Acland).—Question put, That those words stand part of the section.—The Committee divided :

Ayes, 5.	Noes, 2.
Mr. Akroyd.	Mr. Acland.
Mr. Dixon.	Mr. Bazley.
Sir C. Lanyon.	
Lord R. Montagu.	
Mr. Powell.	

Another Amendment proposed, by leaving out the word "poor," in order to insert the word "pauper"—(Lord R. Montagu), instead thereof.—Question put, That the word "poor" stand part of the section.—The Committee divided :

Ayes, 3.	Noes, 4.
Mr. Acland.	Mr. Akroyd.
Mr. Bazley.	Sir C. Lanyon.
Mr. Dixon.	Lord R. Montagu.
	Mr. Powell.

Word inserted.

Question, That the section, as amended, stand part of the paragraph.—The Committee divided :

Ayes, 3.	Noes, 4.
Mr. Akroyd.	Mr. Acland.
Mr. Dixon.	Mr. Bazley.
Lord R. Montagu.	Sir C. Lanyon.
	Mr. Powell.

Section 4.—Amendment proposed, by leaving out “ 16 ” in order to insert “ 14 ”—(Mr. Acland), instead thereof.—Question, That 16 stand part of the section—put, and *negatived*.—Question put, That the word “ 14 ” be there inserted.—The Committee divided :

<p>Ayes, 6.</p> <p>Mr. Acland. Mr. Akroyd. Mr. Bazley. Mr. Powell. Sir C. Lanyon. Mr. Read.</p>	<p>Noes, 2.</p> <p>Mr. Dixon. Lord R. Montagu.</p>
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Section, as amended, *agreed to*.

Section 5 amended, and *agreed to*.

Section 6.—Amendment proposed, by leaving out the section, in order to insert the following section :—That it is desirable that certain endowed schools should be selected in favourable situations for the purpose of being reconstituted as science schools, having in view the special requirements of the district, such schools to be rendered available to the surrounding districts by the establishment of exhibitions open to public competition, so that the children of every grade may be able to rise from the lowest to the highest school—(Mr. Acland), instead thereof.—Question, That Section 6 stand part of the paragraph—put, and *negatived*. Proposed section inserted.

Sections 7 and 8 amended, and *agreed to*.

Section 9.—Amendment proposed, by leaving out from the word “ received ” to the end of section, in order to add the words “ a sufficient proportion of the State Grant for scientific education ”—(Mr. Dixon), instead thereof.—Question, That the words proposed to be left out stand part of the section—put, and *negatived*.—Question put, That those words be there added.—The Committee divided :

<p>Ayes, 5.</p> <p>Mr. Akroyd. Mr. Bazley. Mr. Dixon. Sir C. Lanyon. Mr. Read.</p>	<p>Noes, 2.</p> <p>Lord R. Montagu. Mr. Acland.</p>
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Question, That the section as amended, stand part of paragraph.—The Committee divided :

<p>Ayes, 5.</p> <p>Mr. Akroyd. Mr. Bazley. Mr. Dixon. Sir C. Lanyon. Mr. Read.</p>	<p>Noes, 2.</p> <p>Mr. Acland. Lord R. Montagu.</p>
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Section 10.—Amendment proposed, by leaving out the words “ such a redistribution of the public grants as will afford them increased aid, supplementary to the funds which they may raise in their own localities for the purpose of promoting scientific instruction,” in order to add the words, “ increased Government aid for the promotion of scientific instruction ”—(Mr. Dixon), instead thereof.—Question put, That the word “ such ” stand part of the paragraph.—The Committee divided :

<p>Ayes, 4.</p> <p>Mr. Acland. Mr. Bazley. Sir C. Lanyon. Mr. Read.</p>	<p>Noes, 3.</p> <p>Mr. Akroyd. Mr. Dixon. Lord R. Montagu.</p>
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Further Amendments made.—Question put, That the section as amended, stand part of the paragraph.—The Committee divided :

<p>Ayes, 4.</p> <p>Mr. Akroyd. Mr. Bazley. Mr. Dixon. Mr. Read.</p>	<p>Noes, 3.</p> <p>Mr. Acland. Sir C. Lanyon. Lord R. Montagu.</p>
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Amendment proposed, after last section, to insert the following section: "The grants of money from the National Exchequer for local scientific instruction should be chiefly designed to promote local activity and a better use of resources otherwise available, should be regarded as occasional or temporary"—(Mr. *Acland*).—Question proposed, That this section be there inserted.—Amendment proposed, To leave out from the word "available," to the end of the proposed section—(Mr. *Akroyd*).—Question put, That the words proposed to be left out, stand part of the proposed section.—The Committee divided:

Ayes, 3.

Mr. Acland.
Mr. Bazley.
Mr. Read.

Noes, 2.

Mr. Akroyd.
Mr. Dixon.

Question put, That the proposed Section be there inserted.—The Committee divided:

Ayes, 3.

Mr. Acland.
Mr. Bazley.
Mr. Read.

Noes, 2.

Mr. Akroyd.
Mr. Dixon.

Sections 11, 12, 13, 14, 15, *agreed to*, some with Amendments:

Paragraph (40), as amended, *agreed to*.

Postponed paragraph 1, amended, and *agreed to*.

Paragraph 2, postponed.

Paragraph 3.—Amendment proposed, by leaving out from the words "elementary schools" to the end of the paragraph, in order to add the words "but the amount of education which they, in many instances, possess, is not sufficient to enable them to profit by a scientific instruction"—(Mr. *Akroyd*), instead thereof.—Question, That the words proposed to be left out, stand part of the paragraph—put, and *agreed to*.

Paragraph amended, and *agreed to*.

Paragraph 4.—Amendment proposed, to leave out the words "in this statement the children educated as half-timers under the Factory Acts, must, as a rule, be included," in order to insert the words, "these defects are but partially removed by the Factory Acts"—(Mr. *Akroyd*), instead thereof.—Question put, that the words proposed to be left out, stand part of the paragraph.—The Committee divided:

Ayes, 3.

Mr. Acland.
Mr. Bazley.
Sir Charles Lanyon.

Noes, 2.

Mr. Akroyd.
Mr. Dixon.

Paragraph *agreed to*.

Amendment proposed, after paragraph 4, to insert the following paragraph:—

"In many instances the educational provisions of the Factory Acts are rendered practically inoperative by the short and uncertain attendance of children at school during the half-time period; and in other cases, where a sufficient supply of children above 13 can be obtained, employers refuse to take any short-timers, or to provide means for their education. It has been stated, by Mr. Wright, of Birmingham, that the new Factory and Hours of Labour Regulation Acts have had the effect of throwing out of employment 2,000 to 3,000 hands in Birmingham, and that there are not more than 200 to 250 receiving education under the half-time system; so desirous are employers of ridding themselves of all trouble as to the educational clauses of these Acts.

"It has, however, been admitted by several witnesses, that if children at and above the age of 13 were not allowed to work full time until they had passed an elementary examination in reading, writing, and arithmetic, and obtained a certificate of competency, then the parents and employers of such children, out of regard to their joint interests,

would endeavour to secure the requisite standard of elementary knowledge at an earlier age.

“It has further been suggested that as an incentive to attendance at infant schools previously to entrance on half-time work, a rudimentary examination in simple reading might be deemed a necessary qualification for a half-timer.

“With these additional safeguards against the evasion of the educational provisions of the Factory and Hours of Labour Regulation Acts, it is contended by the advocates of factory education, that these Acts, so amended, might be the means of extending primary education amongst the labouring classes generally.”—(Mr. Akroyd.)

Question, That this paragraph be there inserted—put, and *negatived*.

Paragraphs 5, 6, amended, and *agreed to*.

Amendment proposed, after paragraph 6, to insert the following paragraph:—

“(7.) *As respects the Instruction of the Industrial or Artizan Classes in Elementary Science.*—After the formation of the Science and Art Department in 1853, attempts were made in various forms to afford the working classes opportunities for instruction in the elements of science. These experiments do not appear to have met with much success till, in 1859, a general minute on the subject was passed by the Lords of the Committee of Council on Education. This minute, greatly enlarged, and with various modifications which experience has suggested from time to time, forms the code of rules termed the Science Directory; and according to its provisions the grants in aid of science schools are administered. It is a pure system of payments on the results of instruction, as tested by the annual examinations of the department. The payments are only made on account of the instruction of students of the artizan or industrial classes. The prizes are open to all. Under this system a steady and rapid increase has been maintained, both in the number of classes and the students under instruction. This will appear from the following Table :

	Number of Schools.	Number under Instruction.
1860	9	500
1861	38	1,330
1862	70	2,543
1863	75	3,111
1864	91	4,666
1865	120	5,479
1866	153	6,835
1867	212	10,230
1868	300	14,600

“In this each separate institution in which scientific instruction is given is treated as a school, but the subjects taught and the number of classes in the different schools vary much. In some cases a school consists of but one class, and there is only one subject taught; in others there are as many as nine and ten classes in different subjects. The general results, as compared with the two previous years, are given below.”

“RESULTS of the SCIENCE SCHOOL EXAMINATIONS, May 1866, 1867, and 1868.

	1866.	1867.	1868.
Number of schools under certificated teachers examined	153	212	300
Number of classes in the same	400	560	789
Number of individuals under instruction in classes under certificated teachers	6,835	10,230	14,600
Number of the above who came up for examination	2,980	4,520	—
Number examined in addition to the above who were not in schools under certificated teachers	170	400	300

" Results of the Science School Examinations, May 1866, 1867, and 1868—continued.

	1866.	1867.	1868.
Number of Papers worked in:—			
Subject			
I. Practical, Plane, and Descriptive Geometry -	517	783	1,337
II. Mechanical and Machine Drawing - - -	469	764	1,671
III. Building, Construction, and Naval Architecture -	233	467	1,206
IV. Elementary Mathematics - - - - -	290	778	1,390
V. Higher Mathematics - - - - -	24	36	33
VI. Theoretical Mathematics - - - - -	178	228	353
VII. Applied Mechanics - - - - -	86	110	167
VIII. Acoustics, Light and Heat - - - - -	327	590	769
IX. Magnetism and Electricity - - - - -	352	728	1,038
X. Inorganic Chemistry - - - - -	1,043	1,082	964
XI. Organic Chemistry - - - - -	121	121	123
XII. Geology - - - - -	194	207	309
XIII. Mineralogy - - - - -	21	34	38
XIV. Animal Physiology - - - - -	497	599	1,182
XV. Zoology - - - - -	79	127	298
XVI. Vegetable Physiology and Economic Botany -	138	100	112
XVII. Systematic Botany - - - - -	114	79	73
XVIII. Mining - - - - -	22	38	41
XIX. Metallurgy - - - - -	62	63	81
XX. Navigation - - - - -	118	144	219
XXI. Nautical Astronomy - - - - -	77	83	87
XXII. Steam - - - - -	95	121	106
XXIII. Physical Geography - - - - -	409	931	1,516
TOTAL Number of Papers worked - - -	5,466	8,213	13,113
Number of provincial centres where examinations were held - - - - -			
	121	152	241
Number of metropolitan centres where examinations were held (including South Kensington Museum) - -			
	13	15	23
Number of 5th Class - - - - -			
	778	1,587	2,359
" 4th " - - - - -	713	973	1,044
" 3rd Queen's Prizes - - - - -	1,228	1,576	2,475
" 2nd Queen's Prizes - - - - -	501	1,122	1,692
" 1st Queen's Prizes - - - - -	342	755	1,079
TOTAL Number of Successes - - - - -	3,562	6,013	8,649
Failures - - - - -			
	1,904	2,200	4,464

" From the evidence we have had before us, and from the reports made by the examiners to the Science and Art Department, it appears that there is a marked improvement as well in the nature of the instruction given as in the number of students. That this progress should have been made in eight years, cannot but be considered highly satisfactory, when it is remembered that during that time a knowledge of the existence of the system has had to be diffused in the country, necessarily a slow operation; and not only the classes, but the teachers to be created. The payments on the results of the May 1867 examination amounted to 7,976 *l.*, being at the rate of 15 *s.* 7 *d.* per person under instruction, or nearly 1 *l.* per examination paper worked, or nearly 1 *l.* 15 *s.* per individual student examined. By a recent minute these payments are increased at least 10 per cent.

" That the country has not more generally taken advantage of the aid offered by the State can be due only to the apathy and indifference on the subject which has unfortunately hitherto obtained.

" We find that under existing rules large payments can be earned in well-organised secondary schools, such as the Bristol Trade School; and in night classes, as at Heywood, Droydsden, Bolton, and Bury, though these do not occupy the whole time of the teacher, who may devote his day to other occupations."—(Lord Robert Montagu.)

Question, That this paragraph be there inserted—put, and *negatived*.

Remaining paragraphs *agreed to*, some with Amendments.

Postponed paragraph 2, further considered.

Amendment proposed, at the end of the paragraph, to add the words:—"3rd. The duty of the State with reference to the promotion of scientific instruction"—(Mr. Dixon).—
Question, That those words be there added—put, and *negatived*.

Question, That this Report be the Report of the Committee to the House—put, and *agreed to*.

Ordered, To Report, together with Minutes of Evidence and Appendix.

EXPENSES OF WITNESSES.

