SYSTEMATIC
TECHNICAL EDUCATION
FOR THE
ENGLISH PEOPLE.

LONDON:
BRADBURY, EVANS, AND CO., PRINTERS, WHITEFRIARS.

Dedication

TO

HER MOST GRACIOUS MAJESTY

THE QUEEN.

May it please Your Majesty,

The object of this Volume is to move the minds of English Statesmen towards making the English Nation the Best Educated People in Europe.

This effort can be excused only by making the admission that there are now better-educated Nations in Europe than the English.

That is a sad truth. This Volume proves it—shows how it has come about—shows the way to set it right.

The object of this Dedication is to entreat Your Majesty graciously to consider the case of the uneducated English Folk, who are now suffering great misfortune in their Trades, Commerce, and Manufactures, as well as in their Social, Moral, and Intellectual condition, through having been neglected and allowed to fall behind other Nations, better cared for, by the men whose duty it was to lead as well as to govern the People.

It is the humble prayer of the Author that it may please Your Majesty to issue your most gracious commands to Your Majesty's Ministers, to see to it, that for the future the dexterous, energetic, willing working People of England receive at the hands of their Government a practical Education for useful life, as thorough and systematic as the Best Educated Nation in Europe.

If Your Majesty will only say the word, the thing will be done, and a generation of Educated English men and English women will speedily come forward and bless Your Majesty for having given it the greatest blessing an Enlightened Monarch can bestow on a loving People.

That is the fervent prayer of

Your Majesty's very obedient, old, and
grateful Servant,

J. SCOTT RUSSELL.

SYDENHAM HILL,
1 *March*, 1869.

CONTENTS.

CHAPTER I.

THE APOLOGY FOR THE BOOK.

PAGE

English dislike to education.—The English an ill-educated nation.—The national advantage of organised education.—Successful education of foreign nations.—To be emulated by the English.—The money value of systematic education.—Better than gold.—Apology for the author.—His technical education and experience.—Example of a successful English technical college.—The Royal School of Naval Architecture.—All other professions equally require technical colleges.—Classes of Englishman in want of technical education.—A. Table of professions.—B. Table of trades.—C. Table of crafts 1

CHAPTER II.

AN EDUCATED NATION.

Systematic education in Germany.—Fragmentary education in England.—Patriotism of Germany in education.—Evils of partial education:—Corrected by complete education.—Englishmen put to the test of decision.—Shall England be well or ill educated?—Value of system in national education.—Education diffused on the Continent.—Education of two kinds, general and special.—The five educational periods:—Begin with the sixth and end with the twenty-first year.—Education identical through all ranks of society.—Systematic organisation.—General and special education.—School in aid.—Apprentice school.—Educational organisation of military service.—Education of the third period.—Where shall general education end, and teaching begin?—When it has to end with the third period—When it continues.—Fourth period the right beginning of technical education.—Technical college and gymnasium, or classical college.—Separation into literary and technic.—Universities, literary and technic.—The two last the technic periods.—Fourth period learned or technic: (1) The gymnasium or college; (2) The technical college.—The fifth period: (1) The learned university; (2) The technical university.—Table of systematic education 11

CHAPTER III.

THE PRACTICAL ORGANISATION OF SYSTEMATIC AND TECHNICAL EDUCATION ABROAD, AND ITS CONSEQUENCES.

PAGE

Organisation abroad.—A small German kingdom.—Würtemberg, with 1,778,478 souls, one-twelfth of England—Has a technical university—A college for masters and foremen—Colleges for agriculture, gardening, forestry, farming, and farriery—Eighty-eight grammar schools and science schools in country towns—Elementary and industrial schools.—English education calculated on the same scale.—Table showing the number and nature of universities, colleges, and schools, professors, masters, and pupils, in the kingdom of Würtemberg.—Organisation of technical universities, colleges, and schools :—One technical university—One college for masters and foremen—Three colleges for agriculture, gardening, and forestry—One college for animal culture and medicine—One school for art-workmen—Eighty-eight high schools and science schools—Village schools.—Table of organisation.—Practical results of systematic national education.—Character, manners, works.—An educated peasant.—A revolution among educated peasants.—An educated mob.—Common street life.—Money making in educated nations.—Economy of public works.—Political eminence of educated nations: Prussia.—An organised democracy of educated men.—The educated citizen-soldier.—The army a university.—An educated people a nation of patriots.—Wealth in trade dependent on education . 27

CHAPTER IV.