NAME OF WITNESS.	Profession or Condition.	From whence Summoned.	Number of Days absent from Home, under Orders of Com- mittee.	Expenses of	Allowances	Total
				Journey to London and back:	during Absence from Home.	Expenses allowed to Witness.
				£. s. d.	£. s. d.	£. s. d.
Sir Robert Kane - - -	President, Queen's Col- lege, Cork.	Cork - - -	4	9 - -	4 4 -	13 4 -
Mr. Thomas Coomber - - -	Head Master, Trade School	Bristol - - -	2	1 18 -	2 2 -	4 - -
Mr. Thomas Lawton - - -	Agent of Lancashire and Cheshire Union.	Manchester - - -	4	3 10 -	4 4 -	7 14 -
Mr. John Angell - - -	Head Master, Mechanics' Institution.	Manchester - - -	4	3 10 -	4 4 -	7 14 -
Dr. John Watts - - -	Ph. D. - - -	Manchester - - -	4	3 10 -	4 4 -	7 14 -
Mr. John Henry Chamberlain	Architect - - -	Birmingham - - -	1	1 18 6	3 3 -	5 1 6
Mr. Charles Hibbs - - -	Gunmaker - - -	Birmingham - - -	2	1 10 -	2 2 -	3 12 -
Mr. W. H. Stopford - - -	Schoolmaster - - -	Halifax - - -	4	3 7 6	4 4 -	7 11 6
Mr. George Gibb - - -	- ditto - - -	Halifax - - -	4	3 7 6	4 4 -	7 11 6
Mr. G. Jarman - - -	Science Teacher - - -	Huddersfield - - -	4	3 4 -	4 4 -	7 8 -
Mr. W. Cochrane - - -	Engineer - - -	Newcastle-on-Tyne -	3	4 13 -	9 9 -	14 2 -
Mr. Henry Watson - - -	- ditto - - -	Newcastle-on-Tyne -	3	4 13 -	9 9 -	14 2 -
Mr. J. Daglish - - -	- ditto - - -	Newcastle-on-Tyne -	3	4 13 -	9 9 -	14 2 -
Mr. R. C. Clapham - - -	Chemical Manufacturer -	Newcastle-on-Tyne -	3	4 13 -	3 3 -	7 16 -
Dr. Stevenson Macadam - - -	Lecturer on Chemistry -	Edinburgh - - -	3	6 6 -	3 3 -	9 9 -
Mr. John Mayer - - -	Science Teacher - - -	Glasgow - - -	3	6 6 -	3 3 -	9 9 -
Mr. William Bain - - -	Ironwork Contractor -	Edinburgh - - -	3	6 6 -	3 3 -	9 9 -
Mr. Robert Gill - - -	Manufacturer - - -	Innerleithen, Gala- shiels.	3	6 10 -	3 3 -	9 19 -
Mr. Henry Sales - - -	- - -	Leeds - - -	-	2 15 -	- - -	2 15 -
						162 13 6

MINUTES OF EVIDENCE.

MINUTES OF EVIDENCE.

Thursday, 23rd April 1868.

MEMBERS PRESENT:

Mr. Bagnall.
Mr. Bazley.
Mr. Henry Austin Bruce.
Lord Frederick Cavendish.
Mr. Dixon.
Mr. Graves.
Mr. Gregory.

Sir Charles Lanyon.
Mr. M'Lagan.
Lord Robert Montagu.
Mr. Edmund Potter.
Mr. Samuelson.
Mr. William Lowther.

BERNHARD SAMUELSON, Esq., IN THE CHAIR.

HENRY COLE, Esq., C.B., and Captain DONNELLY, R.E.; Examined.

1. *Chairman.*] You are Secretary of the Science and Art Department, are you not?—I am.

2. That department is an enlargement of the Practical Art Department, and that enlargement was made in 1853?—It was.

3. At that time Mr. Cardwell was President of the Board of Trade, was he not?—He was. I have a letter of the Board of Trade reporting the intention of the Government to enlarge the department at that time. The Board of Trade write: "My Lords have had under their consideration, by desire of the First Lord of the Treasury, the question of the best means of carrying into effect, so far as this department is concerned, the announcement contained in the speech delivered from the Throne at the commencement of the present Session of Parliament. The advancement of the fine arts and of practical science will be readily recognised by you as worthy the attention of a great and enlightened nation. I have directed that a comprehensive scheme shall be laid before you, having in view the promotion of these objects, towards which I invite your aid and co-operation. Their lordships understand that the object in view is to extend a system of encouragement to local institutions for practical science, similar to that already commenced in the Department of Practical Art; that the systems should be combined on an enlarged scale, and that arrangements should be made for furnishing, through the instrumentality of one department in connection with the executive government, having the support and being subject to the control of Parliament, the means for mutual co-operation and correspondence to every district of the kingdom where the local intelligence and energy

of the inhabitants shall create schools of industrial science and art. My Lords can have no hesitation in stating that the time has now arrived when the consideration of the important question of supplying scientific and artistic instruction to the industrial classes of this country in a more systematic manner than has hitherto been possible can no longer be postponed." That is dated in 1853. Then they go on to the end with the reasons for that opinion.

4. I see that the words made use of there are the industrial class, and not the working class; do you think there is any distinction to be drawn between the two classes?—In one sense, none; in a limited sense, a broad distinction. The action of the department from the very beginning has been, without discouraging any good that it might confer on the middle and upper classes, to make public payments directly only on behalf of artizans,—the definition of the word "artizan" being a man who gets his bread by manual labour, and who is not assessed to the Income Tax.

5. In fact, you have understood the term industrial class to mean artizans?—Yes.

6. *Mr. Bruce.*] Was not the word probably used in order to distinguish it from the words used in the Minutes of Council, where the words "labouring poor" were used, and so as to show that the system was not to be confined merely to those who could not assist themselves, but to be extended to rather a higher class?—Probably. When the schools of design were first formed, about the year 1833, Mr. Poulett Thomson being President of the Board of Trade, any persons but artizans, strictly so, were prohibited from coming to the schools, and it was only in 1852, when the Practical Art Department superseded the

H. Cole,
Esq., C.B.,
and
Captain
Donnelly,
R.E.

23 April
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R.E.

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1868.

the schools of design (Mr. Labouchere beginning the work, and Mr. Henley carrying it on), that it was thought good policy to allow the middle and upper classes, if they were willing to pay adequate fees, to participate in the benefits of the instruction. The whole question has gone rather along with the public desire, and with no other theory than that of the commencement of the plan, namely, that of aiding the industry of the country, and making public payments on behalf of the working classes. It began with that idea; it now gets broader, more or less, every day; but no payments are made directly to the teachers or to the students themselves on behalf of the middle and upper classes. Medals and prizes are given, and those classes are conceived to pay a fair value for their instruction. In the case of the School of Art at South Kensington, they contribute more than 2,000*l.* a year for what they get out of the school.

7. *Chairman.*] You reward those classes which are of a higher grade than the working class by prizes and distinctions, but you make no payment to the teachers on behalf of such pupils?—Yes, but no payment to the teachers.

8. In fact, we may say that the persons on whose behalf you make the payment are of a higher grade than those who receive assistance from the Committee of Council for Education in respect of primary instruction?—I apprehend some rather higher.

9. Will you be kind enough to tell the Committee whether you put a very strict interpretation in practice on this limitation to the industrial classes?—I should say we do not; broadly speaking, we certainly do not. If an applicant appear to be well able to pay for his own instruction, it does not signify that he is a craftsman of some kind, or that his father is a craftsman of some kind. If he tries to defraud the department, we look sharp after him, but otherwise the rule is rather leniently administered.

10. If the son of a person in the middle class were apprenticed to a craft, you would consider him to be an artizan?—I think he would be accepted without inquiry.

11. Do you consider that that is generally known throughout the country, so that there might be no unfairness with regard to one locality compared with another?—I think so. I think if a man puts his name down as a stonemason he would be accepted generally as such.

12. *Mr. Potter.*] You would accept a clerk's son as a poor student?—Yes.

13. *Chairman.*] You would also accept a manufacturer's son if he were apprenticed to his father?—Yes, if earning his own livelihood, and receiving less than 100*l.* a year; if dependent on his father, not.

14. In the first instance, when the aid was extended from art to science, two secretaries were appointed?—When the department was enlarged, two officers were appointed who were called secretaries and inspectors-general. Doctor Playfair was appointed to hold office in respect of science, and I retained the office which I had formerly held in respect of art.

15. That arrangement is not in existence now?—That arrangement was abolished after a few years' experience; it was found to be practically unnecessary and somewhat inconvenient to have two secretaries; it rather divided the responsibility. Before Doctor Playfair resigned, the

offices were consolidated into one secretary and one inspector-general.

16. Who became the inspector-general?—I was made inspector-general, and Doctor Playfair secretary.

17. At that time, of course, the labour of the department and the responsibility of the department was very much less than it is now?—Yes, infinitely less than it is now.

18. Is there still an officer who is called the inspector-general, and who performs those duties?—No, that office is abolished. The present organisation of the Department of Science and Art has a secretary and assistant-secretary, two official inspectors (as distinguished from professional inspectors), and two official examiners. In the conduct of the work, the aim generally is to keep the permanent staff of the department as low as possible, and to get all the clerical and accidental work, which accumulates very much at certain times of the year, done by provisional assistants. To illustrate that, I may say that at this time the science examinations are coming on; they are going on at 300 centres at one time; at the same hour, at probably 250 places, the examination in chemistry would be going on; of course it is quite impossible to have a body of inspectors permanently appointed to see that the official rules are obeyed for a month only. Recently the War Department have allowed officers stationed in different districts in various localities during May, in the evening, to go round to the respective committees and see that the examinations are conducted according to the rules; those are officers of Engineers.

19. *Lord Robert Montagu.*] For a stipulated payment?—£.1 a-night. Although, even that organisation will not include systematic visits to every one of the 300 centres, still a gentleman going in accidentally will see at once whether the rules are being properly followed out or not. It may be possible, perhaps, to give one visit to each of the 300 centres; but there being 23 or 24 subjects, and it being possible that one centre may have those 23 or 24 subjects, the number of visitors required to be present at every examination would be beyond any possibility.

20. *Chairman.*] The duty of those gentlemen is only to see that the rules laid down by the department are complied with?—Yes; to see that two members of the committee are present, and that the students sit far enough apart, and that the work is done fairly; that inspection is a very necessary thing.

21. I understand you to say that the office of Inspector General was not found to be one that could be usefully continued?—It was thought unnecessary; before the office was abolished two inspectors general, under a different idea, were created. Dr. Playfair became Inspector General for Science, and Mr. Redgrave became Inspector General for Art, with one secretary.

22. Dr. Playfair fulfilling the duties of secretary at the same time?—No, he had given up that, and I became secretary. There was another change; in fact, at the start, we could not go on for a year without finding out a necessity for some reorganisation; but since Dr. Playfair retired, the organisation has got settled, and it is now working well.

23. Will you kindly give us the names of the gentlemen who now fill the offices you have just mentioned?—The secretary is myself; the assistant secretary is Mr. Macleod; in the Science Division,

Division, the official inspector for science is Captain Donnelly, R.E.; occasional inspector, Mr. Iselin, M. A., and wrangler of Cambridge; Dr. Sidney, who is in Ireland; and, for navigation, Captain Harris. The official examiner (which means the officer to see that the payments are right, rather than to exert any professional knowledge), is Mr. Bartley; he happens to have taken many certificates in science, but he is a lay administrator; the professional examiners for science now are Mr. Anderson, C.E., Professor Ansted, Professor Bradley, the Rev. Mr. Cowie, Dr. Frankland; Professor Huxley, Professor Ramsay, Mr. Warrington Smyth, Dr. Thompson of Kew, Professor Tyndall, and the Rev. Dr. Woolley.

24. What are the duties of the official inspectors for science?—In the first instance, all letters whatever relating to science are referred to him; his function is to draft minutes and to see that the whole matter is going on according to the orders of the Board; his function is also to make recommendations to the Board; and, in fact, to see that the Governmental part of the work is carried on properly. He also arranges with the professional gentlemen about the examinations. His duty is to see that the papers are prepared in time; that the examinations are made in time, and to see that all the official rules are properly obeyed.

25. When you say "make recommendations," are the Committee to understand that it is part of his duty to make recommendations as to the subjects in which the candidates are to be examined?—No; that is fixed by a Board minute. Suppose a letter comes, on which it is important to have an opinion: the first point is, is it out of the usual rules? He knows that, and he is responsible for saying whether it be so; whether it demands that some new rule should be made. Then he forms an opinion as to what should be done; his business is to endorse a Minute upon that letter. In fact, you might call him a sort of assistant secretary, if you pleased.

26. In such a case as this, for instance, if there were an opinion expressed either by the public or by a professional examiner, that some change should be made in the nature or extent of the examinations, by whom would that in the first instance be considered?—I do not quite put into a concrete shape what the "public" is, but if one of the professional examiners thought that some change should be made, he would write a letter, and it would be referred to Captain Donnelly, who would probably confer personally with the examiner, and then bring the matter before the Board.

27. Is there no Board of Examiners?—Yes; what I have read to you constitutes the Board.

28. Do they act as a Board?—In any case where it is desirable.

29. Lord *Robert Montagu*.] You are speaking not of the Board of Examiners; you mean a Board at South Kensington, do you not?—I meant the Board to be the Lord President and the Vice President. As to any scientific opinion, it would be referred either to the professional examiner, or if it went beyond his specialty, then it would be brought before the Lord President, and he might request two, three, or more gentlemen to report specifically.

30. *Chairman*.] But the matter would be referred in the first instance to the official Inspector for Science?—It is passed to Captain Donnelly;

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then it is brought to the Lord President, and then, if he thinks fit, it is referred to any professional inspector.

31. Practically, the opinion of the professional Inspector of Science would be taken in the first instance?—Yes.

32. Captain Donnelly's is an office of very great importance, then?—Yes; demanding great discretion and common sense.

33. Captain Donnelly is an officer of the Engineers, is he not?—He is; I would impress on the Committee the distinction between lay or unprofessional administration and professional knowledge; which is held to be very important in the department. A man may be an excellent chemist or mechanic, and a very bad man of business; it is necessary to draw the line sharply between what is really professional knowledge and what may be called "red tape," if you please.

34. In fact, we may say that there is no professional authority that would be immediately consulted on such subjects as I have named?—Certainly, there would be; the highest professional authority would be consulted whenever it was wanted, of which the Lord President would judge. If anything happened, for instance, about the geological survey, the Lord President would request Sir Roderick Murchison to come to the Board; if the Lord President thinks it desirable to have a professional opinion, it is referred by writing, or an examiner is asked to attend. On any question in navigation, Dr. Woolley, for instance, is asked to attend the Board.

35. But there is no permanent professional council, the tendency of which I apprehend would be to give unity to it all?—Certainly there is the most perfect council, and the most perfect unity. I cannot conceive any organization more comprehensive, or more complete, or more instantaneous in action, bearing in mind the distinction which I have pointed out; the Lord President in all cases referring to professional advisers on professional questions.

36. But I understand you to say that he would refer to them in detail, do I not?—There have been occasions where Lord Granville has thought it right to invite several, and to preside over them; and other occasions have arisen where professional gentlemen have been asked to form a committee or commission; at this moment we have got a strictly professional commission inquiring whether the lighting at Kensington is damaging to the pictures. If a question ever arises which involves professional knowledge, the Lord President refers that subject to one, two, three, or four professional gentlemen of eminence to report upon.

37. But a permanent professional council forms no part of your organization?—Yes; this body of examiners, a professional council which is called into action whenever it is wanted. If you ask if they meet every week, they do not, there is no occasion for it.

38. I understood you to say, that the Lord President, or the Vice President, called in such a professional man as he thought most likely to advise him; but not that there was any professional council comprising members definitely appointed beforehand who would, as a matter of course, consider professional questions?—There are no professional questions to consider until they arise.

39. Mr. *Bruce*.] But have you a permanent body to whom you refer all such questions, or do you

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you prefer to submit the questions as they arise to selected persons out of the list of your examiners?—In one sense the body of professional examiners are permanent, and go on from year to year, but when questions arise, the Lord President refers the particular question to one or more examiners. If any question of general policy about a change in the examination, for instance, arose, he would refer it to either one or all of those examiners, as he thought fit. It does happen generally that at the end of the annual examination there is a kind of general conference among them if any suggestion is to be made: that goes on as a matter of course. I wish to show that the organization in the department provides for all the work that is going on in an effective way; as to a permanent body of professional gentlemen sitting every week, what would they have to do? But they have definite work to do when it arises.

40. *Chairman.*] The question was not so much whether it was desirable as whether it existed?—I have only gone into detail to make it clear.

41. Will you kindly tell us what was done for science instruction up to the year 1859, which I think was the year in which Dr. Playfair resigned?—Almost all the measures taken at the beginning were experimental, and something like an analogous system to that for art was attempted in two or three places, that is to say, either paying an absolute salary to teachers, or guaranteeing them an income; that was tried, I think, in Birmingham, Aberdeen, Bristol, Leeds, and Stoke-on-Trent, besides being tried in several navigation schools. Before 1859 almost every school had more or less a variety of its own, and we could hardly be said to have formed the system until 1859. I think I have mentioned all the places where there were any science schools at that time. Examinations were held, and prizes awarded.

42. This payment of salaries was not continued after 1859, was it?—No; about 1860 the actual abolition of direct payments to teachers as guarantees or salaries ceased; Mr. Lowe was Vice President at the time.

43. But in 1859 the new system was organized which included payments to teachers, a capitation grant, and payment by results?—Yes, at first.

44. The capitation grant was subsequently abandoned?—Yes. I recollect an expression of the late Marquis of Salisbury: he said, "You seem to have very little science, and unless we can get a scheme to make science common wherever the public want it, I shall abolish the name." The result of that was that, in obedience to his orders, we set about trying to invent a system which should be common to the whole country; and although it is a little modified every year, when the necessity for modification arises, the system in the main is very much what was established in 1859.

45. Who were the principal persons consulted with regard to that system in 1859?—Everybody that we thought could give us any advice, Sir J. Kay Shuttleworth, Canon Moseley, &c. We never do anything without trying to find out beforehand how it will act. First, there was a declaration of the Board of Trade upon the general principles of the department. The exact subjects to be taught at that time were matters of considerable interest to Mr. Adderley. The subjects were limited at the time. Mathematics were not included in 1859; that subject was added

afterwards. I do not think that any commission was appointed at that time to devise a plan, as done lately, for a science college. Within the last three years a commission has been appointed to devise a plan for a science college in Dublin, but nothing of that kind took place in 1859.

46. A new Minute was passed in 1859, was it not?—Yes.

47. Under the presidency of Lord Salisbury?—Yes.

48. Can you give the Committee briefly the heads of that Minute?—The heads are these: First, to have an annual examination to which anybody might come to be certificated as a teacher; he would get a certificate when he passed the examination. Then it was provided that there should be an annual local examination throughout the country, and that prizes should be given in connection with it; that they should be open to all classes; and that payment should be made to the master for holding a certificate, and also payment in respect of the students who passed the examination, those payments being graduated according to the grade of the examination in which the students passed. I think those were the broad features of the arrangement.

49. Can you state what changes have been made in the system since that time?—The subjects of examination have been much enlarged. Captain Donnelly will speak precisely as to what new subjects have been introduced. A better definition has been given to the term "artisan," the payments to teachers have been modified, and they have on the whole been made more liberal lately; the proportionate payments to the certificate have been abolished, as a maximum the prizes have been increased in value, and they have also been greatly increased in number; scholarships have also been introduced.

50. In individual value, have the prizes been increased?—I think in 1859 there were not as many gold or silver medals as there are now; the little prizes of books and so on are much the same, I think.

51. As to the payments on teachers' certificates, I think you said that that payment was abolished in 1860?—I think so.

52. Can you state the reason why that payment was abolished?—It was part of the general policy of the Government at the time. The payments in respect of teachers' certificates for primary instruction were abolished, and so were those on account of science. When the Revised Code came into operation, although it did not directly relate to the Science and Art Department, it was considered good public policy to make its action as uniform as possible.

53. Do you think that the subjects of scientific teaching and elementary teaching are precisely on all fours as to the remuneration to the master?—I think it is very desirable to insure that the work is done for any payment that may be made. I think the payment of salaries in a very broad local action is so much waste of public money. I think it is a very difficult problem to know how to administer public funds in distant parts of the country, and get the work done.

54. But in point of fact is the abolition of the payment on teachers' certificates generally satisfactory to the teachers?—I should say, whatever may be the case with lazy fellows, to industrious men it is not unacceptable.

55. You have not lost good men in consequence of it, and their energies have not flagged?—No; I should

I should say the best men have got a great deal more money. At the Bristol School, where they have an admirable teacher, I am under the impression that the teacher gets double the income he used to get when he had a salary of 80*l.* a year.

56. But he was paid on results also, was he not?—His payment did not amount to what he receives now. Captain Donnelly will give you the precise figures. I do not call to mind the case of any very good teacher being pecuniarily damaged; in fact, the system of payments on results for hard working teachers seemed to promise rather alarming consequences to the Exchequer at one time, and it became necessary to make rules that they should not earn too much.

57. It was the hard working men, not the lazy men, who were earning too much?—I recollect that the question was mooted in the House of Commons five or six years ago. It seemed a little absurd that a man teaching in an elementary science school should be getting 300 *l.* a year from that, besides other things. If every place was to get that amount, the department did not see its way to having reasonable estimates to lay before Parliament.

58. Did not that rather affect the scale than the mode of remuneration?—Of course; but on the other hand what may happen is this,—the highest payment a master gets is 5 *l.* for a very successful student. It is very desirable throughout the country, particularly in small places, that there should be one or two such very successful students bringing in 5 *l.* each to the master, but in very large and populous places the number of those 5 *l.*, as well as the number of other payments, would amount to a very large sum. I do not mean that it would be an unfair sum when it is fairly earned, but you have to consider the question of the estimates.

59. Mr. Gregory.] I think there are 57 payments of 5 *l.* in the Bristol school now?—The Bristol school earns much and is the type of the school that any place with 20,000 people in it might have if the locality pleased.

60. Chairman.] But they had a building to begin with?—They had a building to begin with, otherwise that school has no special peculiarity. They have an excellent teacher; they are rent free, and two or three subjects are well worked out. The fees, too, are within the reach of the persons who want the instruction. If those principles were fairly carried out in any town throughout the country, with 20,000 inhabitants, you would have the State paying 500 *l.* or 600 *l.* a year for results in those places.

61. The payment on results is, I believe, alike for all subjects?—I think so; I think it is divided into grades.

62. Each subject is divided into grades?—Yes; I think there are five grades.

63. The direction of my question was this; you would pay the same sum for a pupil who passed in the first grade, for instance, in such a subject as animal physiology or botany, as if he passed in mechanics, or mining, or metallurgy?—Yes.

64. Have you quite considered the propriety of that?—We have considered the propriety of it. It would be extremely difficult to say that physiology was not worth as much as mechanics, and perhaps it is worth more. But of course each professor can state much better than I can what he considers the relative value of what he teaches.

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65. Would not the labour of passing a pupil in one subject be very much greater than that of passing one in another?—(Captain Donnelly.) That depends on the standard of the papers.

66. But standard for standard, how would it be?—I think the professors try to make them all fairly alike. I do not think that one subject is easier to pass students in than another.

67. You think that to pass a student in the third grade in organic chemistry would not be much easier than to pass one in the third grade of pure mathematics?—No, certainly not. It so happens that Professor Hoffman has made that particular subject very difficult. That particular subject happened last year to be much more difficult than any other subject. It would have been more difficult at that examination to get 3 *l.* for a pupil in chemistry than perhaps in any other subject.

68. I speak of inorganic chemistry?—Yes.

69. Comparing inorganic and organic chemistry, would you say that the difficulty was equal?—The per-centage of failures in inorganic chemistry, last year, was 35.76. The per-centage of failures in animal physiology was 22.53; that is enormously less. The per-centage of failures in elementary mathematics was 27; there was, therefore, a difference of nearly 10 per cent. in favour of elementary mathematics; in the higher mathematics it was larger—38 per cent.

70. Was there not another change made lately, namely, the abolition of examinations for teachers' certificates?—(Mr. Cole.) Yes; a special examination. It was thought that the first and second grade examinations sufficiently covered the ground, and that it was only an unnecessary expenditure of time and money to have a second examination; for the teachers there seemed to be no particular advantage in it, as all the payments were on results.

71. But was not it reported that there was a deficiency of teachers?—I should say that that change was rather a mode of increasing the number of teachers.

72. At the same time, is it not the case that the number of persons holding teachers' certificates was very largely in excess of the number of teachers?—Yes.

73. Can you tell us in what proportion?—(Captain Donnelly.) I do not know that, but there is a great deficiency of teachers. We find that many obtain good appointments, and are taken off. The great difficulty experienced in the country is in finding people to teach. We have constant applications for teachers, but we cannot get them.

74. Mr. Bruce.] That is to say, men have obtained certificates, but do not apply themselves to the teaching?—They teach for a year or two, and then they get good appointments and go off. (Mr. Cole.) I think the demand for anybody who appears above the horizon with any scientific knowledge applicable to industry is so great, that few of those people, comparatively speaking, turn into teachers. (Captain Donnelly.) Comparing the returns from one year to another, we find there are constantly cases in which the schools are closed; nine out of ten, or more perhaps, of those cases are because the teacher is taken off, having got a good appointment of some kind or other.

75. Chairman.] In fact the register of the persons holding teachers' certificates is no indication of the number of persons actually willing to teach?—

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teach?—(Mr. Cole.) No. (Captain Donnelly.) A great many persons who have obtained teachers' certificates are found to be very bad teachers. Many never had any intention of teaching.

76. Mr. Dixon.] In the case which you have just referred to, where a certificated teacher leaves the schools and takes some position, perhaps in a manufactory, do you think it is simply a question of salary, and that a higher salary would induce him to remain as a teacher?—A great deal of the question is salary, no doubt; but if a man obtains a better position, he is apt to look upon teaching as great drudgery, which indeed it is, after a few years. (Mr. Cole.) It is mostly teaching in the evening.

77. Mr. Bruce.] And other appointments outside the school hold out to an able man greater prospects of rising in the world?—(Captain Donnelly.) Yes; for instance if a man gets into a chemical works, he sees his way to becoming a partner in the end perhaps, whereas all he could make as a teacher would be 200*l.* or 300*l.* a-year.

78. Chairman.] But the majority of the classes are evening classes, are they not?—(Mr. Cole.) The majority.

79. If a reasonable supplementary income could be derived from scientific teaching, you would suppose that persons would be found holding certificates, who, in addition to their daily avocations, would be willing to teach those classes, would you not?—(Captain Donnelly.) A good teacher can now easily make 150*l.* a-year by teaching in the evening, and there are many men who do it, and they do not occupy their whole time in teaching.

80. But in order to make that income, a man would have to teach in several localities, would he not; for instance, a man in Lancashire would have to go to Wigan and Preston and three or four towns in order to accommodate a sufficient number of persons to pay him that income in evening classes?—Yes, where the classes are small; but in other towns, for instance, at Oldham, or other places where they have organised science classes on a large scale, I have no doubt a man might make 130*l.* or 140*l.* from the Science and Art Department by evening tuition.

81. Mr. Bazley.] Not being employed in the daytime at all?—Not being employed in the daytime at all.

82. Chairman.] The Minute abolishing examinations for teachers' certificates, and enabling those pupils who pass in the first and second class to become teachers, is a recent Minute, is it not?—(Mr. Cole.) It is a Minute of about two years' standing.

83. Can you state to the Committee that you have as yet any experience of the working of that Minute?—(Captain Donnelly.) We have several cases of people teaching under that Minute, and probably the examination which is now coming on will give us a larger result to judge from.

84. It would be quite possible, after this examination, you think, to distinguish the teachers who hold certificates, and those who merely passed the first examination?—Yes, I think it would be possible.

85. So that a comparison could be made with regard to the success of the two classes of teachers?—Yes; the payments made to them would determine that.

86. But the directory would not show, in its present form, which teachers held teachers' cer-

tificates, and which teachers had simply passed the examination in the first or second grade, would it?—No.

87. Lord Robert Montagu.] The report would show also the payments which those teachers had received?—The payments they had received are given in the next annual report. One great advantage of having done away with the November examination for certificates has been to remove the difficulty persons wishing to be certificated meet with. We could not expect committees to hold two examinations in the year, therefore we had to have a special examination for teachers by officers of the department in London, Dublin, Manchester, and Edinburgh; and many teachers found considerable difficulty in going to those places to be examined. (Mr. Cole.) They went to those places at their own cost, and if they passed their examination they were paid, but if they failed to pass the examination, they had to pay their own travelling expenses. The present system, however, opens up 300 centres; it takes the examination to them instead of their coming to the examination.

88. Chairman.] But that examination is conducted wholly by papers, is it not?—The greater part of our examination was paper work; there was only a little *vivá voce* examination. (Captain Donnelly.) The *vivá voce* examination was only in very early days, when teachers were examined only in London. As soon as examinations were held in Dublin, Edinburgh, and Manchester, this was necessarily dropped. The examiners found that the *vivá voce* examination was not of much use.