TECHNICAL EDUCATION A NATIONAL WANT.

Educated, helpful, patriotic citizens, the real wealth of a nation.—Knowledge helps work, hinders waste.—Educated skill a way to wealth and well-doing.—English aversion to technical education.—General belief in England's perpetual supremacy :—A national error, its correction.—National lessons :—Lesson I., 1851.—Lesson II., 1857.—Lesson III., 1862.—Lesson IV., 1867, reformation, education.—Practical examples of benefits arising from organised technical education :—In iron manufactures—In iron armour and ships—In artillery—In railway plant—In manufactures of machinery—In quantity and price—In intelligent workmanship—In the English specialty of steel work.—Results of a generation of foreign technical education.—One generation of fifteen years lost to England.—Testimony of technical men to our national want of technical education : —Jurors—Government reporters—Government commissioner—Working men.—I. Jurors.—Schools Commission.—II. Reports of Government Commissioner.—III. Reports of workmen.—Workmen on technical training :—A chair maker—A hosier—A stone-mason—A china painter—A wood carver—Birmingham artisans.—Summing up the evidence 77

CHAPTER V.

THE TRUE WAY TO EXCELLENCE IN WORK AND EXCELLENCE IN WORKMEN.

PAGE

The same education for masters and men.—Mutual good understanding. —Separate education of ranks in society an evil.—Leads to misunderstanding and estrangement.—The master ceases to unite and lead his men; the men seek other leaders.—Estrangement of masters from men deteriorates both.—The master descends from skilled leader to become mere middle-man.—With the master the work also loses caste.—The skilled master gone, the skilled foremen and men go also.—Excellence ceases to be the aim of work.—Cheapness is installed lord of work.—The building trades:—Conditions of excellence—Causes of decadence.—The unskilled master-builder:—Unskilled in workmanship—Unskilled in materials.—The master-workman's functions resigned to middle-men. —These causes lead to the degradation of character, in work and in workmen.—Ugliness, untruth, and unsoundness of work.—Skill disappears under the reigning maxim of "cheap work" to be sold "dear."—The old way to wealth, by good work at fair prices.— The new way to wealth, by bad work at low prices.—The remedy for degradation of work and workmen.—Equality of education will redress extremes of earnings—Will raise the rates of wages for skilled labour—And diminish the extremes of social inequality 115

CHAPTER VI.

THE TWO SORTS OF EDUCATION—GENERAL OR GYMNASTIC—SPECIAL OR TECHNIC.

Education, technic and non-technic—Non-technic orgymnastic.—Technical education.—Nature of technical training.—Value of a national system 131

CHAPTER VII.

PRESENT STATE OF TECHNICAL EDUCATION IN ENGLAND.

Five millions of Englishmen.—Two millions and a quarter of boys. —One and a quarter million lads.—Three millions and a half of males requiring education and technical training.—Teaching wanted.—Schools wanted.—Classification of schools and scholars. —Technical school and science teachers wanted.—Technical schools and science teaching given.—State of English technical education. —Good education for the rich:—Individual universities, schools, and teachers of the best sort.—Wants expansion, organisation, PAGE

system.—Conditions of an organised system for England.—Examples of good technical institutions in England :—School of Mines—College of Chemistry—College of Naval Architecture—King's College—University College—Owen's College—Agricultural College—Diocesan School of Chester—Engineering College, Putney—Birkbeck and Mechanics' Institutions.—These institutions only educate 25,000 out of 1,260,000 youths.—Estimate for the better teaching of English youths in the period of science and technical instruction 135

CHAPTER VIII.

A TECHNICAL UNIVERSITY ABROAD.

English impressions of a foreign university :—In Berlin—Carlsruhe—Stuttgardt—Austria—Hanover—Switzerland—Zurich.—Swiss public education.—Swiss patriots and statesmen—Their technical university in Zurich.—Zurich a model for England.—The patriotism and liberality of Swiss citizens in matters of common good.—The technical university of the Swiss nation, Zurich :—Government of the university—List of professorships and courses of instruction—Free choice of courses, subjects, and professors—Organised curriculum for special professions.—Eleven modern professions.—The eight divisions of Zurich.—Organisation of time and place.—Plan of hours in the architectural division.—Material apparatus of education.—Observatory of practical astronomy.—Laboratory of practical chemistry.—Museum of engineering works and drawings.—Museum of engines and machinery.—Laboratory for chemical research.—Museum of architecture.—Antiquarian, zoological, botanical, and geological collections.—English teaching deficient in material apparatus: from poverty?—Criticism of Zurich.—Due mixture of practical work with theoretical study.—Avoiding the danger of cram.—Conclusion.—Cost of the university.—Practical results of education in Zurich.—Criticism . 145

CHAPTER IX.

THE TWO LEARNED UNIVERSITIES OF ENGLAND—GYMNASTIC AND NON-TECHNIC.

The word "gymnastic."—Our universities eminently gymnastic.—Gymnastic education preliminary to technic.—Modern technical occupations :—The statesman—The divine, doctor, lawyer—Soldier, sailor, architect, &c.—The learned universities technical for the divine, doctor, lawyer 178

CHAPTER X.

OUR MODERN PROFESSIONS, AND THE KINDS OF TECHNICAL EDUCATION THEY WANT.

PAGE

What shall be our technical education ?—Where to draw the line between gymnastic and technic.—It must vary with each profession. —For the agriculturist ?—For the miner ?—For the metallurgist ? —For the merchant ?—For the manufacturer ?—For the machinist ? —For the civil engineer ?—For the architect ?—For sea-faring professions ?—For men of science, professors, and teachers ? . . 185

CHAPTER XI.

SHALL WE CREATE NEW INSTITUTIONS, OR ROB OLD ONES ?

Existing institutions should be enlarged and strengthened, not robbed or straitened.—Education of skilled men a good investment of national wealth.—The new institutions will give usefulness and development to the old.—Endowed schools a wise expenditure of trade corporation funds.— Two millions of skilled men require to be educated.—Technical schools no rivals of elementary schools— Nor of secondary schools.—Technical schools supplementary to high schools and grammar schools.—New technical schools should be established in all towns.—Technical colleges wanted in all cities.—Technical universities should be independent and new institutions 212

CHAPTER XII.

OUR ENGLISH TECHNICAL UNIVERSITY—ITS SUBSTANCE AND SCOPE.

An educated English nation.—Higher degrees of professional education.—The professions that require it :—Class I., the old professions, partly provided for—Class II., new professions, untaught —Class III., leaders and teachers.—Twenty-one professions untaught. — Advantage of teaching many professions in one building.—Table 227

CHAPTER XIII.

OUR ENGLISH TECHNICAL UNIVERSITY, ITS TEACHING AND TEACHERS.

PAGE

Technical education, hitherto traditional, must now become scientific. —Wide fields of modern science.—Wide knowledge, sound knowledge.—Narrow knowledge dangerous.—Nature of human knowledge.—Law merely the form of power.—Laws of matter nature.—Laws of human nature.—The two divisions of knowledge:—Sciences, philosophies.—Object of the sciences.—Object of the philosophies.—Two divisions in our university:—Schools of science, schools of philosophy.—Mathematics.—Physics.—Cosmology.—Biology.—Philosophy of mind.—Speech.—History.—Society.—Selection of studies.—Omission of theology, law and medicine. —Table of two philosophies.—Professors and professorships:—In mathematics—In physics—In astronomy, geography, geology—In natural history—In the philosophies—In special applications of science.—Number and nature of special technical applications of science 236

CHAPTER XIV.

OUR ENGLISH TECHNICAL UNIVERSITY—ITS STUDENTS, THEIR PROFESSIONS IN LIFE, AND CURRICULUM OF STUDY.

Education of the twenty-two modern professions 270

CHAPTER XV.

OUR ENGLISH TECHNICAL UNIVERSITY—ITS METHODS AND MECHANISM OF INSTRUCTION.