89. They do not in fact approve of an extended *vivá voce* examination?—They found it did not answer much purpose; if you had a great number of candidates, it would be almost impossible to carry out a *vivá voce* examination unless you could keep them three or four days in London. (Mr. Cole.) The system of payment on results in respect of science has led some to think that the certificate might be abolished altogether; I do not quite hold that opinion, but it is a fair subject for discussion.

90. Mr. Gregory.] Can you say what was the date at which the new system practically came into force?—(Captain Donnelly.) Last year.

Mr. Bruce.] It was in February 1867.

91. Chairman.] In point of fact, no examination has yet been held of pupils taught by this new class of teachers?—(Captain Donnelly.) Yes; last May there were several classes examined who had been taught by people who had passed in the previous May, and who did not get payment on results; this will be the first examination at which any of them will receive payment on results.

92. An examination was held in May 1867?—Yes; there were several teachers who made application that the Minute should be retrospective, and who applied for payment.

93. But no payment was made?—No; the Minute was not made retrospective.

94. Were those applications numerous?—I think there were five or six.

95. Those would be made, I suppose, by the men who had the greatest confidence in their ability to teach?—Men who had taught before, and had not got certificates.

96. Mr. Graves.] Do you keep any record of the alleged causes which have led to the resignation

tion of teachers since 1859?—(Captain *Donnelly*.) No; there is no such record kept; we hear every autumn that a particular class has re-commenced; they send up their form; they tell us that the class is re-opened, but if the teacher goes away we hear no more of the class; I could perhaps get the information in certain cases, but as a general rule we do not know what becomes of the teachers.

97. I understood you to say that many of our teachers were lost in consequence of their obtaining more remunerative appointments; and I inferred from that that you kept a record of the teachers who departed?—No; no official record.

98. May not those resignations be considered to take place in consequence of inadequate remuneration as well as from the teachers getting other employment?—(Mr. *Cole*.) I think there are a great many of them who do not succeed as teachers at all; they are incompetent, and do not succeed in forming a class. (Captain *Donnelly*.) A teacher in science has to do other things beside teach; he has not only to instruct his class when it is formed, but he has got to stir up the town and induce people to come; and there are many teachers who have not sufficient energy for that.

99. I understood you to say that after obtaining a certificate and having taught for a year, many of the teachers had abandoned the work?—I have in my mind at this time two of those teachers who have succeeded, and then we have heard that their classes have suddenly ceased, and we generally find, on inquiry, that the teacher has got something better. There were two successful men at Burnley who did very well; both of them got good situations.

100. Then the teachers apparently do not give any reason when they abandon the teaching; or, at least, your department does not hear of it?—They do not officially assign any reason.

101. Lord *Robert Montagu*.] Have we, as a department, got anything to say to the engagement of teachers, or is that left entirely to the committee of the locality?—It is left entirely to the committee of the locality.

102. *Chairman*.] But I believe you have two or three inspectors who visit the different schools, have you not?—Yes.

103. And also an official whom you call an organizer of science schools?—There is a gentleman who was a science teacher, and who now goes round the country wherever his services are applied for, to assist in organizing the classes, and I get a good deal of the information as to why classes cease, which I am giving the Committee, from him.

104. The general result is, that your best teachers leave you because they get better remuneration elsewhere?—Whenever the good teachers do leave us, I find it is generally on that account, but I do not say that all the good teachers do leave us, because some of them have continued teaching with us from the very commencement; there is one at Bristol, and there is Mr. Angell, of the Mechanics' Institution, at Manchester.

105. With the exception of the one at Bristol, and one or two day schools, I suppose the number of teachers earning a fair income, say 150 *l.* a year and upwards, is not very great?—No, but the late Minute will give them rather a larger payment. I see down in this list here, Mr. Angell, 75 *l.*; Mr. Brady, 103 *l.*, and then passing over minor items, Mr. Collins, of Manchester, 0.72.

126 *l.*; and so on; all that information is contained in the Annual Report of the Department. The recent Minute, in fact, will increase those payments considerably.

106. In the second grade?—There was a reduction made where pupils passed in a second subject, and that has been abolished.

107. Mr. *Dixon*.] In those cases where the teacher resigns, is that resignation generally followed by the giving up of the class?—Perhaps the class cannot lay its hands upon another teacher at the moment; it is sometimes abandoned for six months, and then resumed.

108. Do you think the number of the classes is great that have been discontinued from that cause?—It cannot be very great, because the numbers have continually increased from the time when the system began in 1859; at that time it was next to nothing, but at the present moment, from the returns just come in, I see there are 14,600 pupils under instruction. To make that a fair estimate, you must take off 1,000 or 1,500 from the pupils in the Navigation Schools, who are not really learning science, but when that deduction is made, there still remain 13,000 pupils at the present moment under instruction in the country, and that is really a large number when the system only began in 1859. (Mr. *Cole*.) In 1860 the number of science classes that had created themselves under Lord Salisbury's minutes, were nine, and there were 500 students, while at the present time there are about 13,000 students under instruction, and 300 schools, and it is important to say that this is entirely spontaneous action on the part of the country; the department does not act as a missionary in any way; it does nothing but what it is asked to do.

109. Mr. *Dixon*.] Does it not frequently happen that these classes are of a very ephemeral character, and that the accident of getting hold of a good and energetic teacher causes a large class to spring into existence, while, if he is afterwards called away, the class ceases to exist?—It does happen.

110. *Chairman*.] You are doubtless aware that our inquiry has reference more especially to industrial teaching; that is to say, to scientific teaching which is applicable to industrial pursuits?—Yes.

111. Can you state what proportion of the 13,000 persons you have spoken of, is being instructed in subjects which may be said to bear directly, or indirectly, on industrial occupations?—(Captain *Donnelly*.) I will hand in an explanatory memorandum, which was issued with the recent Minute, and which gives the system of the department as shortly as possible, and I have had the statistics up to the present moment added in the margin, so as to give the number of persons under instruction at the present moment. (Mr. *Cole*.) I should say that when the Board accepted those subjects of teaching, they were all thought, in a greater or lesser degree, to have a bearing on industrial occupations. (Captain *Donnelly*.) Of course the people of any particular place determine what branch of instruction is most useful to themselves, but, on the side of the department, one subject is not given any advantage over another subject.

112. Still the inquiry of this Committee relates to teaching on those subjects which bear directly on industrial occupations?—Perhaps it might be said that animal physiology did not bear directly

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on industrial occupations, or that zoology did not, yet there are applications of zoology to industrial occupations; vegetable physiology and economic botany have such applications; perhaps systematic botany has not, though it is difficult to draw any line at which it can be said absolutely that a science does not bear upon industry. (Mr. Cole.) The business of a gardener may be considered as an industrial occupation, and, undoubtedly, a gardener's knowledge of botany would improve him as a gardener. (Captain Donnelly.) The gardens at Kew are maintained at a large expense on the part of the State, and with a certain amount of industrial purpose. (Mr. Cole.) The museum at Kew is purely industrial. (Captain Donnelly.) It is impossible to say that any science is not capable of industrial application; perhaps animal physiology would rank lowest in the scale of direct applicability.

113. *Chairman.*] Then with regard to the scientific classes, do you not find that those classes have a greater hold upon some districts than they have upon others?—Yes.

114. And that to a very remarkable extent?—Yes; in some districts the people have taken the subject up, and put a good deal of energy into the matter, and worked up the classes thoroughly; in others, they have been either opposed to the thing; or else they have been indifferent. It is entirely a matter for each locality itself, and a question of energy or want of energy in the locality.

115. Take the large industrial centres, and, beginning with Staffordshire, can you tell us whether the system has spread much in Staffordshire?—(Mr. Cole.) Years ago there was a chemistry class started at Stoke, but the teacher went to the bad, and the school never revived; it is now proposed, I believe, to re-establish the school. But if the localities themselves, having this machinery at hand and these public payments for their reception, are not sufficiently alive to the subject, I hardly know by what process you can make the people alive to it. (Captain Donnelly.) There is the Lancashire and Cheshire Union of Mechanics' Institutes; the previous and present secretary have worked the system, and the present secretary stated that he believed by next year he would have a science class in connection with every one of the mechanics' institutes in his union. The Yorkshire Union have, on the other hand, scarcely done anything up to the present time in the matter.

116. Mr. Bruce.] Can you give the number of science classes in connexion with the Lancashire Union, and the number in connexion with the Yorkshire Union?—About 60 in the Lancashire and Cheshire Union, and 12 in the Yorkshire Union.

117. *Chairman.*] Can you, in fact, at a subsequent time, state in what counties this system of instruction in connexion with the Science and Art Department has made much or little progress.—(Mr. Cole.) It would be quite possible to make a return showing how far the system has been adopted in each county throughout England; in fact, I have a rough proof here of the examinations that are now going on. All the manufacturing towns that have adopted the system are contained in the list which I now produce, and that list can be classified in any way that the Committee desire; indeed it might be classified according to the industries, taking, for instance, the centres

of the cotton trade.—(Captain Donnelly.) I can state some particulars with regard to the Lancashire and Cheshire districts. The number of schools is now about 60, and Mr. Lawton, the visiting agent and chief mover of this union, told me that he hoped and thought that he saw his way to establishing science classes in all the institutions in connexion with the union by the Session of 1869-70; that would be little short of 150 schools. The number in Yorkshire is very small.

118. In Staffordshire also I believe the number is very small, is it not?—(Mr. Cole.) I think there are not many.

119. There is a very small school at Wolverhampton, I believe?—Yes.

120. And is not that the only school in what is called the Black Country?—At Wolverhampton there are four classes; at Walsall there is a class at the Grammar School.

121. With how many pupils?—There are 24 pupils under instruction.

122. In more subjects than one?—In inorganic chemistry.

123. Have you any schools at all in the county of Durham?—Apparently but one.

124. Is there not a school at Darlington?—Darlington has 10 pupils under instruction.

125. The subject is what?—The subjects are applied mechanics, magnetism and electricity, inorganic chemistry, and metallurgy.

126. That is the only school in Durham county, is it not?—Yes.

127. There is none in the city of Durham, Gateshead, Sunderland, or Stockton-on-Tees, is there?—At Gateshead there are 39 pupils under instruction in geometrical drawing, mechanical drawing, building, construction, and theoretical mechanics.

128. Is that a recently established school?—I am unable to say. The list of each year shows the schools then existing which desire to be examined, and we could, by going over the history of the place, find out whether it has lasted more than one year.

129. Can you give the Committee any information with regard to Northumberland?—Yes; I find there is a school at Alnwick where they learn elementary mathematics.

130. I think there is none at Newcastle-upon-Tyne, is there?—There is none at Newcastle-upon-Tyne.

131. Is there anything at Tynemouth?—None.

132. Is there anything at Morpeth?—None.

133. In Derbyshire is there any?—There is one; the Grammar School at Derby where they teach inorganic chemistry.

134. Your assistant inspectors report to you on science instruction, do they not, in the country generally after they have made their annual tours?—Yes.

135. And I believe the character of those reports has been, that instruction is proceeding rapidly in the country in general?—(Captain Donnelly.) I think that has been their general purport.

136. Have those reports called your attention to the entire absence of science schools in the great industrial localities?—The inspectors only go and visit the schools that exist, in order to see that they are going on properly.

137. They make no inspection of the country in order to ascertain what is doing?—No.

138. There is a navigation school at Plymouth,
is

is there not?—Yes; at Plymouth the navigation school is simply a cramming school for the Board of Trade examinations. The masters and mates who go there do not come up to our examination.

139. But that school is included in your directory, is it not?—Yes; the school makes a return of the number under instruction, and we cannot cut them out; but it is always pointed out when such schools are not examined by the department.

140. But the Hull navigation school is examined by you, is it not?—Yes; and they are very successful there.

141. The Plymouth school is of a different character from the Hull school, is it not?—Entirely. The Hull school takes boys and brings them up, and teaches them, and then sends them to sea; whereas the Plymouth school takes in scarcely anything but masters and mates, and seamen who have just gone in there for a few days to brush themselves up for going before the Board of Trade, and getting passed in an examination which does not go much beyond a rule of thumb knowledge. In order to meet the position of the navigation schools in this special subject, examinations are held four times a year, so that pupils who may belong to ships only in port a short time, may have every opportunity of coming up to the departmental examination; but those examinations are not largely attended.

142. It is in reference to schools of that character that you said that the deduction of a 1,000, which you previously referred to, ought to be made?—989 is, I find, the precise number of students in the navigation schools who are not examined in May. Then the returns are perhaps rather improperly swelled by the returns which are made from two large institutions in Glasgow, the Andersonian University, and another place which return a large number of students under instruction. The greater proportion of those merely attend lectures in those institutions, and but few of them come up to the department examination.

143. Can you tell us whether there are many day-schools in existence in the country which may be properly called science schools, in connection with your department?—I have a return here of day classes at Andover, Birmingham, Bromsgrove, Cheltenham, Durham, Derby, Hull, Yarmouth, and other places, some of them being in London, and with the permission of the Committee I will hand in that return. (See Appendix.)

144. *Chairman.*] Can you point out any school or schools which you would consider model schools, in connection with your department?—(Mr. Cole.) Emphatically Bristol; Bristol is an excellent example of a secondary school, which, I should say, proved the good working of the present system. (Captain Donnelly.) Manchester is another example; there is a school there in connection with the Mechanics' Institution, taught by Mr. Angell, and there is a similar school at Glasgow.

145. Who is the teacher there?—Mr. Mayer. (Mr. Cole.) In a day school, science instruction is a continuous thing going on every day, but in a night school it is more or less interrupted. That it is possible to establish day schools by the present system is proved to us by those cases which are very successful.

146. Those are instances of schools for the artizan class, or for a class nearly coinciding with the artizan class?—At Bristol, I think the fee

varies from 3 l. to 4 l. 10 s. or 5 l. per annum, and it is paid by the session, or quarterly.

147. *Lord Frederic Cavendish.*] What sort of age are the students?—They go to the Bristol school at an early age for general instruction, and I think they remain there until 14 or 15 years of age.

148. *Mr. Gregory.*] The annual fee is 3 l., is it not?—Yes, and I think the master gets a little more for some subjects in certain cases.