Methods of teaching.—Sink or swim.—Want of competent technical teachers.—Total want of provision for high technical teaching or teachers.—High science.—The gift of teaching.—Practical skill.—Technical teaching aims always at use.—Technical men for technical teaching.—The best men in the nation to be taken for teachers. —Method of teaching in our university.—Illustration from technic geometry.—Arts giving form to matter.—Material mechanism of teaching.—Museum of geometry.—Halls of illustration.—Museums of each science.—Hall of geometry.—Hall of mechanics.—Hall of physical science.—Hall of chemistry.—Hall of astronomy and geology.—Hall of nature.—Botanical garden.—Astronomical, electric, and meteorological observatory.—Hall of zoology.—Chemical and mechanical laboratories.—Drawing schools and workshops.—Experimental school.—School for original research.—Apparatus for illustrations of teaching.—Good teaching will employ many methods and various instruments 283

CHAPTER XVI.

OUR ENGLISH TECHNICAL UNIVERSITY—ITS GOVERNMENT, WORKING, AND FINANCE.

PAGE

Knowledge goes from above downwards in society, not upwards.—High education above must raise education below.—Money value of education for a nation.—Past war costs twenty-five millions per annum.—Coming war costs twenty-five millions per annum.—What should the culture of all England cost?—Five millions?—A grant for technical universities of two hundred and fifty thousand pounds.—Government of the technical university.—Table of finance . 303

CHAPTER XVII.

THE CONNECTION BETWEEN SYSTEMATIC EDUCATION AND THE TRANSITION PERIOD OF CIVILISED COUNTRIES.

Changing material conditions.—Changing relations of men and nations—Require changes in our own culture.—Knowledge which was supplied for the past, worthless for the future.—Training required for the future.—Foreign tongues wanted for wide world commerce.—Requisites of the rapid revolutions of modern trade.—The universal adoption of machinery for works of mere routine and brute force.—Revolution in seafaring life.—A revolution in commerce.—Principals and middle-men.—Loss of value to the public.—Loss of character to the producer.—Necessity of higher training for the merchant and manufacturer.—A moral revolution in commerce and trade.—A revolution in mechanical engineering trade and public works.—Revolution in chemical trades.—Higher morality of an educated, skilled community 313

CHAPTER XVIII.

WAYS, MEANS, AND ORGANISATION FOR THE SYSTEMATIC TECHNICAL EDUCATION OF THE ENGLISH PEOPLE.

Organisation of education the business of Government.—Who will undertake it?—The educated workmen earn double wages.—Increased national revenue from skilled industry.—Difference in value between highly-manufactured goods and rough raw material.—Wanted, a fit minister of public education—A competent council of education—Skilled teachers of technical science.—Duty of Government.—Duty of local authorities.—Special education for local trades and works.—Central university.—Local technical colleges.—Country trade schools.—Cost of these institutions for England.—Table 330

CHAPTER XIX.

THE ORGANISATION OF FIFTEEN LOCAL TECHNICAL COLLEGES IN THE CHIEF CENTRES OF ARTS, MANUFACTURES, AND COMMERCE.

PAGE

The fifteen local technical colleges:—To be organised as preparatory to the university—And also as finishing schools for local industry, commerce, and agriculture.—Their science teaching—Their technical teaching—Its practical nature suited to the wants of the district—Its teachers must teach the practical work of the district. —Agriculture.—Building trades.—Collections of examples of best designs, materials, and workmanship.—Mechanical trades, laws of matter and work.—Work in metals.—Textile workers and works. —Effect of education on taste, wages, and wealth.—Textile education.—Decorative design.—Colouring.—Courses of study.—Education of merchants in commercial cities.—Education of miners in mining districts.—Education of sailors and shipbuilders in seaport towns 345

CHAPTER XX.

A TECHNICAL COLLEGE ABROAD.

Special nature of a local technical college.—To fit the skilled trades of the district—Pattern technical college.—Special for the building trades.—Classes of workmen.—Divisions of their education.—Professors and teachers.—Courses of teaching:—First course—Second course—Third course—Fourth course—Fifth course . . . 370

CHAPTER XXI.