149. Do they get anything for the evening lectures?—Yes; you can enter separately for them only.

150. *Mr. Loether.*] Why do you consider the Bristol school a model school?—It costs so much public money; that is one reason. I attribute the success of the Bristol school to two causes; one is that it is not overcharged with rent for the building and local expenses; and, above all, there is an excellent teacher with an excellent staff; thirdly, I should say that it assesses an amount of fees sufficient to make a revenue for the school, which it finds a sufficient number of people in Bristol to pay.

151. Are those who attend that school properly artizans?—They are either very small tradesmen or artizans, or the children of artizans.

152. *Sir Charles Lanyon.*] Are you aware that there was a great falling-off in that school between 1865 and 1866?—I was under the impression that it was flourishing at that time.

153. *Mr. Gregory.*] There is an increase in the results of the science teaching from 264 l. to 285 l.?—There are always fluctuations. (Captain Donnelly.) At the present moment they return 145 under instruction.

154. *Sir Charles Lanyon.*] And that is 30 less than were under instruction in 1865, I believe?—(Mr. Cole.) Their annual receipts from the department are not diminishing.

155. *Chairman.*] Is there not this peculiarity about the Bristol day school, that the building is provided free of expense?—That is one peculiarity; another is that they are not afraid of charging a reasonable fee; and the third and best reason is that they have an excellent master.

156. Taking the first reason for the moment, I believe that in respect of art schools a grant is made towards the cost of erecting the buildings?—Yes.

157. And also towards the cost of fitting up the schools?—Yes.

158. But I believe that is not the case with regard to science schools?—With regard to science schools, no building grant has yet been made, but with regard to apparatus, an apparatus grant of 50 per cent. is made; it will be obvious that an art school requires special accommodation to be distinctly applied to its peculiar objects, while a class for mathematics requires no special premises or arrangements; in fact, one virtue of our system is that any one may teach in a garret or a cellar, or wherever he likes.

159. Experimental chemistry, for instance; do you think that could be taught in a garret or cellar?—Possibly it might.

160. *Mr. Bruce.*] How would that apply to mechanical drawing?—Mechanical drawing as good drawing is taught in art schools.

161. Is it not taught in science schools also?—I do not think they ever require illustrations as fine as they do in art schools; science, generally speaking, can be taught anywhere. I am not prepared

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prepared to say that a building grant for science, where science was taught as a serious daily business, might not be a proper thing.

162. *Chairman.*] We will assume, then, that science is taught as a serious thing when a Government grant is made: what should you say then?—You could hardly say that the 300 classes throughout the country are all of the character which would justify the expenditure of public money on them in building grants.

163. Then it would be very desirable, would it not, to have some means of distinguishing between the serious and illusory teaching of science, if classes of both kinds receive Government money?—Without saying that any science teaching is illusory, I should say that whenever substantial premises are maintained and permanently devoted to the teaching of science, it might be a proper subject of consideration whether a grant should not be made.

164. *Mr. Potter.*] The highest amount of grant made for an art school has been 500 l., has it not?—Yes.

165. Was that contrary to the recommendation of the Committee that sat in 1854?—I think so.

166. *Chairman.*] But grants are being made to art schools, and have been made to art schools for building purposes?—Yes; I am sorry to say that they are not very eagerly accepted.

167. *Mr. Dixon.*] Is there any such condition attached to the making of a grant as to prevent its being asked for?—For several years past only the sum of 1,000 l. a year has been taken in the Votes for the purpose of assisting art schools with buildings, and I think in some cases the conditions attached prevent a locality from accepting the grant; but I am of opinion that it is rather the apathy of the localities than the conditions of the grant which prevent their being sought for.

168. *Chairman.*] At all events, science schools have this disadvantage, as compared with art schools, that they cannot obtain the building grant; whereas art schools can obtain the building grant?—Yes.

169. *Mr. Bruce.*] Is it a condition attached to your grant to art schools, that the building shall be fitted for the purpose?—Yes.

170. And no such necessity with respect to the building is attached to scientific teaching?—No.

171. *Chairman.*] The second reason which you gave us a few minutes ago was, that there was some hesitation with regard to charging an adequate fee for instruction?—Yes.

172. Then you gave us a third reason; you said that the teacher of the Bristol school possessed peculiar qualifications?—Yes; and I might add a fourth, which is, that the instruction goes on daily.

173. I believe it is the fact that Mr. Coomber was trained at the School of Mines, in Jermyn-street; is it not?—He came up for a short polishing; but my impression is that he had been trained in a training school, and had a love for science, and was found to be a likely sort of man, and then had a year's teaching or so at Jermyn-street, which, no doubt, was very beneficial.

174. With regard to the Navigation School at Hull, that you would also call a successful example of the science school?—Yes.

174* *Mr. Scaping* was also instructed in Jermyn-street, was he not?—(*Captain Donnelly.*) I think not; I believe he was taught in the Greenwich Navigation School.

175. Was he not also taught in Jermyn-street?—I do not think so. (*Mr. Cole.*) I fully agree with the inference to be deduced from the Chairman's question, namely, that a science teacher ought to be properly trained.

176. Can you point out any successful day science school which is conducted by a master of whom you do not know that he has received a competent training?—(*Captain Donnelly.*) Yes; *Mr. Mayer*, at Glasgow, is not a trained science teacher; and certainly *Mr. Angell*, at Manchester, is not a trained science teacher; those are two cases. I do not remember any other at this moment.

177. But the two most successful schools are that at Bristol, and the Navigation School at Hull; and those two are conducted by trained masters, are they not?—As far as my recollection goes, *Mr. Scaping* was taught in the Greenwich Navigation School, and I do not think he had any special science training, though he may have had.

178. Is there any institution, at present, for training science masters?—(*Mr. Cole.*) None.

179. Is there any institution that you could point out that you think might be made available for that purpose, if it should be thought desirable to train such masters for science schools, as you have indicated by the distinction which you made between serious science schools and mere science classes?—I think most of the existing training colleges throughout the country might, with a very moderate assistance, be made thoroughly fit for training teachers of science in secondary schools.

180. *Lord Robert Montagu.*] Does not St. Mark's College at Chelsea obtain grants for science teaching?—(*Captain Donnelly.*) Yes.

181. *Chairman.*] Under what minute is that?—Under the general minute, paying for results.

182. You would consider them poor students?—Those that come within the rules would be paid so.

183. *Lord Robert Montagu.*] Was not a letter written to the principals of the training colleges the other day on that subject?—(*Mr. Cole.*) Yes.

184. Will you put that letter in?—Yes, I put it in.

“Sir,

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“I AM directed by the Lords of the Committee of Council on Education to forward to you the accompanying copy of a science directory, the recent Minute creating scholarships, and an explanatory memorandum, and I am at the same time to point out to you that the students in a training college are on the same footing with regard to the aid given to science instruction as any other students.

“Their teacher or teachers can earn payments on results on exactly the same conditions as for the instruction of students not in a training college.

“In order to carry out the rules of the Science and Art Department, and to give the teachers the necessary vouchers, a committee must be formed. This committee amongst other duties superintends the examination of the students in papers furnished from the Science and Art Department. The question has arisen in one or two cases whether the principal or instructors of the training college could be on this committee. My Lords have in all cases decided that this could not be allowed. The reason for this decision will be evident, and it need scarcely be said that no imputation is thereby cast on the fairness and impartiality of the

the officers of the training college. All the examinations are conducted by local agency, and both as regards medals and Royal Exhibitions schools are competing with one another. In order to give perfect confidence, and to avoid the slightest ground for unpleasant comments, it is necessary to adhere strictly to the rule which has been laid down, that no person should serve on the committee who is in any way connected with the students, or can be considered interested, even remotely, in their success.

“ However well qualified the principals of training colleges might be personally, and however natural it might appear that they should superintend the examination—especially when the students had been taught by some one entirely unconnected with the training college—to make an exception in their favour would place them in a very invidious position with regard to other schools where the rules are strictly enforced.

“ I am, &c.

“ *Norman MacLeod,*
“ Assistant Secretary.”

My answer is not to be taken as suggesting that sufficient is done for training science teachers in training colleges; the training colleges are gradually adopting the present system.

185. *Chairman.*] But you would perhaps consider that for a day school for elementary science teaching, a teacher of a higher grade would be required than those who might be considered simply competent for conducting science classes?—Not higher, but more systematized teaching.

186. *Mr. Potter.*] Have you not stated that there are no schools for training masters for science?—Yes.

187. You have schools for training art masters, and have had for years, have you not?—Yes; we have one central training school at South Kensington, and all the schools of art throughout the country partially train teachers.

188. Could you give any opinion with regard to the number of art masters who have been trained in the central school, who have remained in the profession?—I think I could give you a return of that, pretty accurately; I could give you a very accurate account of those who have been trained, and are still practising as teachers.

189. Will you put that in?—Yes.

190. *Chairman.*] On the whole, you think that sufficient encouragement is not being given to the training of science teachers?—Certainly.

191. In answer to a previous question, you said that although payment on results is not granted to teachers in respect of middle class students, those students obtain prizes, and I think you stated that the value of those prizes has been increased; can you give the committee any more definite information upon that subject?—I will put in a return which will show the progress which has been made in that direction.

192. What does the State pay at this moment through the department for science instruction?—The direct payments to schools in 1867 amounted to 8,000 *l.*; in the previous year they were 5,000 *l.*

193. *Lord Robert Montagu.*] Can you give the Committee the estimate for this year?—In the present year it is proposed that the corresponding sum shall be 13,500 *l.*

194. *Chairman.*] That is a very large increase upon the estimate of last year, is it not?—Yes.

0.72.

195. How do you account for that increase?—There is a relaxation of the rules which prevented a man receiving the full value for teaching more than one subject; another reason is that the classes are increasing largely.

196. *Lord Robert Montagu.*] There has been a general relaxation of the rules wherever it was thought advisable both for science and art, has there not?—Yes; with regard to science the whole vote proposed this year is 18,900 *l.* as against 8,600 *l.* in the preceding year.

197. *Chairman.*] What does that vote for science cover?—Payments to teachers on results, prizes of books, &c., grants for examples, local secretaries for examinations and scholarships; the sum of 2,000 *l.* is put down for the creation of new scholarships of 5 *l.*, 10 *l.*, and 25 *l.* a-year.

198. That is under the minute of the 21st of December 1867, is it not?—Yes.

199. Can you explain the proposed operation of that minute to the Committee?—The minute of the 21st December 1867 provides for two forms of scholarships in connection with elementary schools, whether receiving State aid as such or not; the first of them is an elementary school scholarship at 5 *l.* 5 *l.* is granted to the managers of any elementary school for the support of a deserving pupil if the school undertake to keep him for a year and subscribe 5 *l.*, also if the managers of the school wish to select from the students one pre-eminent among the best, and will undertake to provide 5 *l.* in order to keep him at school, then the department, upon certain conditions, will pay another 5 *l.*; the object being, in fact, to compete with the labour market, and to keep the boy at school for a year.

200. *Lord Robert Montagu.*] They are to select any boy in a poor school by competition, in order to give him a science training?—Yes; the managers can arrange as they please; subject to the approval of the department, they can keep the boy at school, and pay the 5 *l.*, and the department will pay the other 5 *l.*, provided he comes up and passes in the science examination ensuing.

201. But this is previous to the education in science that he is to receive?—Before he receives any education in science.

202. *Chairman.*] I thought he was bound to pass in some subject at the May examination as a condition of receiving the grant?—Yes, afterwards; they begin by selecting a student, and they engage to pay 5 *l.*, and to keep him at the school, and he has to come up and pass in some subject in science, and then on his passing the examination, the department will pay the Government 5 *l.*

203. He does not receive the 10 *l.* unless he passes in one subject, does he?—Not the 10 *l.*; he may receive the local 5 *l.*, but not the Government 5 *l.*

204. What is the second scholarship?—That is a more advanced scholarship; it is called the Science and Art Scholarship; like the other scholarship there may be one for every 100 pupils, but it is granted without any corresponding contribution on the part of the locality.

205. *Lord Robert Montagu.*] Will you explain that point a little more fully?—In the former case the school had to find 5 *l.*, but in this case they are relieved from that obligation, the Science and Art Department making the grant of 10 *l.* towards the maintenance for one year of the most deserving pupil or pupils in the elementary school

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who may have taken a first grade in elementary geometry and freehand or model drawing, and passed in some branch of science; if he has accomplished those two feats, of doing something at a low point in drawing, and something at a low point in science, then he may obtain one of those 10 *l.* scholarships.

206. Will you explain why we do not require the locality to subscribe an equal sum to that which we subscribe in this instance?—The *rationale* of that is, that you have got a promising youth, and you wish to encourage him to go on, while in the other case you rather pay for the results at the end of the year.

207. The object before was to give him a chance, while in this case we have got him, and our object is to educate him?—Yes.

208. *Chairman.*] You think a boy who has got the 5 *l.* will then go in for the 10 *l.* next year?—Yes.

209. *Mr. Bruce.*] That minute is the only one in which the science school exists side by side with that elementary school, is it not?—The elementary school may be in a town, and the science class may be held apart, but the minute contemplates the access of the student to some scientific teaching.

210. If the student were living at home, unless the science class were somewhere near, then there would be no advantage to be derived by the elementary scholarship?—No.

211. *Lord Robert Montagu.*] Must not all these scholarships be contemplated in succession one to the other; the boy at a poor school, which, perhaps, does not receive any grant from the Government, gets the first scholarship, and he is taught science, and then that very boy can go in for the second scholarship; is not that so?—Yes, he can go in for the second scholarship, and again for the third.

212. *Chairman.*] But he must continue to be under instruction in the elementary school, and must be a poor scholar?—Yes.

213. *Mr. Bruce.*] But he may have ceased to be an elementary scholar, may he not?—He must attend the school during the day, that is the condition.

214. *Chairman.*] He must continue to be a scholar, in fact?—Yes.

215. *Mr. Bruce.*] Supposing the case of a boy who has done well at an elementary school, and has earned this 5 *l.*, can he only enjoy the advantage of the 5 *l.* as long as he is a day scholar?—That is all, it is to support him while he does not go to work.

216. *Chairman.*] And the same condition attaches to the 10 *l.* scholarship?—Yes.