ON ENGLISH CLASS EDUCATION, OR THE EDUCATION OF CASTE.

Marked distinctions of caste in English universities.—Teachers of the poor, and teachers of the rich.—Ought the poor to be ill taught ?—Do not the difficulties of poor scholars require able teachers ?—The poor scholars' school.—Necessity of refined teaching.—Middle-class teaching should be also the highest-class teaching.—Higher class teaching must not be lowered.—Middle and lower class teaching must be raised.—Abolition of class distinctions, its social value.—Are not technical schools class schools, inevitably ?—Therefore elementary schools should be broad, not narrow 383

CHAPTER XXII.

THE ORGANISATION OF TECHNICAL SCHOOLS, SCIENCE SCHOOLS, AND TRADE SCHOOLS THROUGHOUT ENGLAND.

PAGE

Higher technical schools to be placed in centres of twenty thousand inhabitants.—Education of higher scholars in science and skill.—Ages 12-15.—School in two divisions:—I. Preparatory for the technical college—II. Finishing school for skilled trades—III. Night courses for the extended education of Division II.—List of teachers.—Six teachers for special local teaching.—These will be preparatory schools for technical colleges and universities 391

CHAPTER XXIII.

THE ORGANISATION OF TECHNICAL SCHOOLS FOR TRAINING SKILLED WORKMEN AND APPRENTICES THROUGHOUT ENGLAND.

Educated craftsmen only can achieve perfect work.—Educated workmen do the commonest work better than the uneducated.—Education teaches quick, easy ways of work.—Ignorant men waste materials, tools, and time.—Improvements of great value to society are lost from want of skilled men to use them.—Value of education even for "unskilled" occupations.—Education the essence of skilled trades.—Geometry.—Laws of motion, force, and mechanics.—Better schools, teachers, and teaching.—New laws of apprenticeship.—Short time of schooling.—Education of apprentices the only way to educate skilled workmen.—National want of organised village and workmen's schools:—1. Elementary village school—2. Upper village school—3. Town higher school—4. Village evening science schools.—Exhibitions for apprentices.—Table . 399

CHAPTER XXIV.

THE TECHNICAL EDUCATION OF THE ENGLISHWOMAN.

The English home.—Woman's work, home administration.—Foundation of home.—Wise spending of husband's earnings.—Value and economy of fuel.—Wise treatment of fuel.—Value of food:—Money value—Health value—Strength value.—Cookery:—Waste—Frugality.—Family clothing:—Choice of materials—Cutting and shaping—Sewing, embroidery, mending.—Knowledge of laws of health and disease.—Prevention, not cure.—Religion.—Family education and training is special woman's work.—Woman's education should consist of that of all her children.—Virtue of mothers' teaching.—Seven years of home education.—Seven years of school helping.—Mothers' help in higher education.—This higher education of special use to the poor man's wife.—An educated home.—The lone woman.—Education the special business of woman . . . 414

CHAPTER XXV.

WILL ENGLAND CHOOSE TO BE EDUCATED?

PAGE

What are the chances of England's becoming educated?—Why should another country be better educated than England?—Education in other countries one generation ahead of England.—The time for the education of one generation is past and lost.—Whose fault was it?—Look to the future.—I. Find a fit minister of public education.—Many difficulties obstruct him.—English prejudice and apathy.—Will the aristocracy take an earnest lead?—Why they should.—Difficulties in Commons.—The opponents of education.—A high class of teachers indispensable.—Distinguished men can be obtained.—The rank and condition of professors, teachers, and schoolmasters must be raised.—Working men will not accept inferior teachers.—The organisation of teaching must be complete and systematic.—The succession of technical schools, colleges, and universities must form a continuous series.—Success and failure depend entirely on finding a fit man to be Minister of Education, and making him strong 426

TECHNICAL EDUCATION

FOR THE

ENGLISH PEOPLE.

CHAPTER I.

THE APOLOGY FOR THE BOOK.

The aim of this book.—A crusade against ignorance.—English education neglected.—One generation behind.—Educate the new generation.—Apology for the book.—The national advantage of organised education.—Successful education of foreign nations.—To be emulated by the English.—The money value of systematic education.—Better than gold —Apology for the author.—His technical education and experience.—Example of a successful English technical college.—The Royal School of Naval Architecture.—All other professions equally require technical colleges.—Classes of Englishmen in want of technical education.—A. Table of professions.—B. Table of trades.—C. Table of crafts.

THE practical aim of this book is to enlist in one army of co-operation, English statesmen, patriots, men of education, men of refinement, men of work, for a crusade against *ignorance, disorganisation,* and *neglect,* which disgrace our government, distress our manufactures and commerce, and hinder our progress and well-being. Aim of this book.

This *ignorance* consists mainly in not knowing how ill our people are educated; how well some other peoples have been educated; and how much good those others have received from that better education. This A crusade against ignorance.

disorganisation has arisen from our not having thought fit to give the English people the same systematic training for their duties in life, by the same national expenditure, the same Government intervention, the same popular institutions, and the same professional training, which have enabled the working men of other countries to acquire in a short time, high degrees of skill, intelligence, and training, and so to change their relative position to ourselves, in their own favour.

English education neglected.

This *neglect* has grown from the belief that education is of small use in real life and practical work; that Englishmen require or deserve less education than other breeds of men; or that it is the business of those who are wanting in education to find it for themselves. In other words, that the blind should teach the blind.

One generation behind.

One consequence of this is, that our Legislature and our Government must now bear the blame of not having thought it consistent with their place and duty to foresee and provide as good an education for the English craftsman as other Governments have provided for foreign craftsmen.

Another consequence is, that our rich men, capitalists, and masters, must now bear the burden of having allowed the Government they should have moved, but did not, to neglect the duty of educating and training the people; and they must take blame to themselves for having allowed many branches of trade, skill and commerce, which yielded to England the greatest remuneration, brought to her commerce the greatest reputation, and afforded to her people the highest wages and best work, to pass away into the hands of better educated peoples, in foreign lands guided by wiser heads.

A third consequence of past neglect is, that the time when we could have educated the present generation of Englishmen is gone by. We are "too late." We of this generation must suffer from want of work, want of wealth, and want of rank as a nation, until we can by pains and labour rear a new generation, fit to hold the place among nations from which we have fallen.

Educate the new generation.

It is because it is now too late to mend this generation, that I entreat statesmen, men of education, refinement and skill—men versed in the knowledge of the civil organisation of other lands—those who have not sunk patriotism in that narrow selfishness which calls itself "personal freedom and independence"— to unite in an enduring effort to begin from this day a systematic, organised, national crusade against ignorance; and to resolve that the citizen of England is by race, breeding and moral character, entitled to receive, and able to turn to profit, as good an education as the more favoured citizens of other nations.

The English an ill-educated nation.

If it be true that we dislike education, or at least like it in the least possible quantity; if it be true that we dislike system, organisation, and methodical control; if it be true that we despise the paternal Governments of foreign nations, and spurn interference, control or direction from the executive of our own Government, in matters of every day and vital importance to ourselves; then this book requires a triple apology, for it advocates a far higher measure of education than has ever yet been provided for us, organised in a systematic manner, which must be in great measure borrowed from nations we have long affected to despise; and which, in order to be effectual, must be the work of statesmen wielding the powers of the Legislature, and compelling us to do what we dislike with our own.

Apology for the book.

The triple apology which the author has to offer for assuming this invidious, odious, ungrateful task, is, *First:* That he has been unwillingly driven by long observation abroad, to the conclusion, that the English nation is nearly the worst educated of the peoples of modern Europe. *Second:* That our power, wealth, influence and moral character, are now suffering deeply, and are for the future likely to suffer much more, if the systematic, elementary, scientific, and technical education of the people be not at once organised and made universal, and, by the intervention of our Government, rendered effectual. *Third:* The writer is thoroughly convinced that organised and systematic education is possible in this country; that the people are by nature so docile, so fond of giving out their energies in useful work, and take so much pride in the excellence of what they have learnt to execute, that they deserve and would well reward the pains and care of the statesmen who should undertake their elementary, scientific and technical education; and with this conviction he finds, that what mainly hinders our acquiescence in organised education is the ignorance of what such education is, and their inability to see it carried out.