217. *Mr. Bruce.*] Do you think there is any reason why a boy who has left school, having qualified himself to get this 5 *l.*, and taken to some employment, and who yet wishes to attend the science school, should not have the payment continued to him?—He could attend the science school during the evening, but the object of the scholarship was to afford a boy some support instead of his being compelled to go to work.

218. But the object of the scholarship is not simply to support, but to encourage boys to apply themselves to scientific training?—(*Mr. Cole.*) Certainly.

219. Do you see any reason why a boy of 12 or 13 who has left school, and has obtained this scholarship and taken to some employment, should not, so long as he attends the science classes,

have that payment continued to him?—No, on the contrary; I think that a student should be provided with the means of continuing his instruction, and not be taken away from it too early.

220. You do not limit the age at which he may obtain this scholarship, do you?—Yes; for receiving the 10 *l.* to be paid by the department he must be from 12 to 16 years of age.

221. *Chairman.*] But is it not the case that the time of a boy of the age of 15 or 16 who should be kept at such a school would be simply wasted because there would be no means of giving him corresponding instruction in other subjects?—Pupil-teachers are kept at the elementary schools up to a late period.

222. Do you not except pupil-teachers from the advantages of these grants?—Yes; but the boy could still get some good at the school; the Committee will understand that this Minute is only just beginning to simmer, and I have no doubt that there is a good deal of instructive experience to be got out of the working of it. *Mr. Bruce*, however, raises another question.

223. *Lord Robert Montagu.*] Was not this the object of the Minute; it was supposed that there were certain clever boys in different poor schools throughout the country?—Yes.

224. And we wished to give those boys an opportunity of learning more than under ordinary circumstances they would be likely to learn at their school?—Yes.

225. And in order to do that, we had to compete with the labour market which would, in the natural course of things, take them away from school?—Yes.

226. And the elementary school scholarship was instituted in order to give this 10 *l.* a year, so that a boy might continue at the elementary school, and also obtain some instruction in science?—Yes.

227. And, then, having got the boy so far, our object was to cull out of this mass of boys throughout the country the best of them all, and enable them to obtain some higher scientific instruction?—Yes.

228. And with that object, we instituted this Science and Art Scholarship?—Yes.

229. This Science and Art Scholarship, then, must be taken in succession to the other scholarship?—Yes.

230. The boy is supposed to rise from one to the other, and he is induced to remain at the school by what he will get by remaining?—Yes; the words of the Minute were, "The scholarship is intended to maintain the student while remaining at the elementary school, and the exhibition is to support him while pursuing his studies at some central institution where instruction is of a high grade."

231. *Mr. Bruce.*] Have you considered the advisability of keeping a boy's superior talents at the elementary school from 12 to 16?—That point, except in the way stated in the Minute, has not been specifically considered.

232. *Lord Robert Montagu.*] Do not the pupil-teachers remain at elementary schools until they are 16 years of age?—Yes.

233. And do they not every day undergo at least an hour and a half of instruction?—Yes.

234. Therefore, it is possible, is it not, that boys up to 16 years of age might continue to receive instruction suitable to their age in an elementary school?—I cannot doubt it.

235. There

235. There is no reason, is there, why those boys should not continue to receive instruction suitable to their age in elementary schools, up to the age of 16?—None.

236. Mr. *Bruce*.] But is not a pupil-teacher who continues at the elementary school until he is 16 years of age, receiving a payment which may be taken at an average of about 15*l.* a year in return for his services?—Yes.

237. Is there any analogy between the case of a pupil-teacher in that position and that of an ordinary scholar?—It might be reasonably inferred that if there be a teacher at the school able to continue the instruction of the pupil-teacher as he is bound to do, the pupil-teacher staying till he is 18 years of age might be capable of giving proper instruction to a boy up to 16 years of age.

238. *Chairman*.] But the instruction given to the pupil-teacher is not given during the school hours; the pupil-teachers during school hours are employed in teaching, whereas the Minute requires that the boy should be at school during school hours, is not that so?—If it were found, as experience will show after a year or two, that the scholars did not get their other 5*l.*, of course that would prove that something in the plan required modification.

239. Mr. *Bruce*.] Your argument is that if the master is capable of instructing a pupil-teacher between 13 and 18 years of age, he is also capable of carrying on the instruction of your scholars from 12 to 16 years of age?—Yes; coupled with the test that we apply, namely, that he cannot obtain the 5*l.* unless he passes in science.

240. The school would be receiving no payment for him, he being over 11 years of age, would it?—No.

241. Mr. *Potter*.] Would it not, in your opinion, be desirable to extend the advantages of those scholarships to a lad of 14 who had obtained the 5*l.* previously, and had gone to work at 14 years of age, supposing he chose to devote himself to working it out in an evening school?—I think that is desirable, but it is a distinct proposition.

242. Lord *Robert Montagu*.] Are you not aware that boys at elementary schools can obtain payment at those schools up to 21 years of age?—I am not officially aware of the existing rules.

243. But do you not suppose that what the honourable Member is thinking of is rather this, that the payments for evening schools begin at 12 years of age, and that the payments for day schools do not cease at 12 years of age, but go on to 21 years of age?—I suppose so.

244. *Chairman*.] The third grant, I believe, is an exhibition of 25*l.*?—Yes.

245. Will you kindly state to the Committee the conditions of that exhibition?—“The Science and Art Department will make a grant of 25*l.* per annum to the managers of any school or educational institution, or any local committee formed for the purpose, who will raise the like sum by voluntary contribution, for the maintenance of a student at some college or school where scientific instruction of an advanced character may be obtained. The exhibition may last for one, two, or three years. Conditions: The exhibition must be awarded in competition in one or more branches of science at the May examination of the Science and Art Department. The managers may select any branch or branches of science for the competition, and if more than one be taken they may

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fix any relative amount of marks they consider best to assign to them. The place where the student is to pursue his studies may be fixed by the managers, subject to the approval of the Science and Art Department.” That is to say, you may send a youth to Glasgow, or to Owens College, Manchester, or to Dublin, or anywhere where scientific instruction of a specific character is afforded. “If a Government institution be selected, such as the Royal School of Mines, or Royal College of Chemistry, London, or the Royal College of Science, Dublin, the fees of the student will be remitted.” Those institutions being under the control of the Lord President, he is able to say that they shall not pay any fees. “The exhibitor must be of the artisan class, or a poor student, as defined by the Science Directory. The grant of the department will be paid from year to year on condition that a like payment has been made by the managers or local committee, and that the student has pursued his studies satisfactorily, according to regulations fixed by the department.”

246. You understand by that, of course, that the department will engage to make the payment for three years at the least?—The Minute fixes one, two, or three years.

247. But if the locality granted the payment on its own account for three years, I presume the Science and Art Department would make the grant for the same time?—Yes, I should think so.

248. Changes have been rather frequent in your department, have they not?—Every change has been a beneficial one, in my opinion; the work is comparatively very new at this time of day, notwithstanding all we know. France is beginning to contemplate something like what we are doing in this country; therefore I hope that the Chairman and the country will excuse us for finding it necessary to learn the business slowly.

249. Mr. *Potter*.] Do you think that any locality is likely to guarantee 25*l.* for three years?—(Captain *Donnelly*.) I am pretty nearly sure that there are six cases of applications. (Mr. *Cole*.) I have reason to think that it will very soon be done in 30 cases.

250. Lord *Robert Montagu*.] Some communications have been made to you upon the subject, have they not?—Six different localities have written, and some of the places have specifically offered to establish scholarships.

251. *Chairman*.] In fact, unless the localities were prepared to do something, you would scarcely think the Government will be justified in making the grant, I suppose?—That is the principle upon which we have always proceeded.

252. Now with regard to the competition in May for the purpose of those exhibitions, have any regulations been determined on?—The forms for obtaining those scholarships have been prepared, and they are about to be submitted to the Lord President. The thing, in fact, works itself. The examinations are established in May, the subjects are settled, and the managers of the different localities will select the subjects upon which they themselves set a value.

253. But the Minute does not state clearly whether the competition is to be throughout the country at large, or confined to certain localities only; neither does it state in what grade the competitors shall be expected to pass? (Captain *Donnelly*.) Let us suppose that Manchester raises 25*l.* for one of those scholarships. Manchester has then power, under the Minute, to say, “We will

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will confine this to the artizans of Manchester," or, on the other hand, Manchester has power under the Minute to say, "We will extend this to all the artizans of Lancashire."

254. *Chairman.*] But would Manchester have the power to say this, "We will be content if the students pass in the fourth grade?"—Yes, as far as the department is concerned, there is no limit put with regard to the grade; it is for the locality to say whether they will prefer a student who passes fourth in chemistry, and first in mathematics, or whether they will prefer a student who passes fourth in mathematics, and first in chemistry.

255. In fact, they are to attach their own value to each grade and each subject?—Just so. This scholarship is based upon the impression that the locality will know exactly what class of advanced students it is desirous to aid, and what are the subjects it is particularly interested in; the only condition is that they must pass our May examinations.

256. That is to say, the localities assign the value, not only to the subject, but to the grade, and all the department has to do is to say what the summing up of the numbers has been?—Yes; practically it comes to that. I do not apprehend that the locality would put any absolutely indefensible number on a low grade, though a locality might say, for example, that it attached more importance to passing low in chemistry than to passing very high in physiology.

257. You would not refuse to grant the scholarship, simply on the ground that the grades in which the pupil had passed were not sufficiently advanced?—No.

258. The payments to universities are not made through the Department of Science and Art, are they?—(Mr. Cole.) No. I made, for the information of the Vice President, a summary of those payments, which I will put in; the information is collected from the votes. "University of London examinations, in mathematics, natural philosophy, chemistry, experimental philosophy, botany, geology, physiology, and zoology, 1,700*l.*; University of Saint Andrew's examinations in natural philosophy, mathematics, and chemistry, 384*l.*; University of Aberdeen, examinations in chemistry and botany, 490*l.*; University of Glasgow, examinations in mathematics, natural philosophy, natural history, chemistry, botany, civil engineering, and mechanics, 1,258*l.*; University of Edinburgh, examinations in mathematics, natural philosophy, natural history, botany, and chemistry, 980*l.*" I am unable to explain why the subjects were chosen, or why the sums appear to vary in different places; if you take it according to the subjects, the State contributes, through the universities, in respect of mathematics, 951*l.*; chemistry, 1,315*l.*; natural and experimental philosophy, 751*l.*; botany, 710*l.*; geology, 150*l.*; physiology, zoology, and natural history, 660*l.*; mechanics and civil engineering, 275*l.*

259. Mr. Bruce.] Is this outside of the science schools?—Yes; those are on the votes, and I do not know whether any parliamentary responsibility looks after them; those do not include the payment for science in respect of the Queen's Colleges in Ireland, which do not come annually before Parliament.

260. *Chairman.*] Nor the payment in respect of Jermyn-street?—No.

261. But in connection with the department, you have payments for the college in Jermyn-

street, and for the Royal Colleges of Science in Dublin, have you not?—Yes.

262. All those payments, I suppose, you would say were not payments in respect of the artizans or poor students?—I apprehend that, in Edinburgh, the class of students are many of them very poor; Dr. Playfair told me that a student can pay his fees in Edinburgh, and live very well for 50*l.* a year.

263. But the payments are to the professor, irrespective of the grade of the students whom he teaches, are they not?—Quite so.

264. They are not also exclusively payments to metropolitan institutions?—No, Glasgow is not.

265. Nor is Saint Andrew's?—No; nor Aberdeen, and I do not think you could call the London University metropolitan, it is national.

266. Then we cannot say, can we, that the rule has ever been strictly adhered to, that for teaching science no payment shall be made, except to artizans, or to metropolitan institutions?—No. Like elementary education, this secondary education, which has been promoted by the Science and Art Department, has been promoted on behalf of those who could not pay for themselves.

267. Lord Robert Montagu.] These grants are not administered by the South Kensington Department?—No.

268. Mr. Dixon.] I think you stated in answer to a previous question that money was given by the State for the education in science of the superior classes?—Undoubtedly, to take it broadly, it is nearly 5,000*l.* a year, or more than that.

269. But you say that the money given through the Science and Art Department is limited to the education of the poor?—Yes, except so far as prizes are concerned.

270. *Chairman.*] And except so far as Jermyn-street and the Royal College of Science in Dublin are concerned?—Yes.

271. Lord Robert Montagu.] The object in view is the education of the artizan class, is it not?—I think you would say that the Jermyn-street School was organized on the principle of mining without reference to persons, and that the Royal College of Science is certainly on the principle of aiding the subjects rather than the persons requiring the information; at the College of Chemistry the students pay a fee of about 30*l.* a year; therefore it is obvious it is not for working people, though it may be said to be for the benefit of industry in a broad sense.

272. *Chairman.*] You have prepared some notes, I think, on education at the request of the Vice President, and you have also prepared a paper by the direction of the Lord President, have you not?—Yes; the Vice President requested me in November last to state any opinion which I might hold on the subject of education, and I prepared a paper at his desire.

273. It relates to the education in science of the industrial classes?—In one section I venture to express curtly a few opinions on primary education, and then on secondary or technical instruction; then, thirdly, on public libraries and museums, which, in my humble judgment, have a most important bearing on technical instruction.

274. And those notes refer to the question before this Committee, do they not?—Yes, and with the Vice President's permission I hand them in (*see Appendix*).

275. You

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275. You also prepared a paper by the direction of the Lord President, did you not?—By the direction of the Lord President, I prepared a kind of brief history of the department, which I also hand in (*see Appendix*).

276. You have, no doubt, considered what improvements might be made in the general regulations of the department, in order to give full effect to its object as far as science is concerned?—It is the duty of the department, and the earnest wish of all the officers employed in it, to perfect the existing system, and I dare say some of us have our own personal views about what might be done in the way of improvement. I have the permission of the Lord President to give any evidence on the subject here, it being understood that, with regard to the future, my opinions are only my own opinions.

277. Lord Robert Montagu.] The word "poor," or the term "artizan class," applying to those to whom we give grants in the Whitehall Department, includes not only men who support themselves by manual labour, but also those who are on the same level with regard to affluence, does it not?—Yes.