The national advantage of organised education.

It is the aim of this book to show how to form a nation of well-educated Englishmen; where each workman shall thoroughly know his work; where each foreman shall thoroughly understand the right principles and best methods of executing that work; and where each master of a manufactory, and each member of a profession, shall have received the highest education in the philosophical principles and modern methods of his art, science, or profession.

Successful education of foreign nations.

It is the further object of this book to show that these are not idle theories of an abstract thinker, nor dreams of an enthusiastic socialist. It will show that the most advanced nations of Europe are those where education has been most diffused, best organised, and most thoroughly fitted to use. It will show that the rivals we have raised up to our trade, our commerce, and our power, have employed as the most powerful instruments of rivalry, a national system of science and trade education, such as we have scarcely conceived, much less brought into general use. Further, this book professes to make the principles of a national system of education so clear, the methods of organising it so simple, and the good to be derived from it so plain, that it shall only remain for the English people to decide whether they will accept or refuse it.

To be emulated by the English.

The money value of systematic education.

It is even the object of this work to point out what the money value of an educated English citizen is, over the money value of an uneducated English boor. It is shown how easily education might double the value of the work done, of the profit reaped, and of the wages received. £25 represents the actual cost in education of a highly skilled over a skill-less workman. In other words, the cost of producing a skilled workman is less than one year's purchase of his increased value to the nation. If then, the matter were put before the English merchant as a question of mere pecuniary investment, it might be done in this shape: "Some nations abroad advance to poor meritorious men the school fees for their superior education, as a loan to be repaid without interest." If the nation were to advance as a loan to each working man, the cost of his superior education, it would be paid back by $\frac{1}{25}$th part of the increase of his weekly wages.

Such is the profit and loss account of systematic and technical education, carried out by the nation on the capital of the nation.

Better than gold.

I have not been led to this money account of the value of education by any conviction of my own that the sordid is the wise method of reasoning, or that the English people or their statesmen would be more moved by that than by other higher considerations. My own opinion regarding the wealth of nations has quite another standard. The greatest nation is not, in my mind, that which has, like the Dutch, the largest amount of gold and silver coin buried in its cellars, nor that which, like the French, has the largest store of bullion in the State bank; but that, to my mind, is the greatest nation which counts the largest number of well-trained, virtuous, and well-doing citizens, patriotic, frugal and religious. That is the wealth by which it is my heartfelt desire to see my country distinguished.

Apology for the author:

In addition to this apology for the book itself, the author owes a few words of apology to the reader for having ventured to undertake its authorship. He is himself a technical man, deeply desirous of obtaining for all technical men the advantages to be derived from early education and fit training. He desires to acknowledge the great benefit he has through life derived from having in his youth enjoyed the triple advantage of university education in the humanities, a course of mathematical and theoretical education, and a thorough workshop training. The earlier part of his professional life was devoted to the advancement of the scientific and technical knowledge peculiar

His technical education and experience.

to his own technical duties, and to the diffusion of such knowledge among the members of his profession. The middle portion of his life has given him experience in the practical duties of his profession on the largest scale, and in the most arduous tasks; and he now knows, by long experience, the virtues and the defects of the English system, or want of system, in the education and training of the various classes of craftsmen, from the mere labourer to the most skilled artisan. It is therefore after a life of long and large technical experience that he now ventures to express opinions designed to benefit mainly the race of technical men who are to succeed this passing generation.

Example of a successful English technical college.

It may not be irrelevant to add that in this endeavour to obtain for the young generation of Englishmen as good a technical education as that which is given to the youth of any other nation, he is only striving to extend to them a boon which he has already had the privilege to assist in obtaining for the rising members of his own profession.

The Royal School of Naval Architecture.

The Royal College of Naval Architecture at Kensington is one of the few establishments created by the British Government for the technical education of its professional men.