278. So that the children of policemen, or the children of small shopkeepers, can bring aid to their schools?—Yes.

279. Then, what did you mean to convey by saying that aid is given by the Science and Art Department to a higher class than aid is given to by the Whitehall Department?—A peer's son might obtain the prize of a colour box in the Science and Art Department, and get nothing in the Whitehall Department.

280. Then, except with regard to prizes, the aid given is to the same class in both cases, is it not?—Yes.

281. Medals and prizes are given to the middle and higher classes, in order to induce them to attend examinations?—Yes.

282. What is the reason why you are anxious to induce them to attend the examinations?—There are several reasons; it is highly important, for the sake of supporting the schools, that high fees should be paid, and it is the interest of those who want the instruction to come and obtain a better kind of instruction, in the art schools particularly, at a comparatively moderate sum. It is a point of the highest importance, and was held to be so in the reconstitution of the Practical Art Department, that if you want to improve the manufactures of a country, the best thing is to create a demand for improved manufactures, and that in proportion as the upper and middle classes, who are the consumers to a great extent of such things, were willing to be instructed, in that proportion you would induce producers to respond to their wants.

283. Chairman.] That applies to art more particularly?—Yes.

284. Lord Robert Montagu.] Then, this small payment that we make to the middle and upper classes is not for the sake of the middle and upper classes, but for the sake of the poor, our intention being not to aid the education of the middle classes, but to aid the education of the working classes; is not that so?—The direct object, based on old tradition, is to aid the artizan class.

285. We give the medals and prizes, in order that we may thereby obtain a better support for the schools in which the poor are taught?—Exactly; at the first foundation of the schools of design, it was the rule at Somerset House that

nobody above the grade of an artizan should be admitted.

286. Mr. Potter.] The schools of design in the country could not exist without payment from the higher classes, could they?—They could not exist under the old system 20 years ago, the theory being that only the working classes should be aided, the middle and upper classes being prohibited from going to the schools; the funds of the schools had to be got by taking the hat round in each locality; that was found to be an extremely precarious source of revenue, and when the Practical Art Department was formed, Mr. Henley assented to the principle that it was far better to induce richer people to come in and be taught, than to take the begging box round; the result of that has been that the schools are not extravagantly supported by the State, and there are nearly 20,000*l.* contributed by the upper and middle classes.

287. Are you correct in saying that the middle and upper classes were prohibited from attending the schools 20 years ago?—I think that was so; I cannot undertake to answer for every one of the schools; but most distinctly that was the view of the subject taken in Somerset House.

288. Lord Robert Montagu.] The policy of all parties has hitherto been to allow the middle and upper classes to obtain their own education and pay for it, but to assist by means of the funds of the State the education of the poor; is not that so?—That has been the policy, and still is the policy.

289. Do you consider that a sound policy?—As far as it goes, I think it is very sound.

290. Chairman.] But I think an answer which you gave to a previous question indicated that the State does give aid to science teaching in the universities and to the higher schools, partly through the Department of Science and Art, and partly by means of other grants over which the department has no control?—Yes.

291. Aid for the education of higher classes than those to which the Vice-President alludes; is not that so?—Yes; to make my own personal answer quite clear, I will add that I am of opinion that the principle of State aid for the encouragement of certain sciences, as sciences, without regard to any particular class of persons is an expedient thing.

292. Lord Robert Montagu.] But do you think that all parties in the State have hitherto been right in giving assistance towards the education of the poor, and refusing State funds towards the education of the middle and higher classes?—Certainly; and I think that, unless you want to pauperise the whole country, it would require extreme caution if you were to take any future action as to dealing with the middle and upper classes in this matter.

293. With regard to the education of the poor it has always been the policy of the department to encourage local energy and local institutions, rather than to force those institutions upon the localities?—Clearly, the department considers itself the humble servant of all the localities.

294. Chairman.] But is there not some discrepancy between that answer and a previous answer of yours; in answer to the questions of the Vice-President, you say that the aid of the State has been confined to the poor; but in answer to previous questions, I thought you stated that the aid of the State had been given to institutions which provided for the education of classes above the

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the poor?—Any very general statement might convey an incorrect impression. The direct aid of the department has been conferred for the instruction of the working people and the poor; but even that is not an exhaustive statement, because aid has been given to Jermyn-street and to the science college at Dublin. Then, again, no doubt the State, extrinsically to the department, has given aid for the promotion of certain sciences at the universities which I have mentioned.

295. Mr. Bruce.] The aid given to the education of the upper classes is utterly insignificant, but that given to the education of the poorer classes amounts to nearly a million a year; is not that so?—That, if it were made to include elementary education, would be true; but it must be qualified with regard to science and art; for instance, the existence of the museum at Kensington is for the technical instruction of all classes of persons that go to it.

296. Mr. Gregory.] The general answer which you would give upon these questions is, that you think it is sound policy to extend on certain subjects the instruction or education to other classes than the working classes?—Yes; to allow them to receive benefit from the aid of the State.

297. Lord Robert Montagu.] But did I understand you rightly to say, that you would allow the middle and upper classes to obtain the aid of these schools; but that if they were to obtain the aid of these schools they must pay for it?—Yes, clearly.

298. With regard to the poor, on the other hand, you would give the assistance of the State towards their education?—Yes; I should say that the State might fairly take the risk of the adventure.

299. Making the richer classes pay for the education conferred, but letting the State give, or partially give, an education to the poorer classes?—Yes.

300. But, in the second place, do you think that the State should not force these educational establishments on any locality, but wait till the energy of the locality has established an appropriate institution?—Clearly, I think that the locality must woo the State.

301. And, thirdly, with regard to industrial teaching, when you say that the South Kensington Department aids industrial teaching, you do not mean to say that we endeavour to teach special trades, do you?—No, certainly not. With the exception of naval architecture, we do nothing of that kind. We do teach something technical and specific in naval architecture, in order to provide for the wants of the Admiralty.

302. With that exception, which is based on an exceptional reason, you would not teach special trades?—Certainly not.

303. Your object would rather be to educate the mind of the artizan than to enable his fingers to earn money?—Certainly; the utmost you can do is to teach all those general principles of science which tend to improve the industry of a country.

304. Your object being, not the work, but the intelligence of the man in his work?—Certainly.

305. Was there not a change of policy in 1853; formerly we endeavoured to give special instruction in trades, and we had special masters and special classes, did we not?—When the Practical Art Department was formed, there was very frequently an expression of public opinion that the

school of design was of no direct benefit to manufactures. Owing to the unfortunate translation given to the words, *Ecole du Dessin*, they called our own school the School of Design, and the popular opinion was that its business was to make designs (not merely drawing). To show that at least it was possible to teach a technicality, I may say, that in 1853 four classes were formed to teach specialties—one to teach wood engraving, one for metal working, one for woollen fabrics, and one for porcelain painting. So far as training students to higher employments than they had reached before, the result was satisfactory; but then, having trained the students, we found that the manufacturers did not want them; we found that four students having been got up at a cost of something like 80*l.* a year each, for three or four years, turned out admirable painters on porcelain, but people did not want their labour; only one of them ever got back into the trade, and he is now the principal painter at Minton's; the other three are living in London. They came away from the Potteries, and one of them is the man who obtained the chief prize in Paris for what I believe was the best piece of porcelain painting in the Paris Exhibition. With regard to woollen fabrics, three or four young women were taught designing. One of them went to Dunfermline. She remained there a year or two, and Mr. Beverege employed her in his factory; but after a time he gave up business, and she became a teacher. The conclusion forced upon us by these facts was, that you could not dictate to the country what it wanted. We concluded that we could do something, however—namely, that we could teach generalities, and make good draftsmen or good painters; but as to decreeing that there should be a demand for porcelain painters, or for good designers, we found that the whole thing was a failure.

306. The French Imperial Commission, I believe, has recommended the Emperor to give up the plan which had been adopted in France, and merely to give scientific instruction, not special instruction in trades?—Yes.

307. Are they not giving the thing up in Germany too; or rather, have they not actually given it up in Germany?—I am not aware; there are some places in Germany where they promote a special action for the purpose of benefiting the locality; as, for instance, in the Hartz Mountains.

308. But I think the Chairman of this Committee has stated, in his letter on the subject, that in Germany the idea is pretty nearly given up; has he not?—I think so; my own impression is, that at the present time you have a good illustration of the effect of the State trying to make manufacturers in what is going on at Sevres and Meissen in Saxony. My belief is that they are there below the chief manufacturers of other parts of Europe.

309. Chairman.] When you say that you would not teach a trade, you do not mean to say that you would not give technical instruction at all, do you?—I would give technical instruction in the sense of teaching the principles of the various sciences applied to industry.

310. For instance, you would teach mechanical drawing?—Yes.

311. And mining?—Yes, but that is exceptional.

312. With regard to civil engineering, the Government has agreed to contribute towards the stipend of a Professor of Engineering at Edinburgh, and I believe it is also contributing towards

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towards the stipend of a similar professor at Glasgow?—I do not object to call that technical instruction, and I think it a right thing; but I would not teach China painting or specific designing for manufactures or any actual trade. I do not think that the Government should undertake to keep a workshop.

313. Lord *Robert Montagu.*] You would teach the sciences which are applied to trades, but not the trades to which the sciences are applied?—Just so.

314. *Chairman.*] I suppose you would teach the sciences in their application to trades?—If I were to say yes, without qualification, my answer might be misunderstood.

315. Mr. *Bruce.*] At a place like Oldham, mechanical drawing is no doubt a great deal more learnt than it is learnt in places like the cotton districts, for instance?—Doubtless.

316. There would always be a tendency in each particular science school to learn those sciences which were of immediate application to the arts which were practised in the district?—Certainly; take the case of calico printing; you might make a manager of a calico print-works a good chemist and a good draftsman, and perhaps if he also knew something of geometry it would be so much the better, as well as if he knew a little of mechanism; but to teach him all those intimate details of practice which are involved in the successful application of certain sciences to calico printing would seem to be a most unwarrantable thing.

317. *Chairman.*] Quite inexpedient, and quite impossible, you think?—Yes; and I think if the State were to attempt it, it would be ignominiously beaten.

318. Lord *Robert Montagu.*] Our object is to cultivate the intelligence of the worker, and to teach him natural laws?—Yes.

319. *Chairman.*] But do you not go beyond that in teaching mechanical drawing?—No. That is not a trade.

320. But to teach mechanical drawing is not to teach natural law, is it?—No. It is a special form of geometrical drawing.

321. Lord *Robert Montagu.*] But would not the value of drawing consist in the education of the eye, unless it were merely scientific drawing, which would be the education of the eye combined with scientific knowledge?—Yes; I might here read a passage from Lord Ross's Commission, with regard to that college in Ireland, which is, I believe, the best organised place of the kind in the country: "We do not consider that the practical applications of science to industry, or the arts themselves, should be undertaken by the new college of science, as a special part of its teaching; its aim should rather be to impart a sound and thorough knowledge of those branches of science which may be so applied, leaving it to the student subsequently to specialize his knowledge, and turn his attention in the direction he may find most suitable; but practical subjects, when capable of being rendered illustrative of scientific principles, should in all cases be introduced in the course of instruction."

322. And that expresses your opinion, does it?—Fully.

323. Mr. *Dixon.*] Chemistry is applied in various centres of manufacturing industry in very different ways; for instance, in Birmingham, Manchester, and further north, now; would you let the

teaching be the same in every one of those centres, or would you vary it so as to have a special application to that branch in the science of chemistry, which was acquired in that particular locality?—I think the utmost the State could do, would be to teach broad principles; I think it would be quite competent for each locality to go into the more minute application of those principles, and to afford specific instruction according to its sense of the want of it. At Owens College they have already a professor of mechanics, but Manchester being a centre of machinery of very various kinds, that is to say, that there is tool-making there, locomotive making, the making of weaving machinery; each of those different branches constitutes a specialty of its own. It seems to me that the application of the general principles of mechanism to each specialty is the special business of the locality. I do not think in a training school you could train people for loom making, or locomotive making, or the making of sugar refining machinery; all you can do is to teach what is at the base of those different matters, and then each locality must supply anything special, according to its own views.

324. *Chairman.*] How would you teach mechanism without teaching the construction of machinery?—You would teach the principles. At South Kennington we have a set of models illustrating the construction of buildings of all kinds, and the principles of mechanism.

325. But those you would illustrate by their application to special machines, would you not?—We should illustrate the broad principles.

326. Lord *Robert Montagu.*] You have been asked some questions with regard to the employment of the Royal Engineers for the examinations; that plan was adopted merely as the cheapest way of preventing undue grants of public money, was it not?—Yes, certainly the cheapest mode by which we could obtain scientific inspection.

327. Any other way of obtaining scientific inspection, and preventing grants of the public money from being wasted or misapplied, would have been much more costly, would it?—Very much more so; in fact, you could hardly find a numerous corps of scientific inspectors, at present, except in that particular body.

328. That was your only object in employing them, was it not?—Yes.

329. Your Board consists of the Lord President, the Vice President, or either of them separately?—Yes.

330. You, Mr. Macleod, Captain Donnelly, and Mr. Redgrave always attend the Board?—Yes.

331. When any question has arisen, you have all, or some of you, investigated it, and reduced it to its proper issue, and then that issue you lay before the Board for its decision?—Yes.

332. And when you find it necessary, you obtain professional assistance in order to enable you to arrive at the proper issue?—Yes, in commonplace cases, such as the purchase of subjects, we obtain professional assistance in the first instance; in more complicated cases the Lord President takes the initiative, and directs what shall be done.

333. But when you lay a question before the Board, you are always in a position to state the views which are entertained on the one side or the other of the question?—I always endeavour to obtain whatever information I can.

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334. And if that information does not seem to be sufficient, the Board order a further investigation, or employ professional assistance?—Invariably.

335. So that unity is maintained, although the questions are more thoroughly investigated than they would be if there were a council or board of examiners to decide upon them?—I think that the organisation of South Kensington ensures the highest amount of Parliamentary responsibility and the greatest promptitude of action, and, in all cases where a council is required, it is obtained to the full extent. I cannot conceive any piece of organisation better adapted for its purpose.

336. *Chairman.*] Are you acquainted with any other organisation for scientific instruction of which professors of science do not form a permanent and necessary part?—As I understand it, the professional examiners at South Kensington are permanent. I do not know in what sense you could make them more permanent.

337. Could you not make them more permanent in this sense; can you conceive your 25 illustrious men sitting regularly as a board?—I think it would be a great interruption to public business, and incur a great cost, to keep 25 illustrious men sitting there every week.

338. But could you not at least conceive a selection from the 25 illustrious men sitting once in three months?—They do, and still oftener.

339. *Lord Robert Montagu.*] Are not the Lord President, the Vice President, and the persons whom I have mentioned, a permanent committee?—Yes, I am neither scientific nor artistic; my business is simply to carry out to the best of my ability the orders of my superiors; if I am supposed to represent anything, it is common sense; that is all that I affect. With respect to science, I do not think Captain Donnelly affects to be an Admirable Crichton; he simply happens to have undergone a scientific course of instruction, and from a general point of view he knows something of science, but he would hardly affect, for instance, to pass judgment on a difficult question in chemistry; he would rather refer it to Dr. Frankland, or to Dr. Hofmann. With regard to art, Mr. Redgrave is undoubtedly a man of considerable judgment and eminence; he is a Royal Academician, and in almost all cases of the doctrine of art, his opinion is about the best that could possibly be obtained. He comes to the board whenever he is summoned. If it were proposed, along with the present action of the department, to constitute a board of illustrious men to sit every now and then, unless there were some specific work to be done, I think you would be creating a costly impediment to public business.

340. *Chairman.*] What is the precise office of Mr. Redgrave?—He is Inspector General for Art.

341. Is there any gentleman who holds a similar position with regard to science?—No; and there could not be with any advantage, because science consists of at least 25 different subjects, while art is but painting, drawing, and modelling.

342. But it is usual, is it not, that there should be a director of a science school?—If you wish to create a science school, unquestionably you must have a director, but the executive and the council necessary for the carrying on a scientific teaching establishment are two different things.

343. Take the University of London, which is not a science school, but is very analogous to the science branch of the Science and Art Department; has not that a scientific chief?—I think not; it has a secretary and a senate, and so have we a secretary and a senate, if you like to call our body of professors by that name.

344. But is there any analogy between your body of examiners and the senate of the university?—A precise analogy, I think.

345. But your professors are not a consultative body?—I should call them so.

346. But at all events they are not constituted as a consultative body, are they?—They are used as a consultative body; I think there are frequent occasions when a consultative body is of the highest importance, and the practice of the department has been *ad hoc* to create a consultative body always whenever it was required.

347. *Mr. Bruce.*] Your system enables you to select, for purposes of consultation, the men who are most immediately capable of giving you advice upon the matter in hand?—Yes.

348. If you had, on the other hand, a fixed body, it might not include the very men whom you wished most to consult?—Exactly; in the case of the College of Science, that being a very difficult thing to attempt to organise, the following gentlemen were constituted a commission: “Lord Rosse, Lord Talbot de Malahide, Dr. W. B. Carpenter, Dr. B. M. Cowie, Mr. John Fowler, President of the Civil Engineers, Dr. E. Frankland, Mr. W. H. Gregory, M.P., Colonel H. D. Harness, R.E., Dr. A. W. Hofmann, Professor Thomas H. Huxley, Dr. J. Beete Jukes, Sir Robert Kane, Mr. Myles O’Reilly, M.P., Dr. Lyon Playfair, Lieutenant General E. Sabine, R.A., Professor Warrington W. Smith, Professor William K. Sullivan, Professor John Tyndall, Captain J. F. D. Donnelly, R.E.,” who also acted as secretary.

349. *Lord Robert Montagu.*] Since the system of payment for results has been introduced, and the augmentation grant or payment on certificates has been abolished, have you observed any tendency on the part of the teachers to pay attention to the middle classes who pay them for the instruction, to the neglect of the poorer classes?—I think in the schools of art, yes; I am inclined to think the more open system that was adopted three years ago has had rather a mischievous tendency, by making it the interest of the teachers to get all they could out of the middle classes.

350. Has it had a tendency to make us miss the mark, and fall short of the end which the department has always put before it, namely, the teaching of the poor?—I think, until lately, the Minutes arising out of the last Committee have been rather disadvantageous to the schools of art.

351. That does not apply, does it, to the schools of science, because the teachers in the schools of science have not to be certificated?—I should not say that, in the case of science, the middle and upper classes have had a preference given to them, or that the work was not done with perfect equity between both parties; in the case of art, undoubtedly, the middle classes want what we consider rather an improper mode of teaching. They like to have it very rapid and very loose; they do not like to be pulled up strictly to the test of accuracy, and as a teacher

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has to depend on them to a considerable extent for his income, he does a good many things which he would not be permitted to do to artizans.

352. Mr. *Potter*.] The department has advanced the rate of the emoluments, and is advancing the rate of emoluments, to the masters every year since the Committee of 1864, I believe?—It has advanced them, and is advancing them.

353. Sir *Charles Lanyon*.] With regard to the payments to masters, what regulates the number of schools in any given locality?—The locality itself, unless the locality wanted a grant in aid of the building; there would be only one building grant for the locality; but in the case of the science classes in Birmingham, there are five or six of the schools themselves which make their own arrangements for holding their examinations, and they are themselves the judges whether they will teach and hold the examination or not.

354. Do you not think that it would be more desirable in those localities to limit those schools, so that you would insure a better class of masters and a greater amount of competition. I see there are no fewer than 12 schools in Belfast?—As far as we dare exercise any kind of despotic action, we are going on the plan of trying to reduce the centres in Belfast; the inspector is going to Belfast to try and induce them to get into some plan of more consolidated action if possible.

355. Does it not strike you with respect to the emoluments to be derived by the teachers, that the more the schools are limited, the better the class of teachers you will get, and the more competition; and that as your scholarships are limited to schools in which there are only 100 scholars, you do not give the best opportunity of obtaining the scholarships in those schools which are so divided?—With regard to the scholarships the limit is under 100.

356. Mr. *Bruce*.] But there would be two for 101?—Yes, that would be so, but the general answer to the question of the honourable member is, I think, that the localities are the judges of their own affairs.

357. Sir *Charles Lanyon*.] But do you not think that there might be some supervision with regard to the number of schools?—(Captain *Donnelly*.) In elementary instruction it would not be possible. If the teachers of elementary schools chose to teach science in the evening, it would be very hard to say that they should not do it.

358. Mr. *Bruce*.] But that limitation could very well be applied in the case of a building grant being asked for, could it not?—Yes.

359. But as you pay for the results, you are bound to pay for them wherever they are produced?—Yes, that is the principle.

360. And to adopt the suggestion of limiting the number of schools would be a departure from the principle on which your institution is founded?—Yes.

361. Sir *Charles Lanyon*.] Do you not think that it might produce a better class of teachers, if in all large towns the schools were limited?—(Mr. *Cole*.) If Belfast itself is not sufficiently alive to its own interest to make one or two substantial places where it may have the best possible instruction, and therefore of necessity compete with any smaller schools, it would be utterly impossible for the department to do it for them.

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362. Lord *Robert Montagu*.] You have been asked some questions with regard to the relative difficulty of different subjects in scientific instruction; the ratio of failures in the different subjects taught would depend rather on the standard adopted in the examination papers, would it not?—Yes.

363. So that by making them in each case easier or more difficult, you might make the ratio of failures the same in every subject?—Yes.

364. And therefore no argument can be drawn from that ratio of failures, can there?—Not much.

365. If you have payments for results, it must be pretty well the same throughout; we cannot make a larger payment for some subjects than for others, can we?—No; I think that would be inexpedient.

366. You stated that art schools could obtain building grants, while science schools cannot obtain building grants; can you recall to memory a deputation which was introduced to me by the honourable Member for Lambeth (Mr. *Hughes*), among whom Professor *Maurice* appeared, which had reference to the Working Men's College in London?—Yes.

367. Do you remember that that deputation were told that they might receive 500 *l.* as a building grant?—Yes.

368. And are you aware that, nevertheless, in that college it was chiefly science that was taught?—I was not aware whether science was chiefly taught there.

369. They obtained the grant because art was taught also, did they not?—They might obtain the grant provided they conformed to the conditions of the Art Directory.

370. Their teaching science in that college does not preclude their obtaining the grant as an art school?—Certainly not.

371. So that any other college might in the same way obtain a grant, although it chiefly taught science?—Yes; there is one case where a school was established specially as a science school, and performed all the necessary conditions in order to obtain the grant of 500 *l.* for an art school, but to this day they have not established a proper art school.

372. The only reason why the building grant for a science school is not mentioned in the Directory is this, that any locality will serve for a class in science teaching, while any locality will not serve for art teaching?—Yes.

373. We do not wish to preclude science from those advantages which are given to art, but we allow them to obtain a grant for teaching science if they also teach a little art?—Yes.

374. *Chairman*.] Suppose a locality were to apply for a grant as an art school, and were to send you up a plan showing a chemical laboratory as part of the building; would you sanction a grant in respect of the space occupied by that laboratory?—No.

375. Mr. *Bruce*.] You would be bound to see that the building fulfilled all the requirements of a good art school?—Yes.

376. But they could not obtain the public money for the space occupied by the laboratory?—Just so.

377. Mr. *Gregory*.] Have you anything like an annual meeting of a scientific council in your department, to make general suggestions and re-

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H. Cole,
Esq., c.b.,
and
Captain
Donnelly,
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view the whole system of scientific education which has been pursued?—(Captain *Donnelly*.) There has never been a fixed day appointed for it, but I think there has been a meeting of the whole body, generally at least once a year. On various occasions the whole system of examination and other general questions have been brought before the body.

378. But there has been no actual fixed day for the meeting?—No; the meeting has taken place when the occasion for it has arisen; but there is no fixed day for such a meeting.

379. Do you not think it would be an advisable thing if the principle were adopted, of having a meeting on a fixed day?—If there is a suggestion of any kind to be made, the examiner puts it in when he makes his report on the examination, and if any general question arose there would be a meeting of all the examiners; I think the examiners would all say, if they were asked, that whenever they have had any particular views to put forward, they have always had an opportunity of discussing them.

380. Mr. *Louther*.] With regard to these certificated teachers, who, you say, leave their classes; are there no means of engaging them for certain specified times?—The locality may engage them for a certain number of years, if they please; but the department has no control over that.

381. Do you think the teachers themselves would like to agree to such a thing?—It would be entirely a question for the locality to make it worth their while; the Science and Art Department simply pays on the results of each year's work.

382. Mr. *Bruce*.] Do you think that the success of the science schools suffers from the want of good elementary education being continued for a sufficient length of time?—(Mr. *Cole*.) I have no doubt whatever, that if the elementary education were better than it is, the science schools would be much increased in numbers, and much better attended; therefore I say that science has not prospered as much as it would have done if the elementary education had been better.

383. You have no means of acquainting the Committee with the length of time for which the pupils of the science classes attend those classes?—(Captain *Donnelly*.) I think we could show from the day-book.

384. I dare say you are aware that, from time to time, the Department of Whitehall publishes a statement showing how long the scholars have remained at the schools?—We have not gone into any inquiry of that kind; what we could tell would be the number of lessons that each of the students had received during the year.

385. But you could not say for how many successive years the students have remained at the school?—We could fish it out with some trouble.

386. Are you able to say that any particular number of students have received the substantial scientific education befitting an intelligent man of the class we have in our eye, at any of those night schools?—There have been many people who have competed for the Royal Exhibition at Jermyn-street and the College of Sciences in Ireland, who have obtained their information entirely in the night schools, and they have done exceedingly well in a number of subjects.

387. You think, then, that there is evidence that a considerable number of persons of the artizan classes have obtained at the night schools the amount

of information which I have referred to?—I think so. (Mr. *Cole*.) I could perhaps answer your question thus: You are aware that Mr. Whitworth is proposing to establish some scholarships of 100*l.* a year, and that he proposes, by means of those scholarships, to promote proficiency in mechanical science, which he says shall be tested by the hand power of the handicraftsman and the theoretical power of the scholar. He, I believe, is going to make it essential that both these qualifications shall be necessary for a person who obtains a scholarship, that equal importance shall be given to perfect workmanship and to complete theory, so as to handicap each party fairly. Now, if I have any apprehension at all with regard to the working of that scheme, it is this;—my present impression is that the 10 first scholarships will be taken by handicraftsmen who have got a little theory, rather than by theoretical men who have got a little handicraft. I have been looking into the return of students who have succeeded, and I am surprised to find so many artizans who have been earning their daily bread, who have qualified in a number of the subjects which Mr. Whitworth is likely to insist upon his candidates being examined in. I have in my eye, while I am speaking, a cabinet-maker who is of such an age as to be earning his living. I have no doubt that he has attended only night classes, and we are assuming him to be a good cabinet-maker. He has qualified in mathematics, mechanical drawing, geometrical drawing, mechanics, and physics. I do not know how long he has been going on with his studies, but when I look at facts like these, my expectation certainly is that the artizan will run away with these scholarships.

388. Do you not think that the effect of the condition attached by Mr. Whitworth will be very much practically to limit the benefit of his scheme to working men; is not, in fact, the number of men belonging to the easier classes who are theoretically advanced in science, and who can also manage an axe or some finer tool, very small?—I should think so.

389. Would not, therefore, the effect be to limit the benefit of Mr. Whitworth's endowment almost entirely to the working classes?—He is about to take some trouble in order to endeavour to bring the thing fairly before all classes; my impression is, however, that for those 100*l.* scholarships, the man of the hand is more likely to win than the man of brains.

390. Will not the effect be, that the men of brains, whom we are so anxious to have as the future instructors of the country, will be almost entirely excluded?—The man of the hand would be also a man of brains, as far as our night classes could make him one.

391. But the effect of the condition would surely be very much to exclude men who were not also handicraftsmen?—I am in hopes ultimately not.

392. *Chairman* (to Captain *Donnelly*).] You stated that a great many artizans had taken scholarships in the higher schools; can you give approximately the number of those artizans?—There are three to each of those places annually; three to the College of Science in Ireland, and three to Jermyn-street, tenable each of them for three years. The following candidates obtained the Royal Exhibitions in 1867:—To the Royal School of Mines: Wm. Garnett, aged 16, father a commercial