The author was one of those members of the Institution of Naval Architects who urged on the Government of the day the establishment of that technical college. Aided by Sir J. Pakington, they succeeded in obtaining the necessary endowment. Her Majesty, who has always been a true friend to the cause of superior education, authorised the founding of a royal college. Mr. Cole at Kensington organised the appropriation of buildings and an establishment to that purpose; the Constructor of the Navy's department aided in the organisation of the school; and under Mr. Merrifield as Principal, and Dr. Woolley as Admiralty Inspector, the Royal College of Naval Architecture is now a type of that class of institutions which no English profession ought to continue deprived of, and where young Englishmen may obtain a training which they need not be ashamed to compare with that of similar institutions abroad.

All other professions equally require technical colleges.

The classes of Englishmen for whom systematic technical education is required, and for whom scarcely any means have been provided, are so numerous, that those professions which are trained form rare exceptions. As a rule, technical education does not exist. By technical education of course I mean, not that general education which we all ought to have, and which helps to make us intelligent, able, good men, but that special education in our calling which should fit and enable each of us to discharge in the best manner the special narrow round of duty by which each citizen fills his own personal place in social life.

Classes of Englishmen in want of technical education.

The following tables comprehend in three classes the professions, trades, and crafts, every one of which requires, and should be provided with, special education. In the first category, slender but inadequate education is provided in England; for the second, scarcely any; and for the third, nearly none. The extent of the want may be judged by the fact that these classes comprehend nearly a million and a half of Englishmen.

Classes for whom Systematic Technical Education is necessary.

A.

PROFESSIONAL EDUCATION AND TRAINING FOR—

I.

1. The Statesman.
2. The Theologian.
3. The Lawyer.
4. The Doctor.

(These four are already provided for by the Universities.)

II.

5. The Agriculturist.
6. The Miner.
7. The Metallurgist.
8. The Merchant.
9. The Manufacturer.
10. The Civil Engineer.
11. The Mechanical Engineer.
12. The Machinist.
13. The Architect.
14. The Naval Architect.
15. The Ship Owner.
16. The Marine Engineer.
17. The Sailor.
18. The Practical Chemist.
19. The Astronomer.
20. The Surveyor.

(Some of these are provided for by Government in the Royal Schools of Mines and of Naval Architecture, which might form portions of the future Systematic Course of Education).

III.

21. The Professor of Pure Science.
22. The Professor of Literature.
23. The Professor of Fine Art.
24. The Teacher or Schoolmaster.
25. The Political Economist.

(Some of these are imperfectly provided for in Universities and Schools.)

B.

HIGHER TECHNICAL EDUCATION FOR SKILLED OCCUPATIONS AND TRADES AS TRAINING FOR—

1. Directors.
2. Practical Superintendents.
3. Foremen.
4. Leading Workmen.
5. Practical Farmers.
6. Superintendents, Surveyors, and Engineers of mines, metal works, rolling mills, and foundries.
7. Chief Clerks and Correspondents in mercantile firms.
8. Managers and Superintendents of large manufactories; Superintendents of manufacturing machinery; Assistant Engineers, Contractors, and Surveyors.
9. Land Measurers and Valuers.

B.—*continued.*

10. Mechanical Foremen and leading Millwrights, Pattern Makers, Founders, Smiths, and Fitters.
11. Building Trades : — Chief Masons, Carvers, Bricklayers, Joiners, Plasterers, Plumbers, and Glaziers.
12. Shipbuilders, Fitters, Equippers.
13. Marine Engine Makers.
14. Captains and Officers and Petty Officers of merchant ships.
15. Manufacturers and Refiners of chemical materials.
16. Dyers, Bleachers, Distillers, and general Chemical Manufacturers.
17. Trigonometrical and Nautical Surveyors.
18. Practical Astronomers, Mathematical and Physical Geographers.
19. Designers.
20. Draughtsmen.
21. Schoolmasters and Schoolmistresses.

(These are scarcely anywhere provided for.)

C.

TECHNICAL EDUCATION FOR SKILLED WORKMEN AND APPRENTICES.

1. Ploughmen.
2. Shepherds.
3. Woodmen.
4. Gardeners.
5. Miners.
6. Colliers.
7. Engine Men.
8. Furnace Men, Foremen, Puddlers, Rollers, Founders, Smiths.
9. Engineers, Fitters, Pattern Makers, Founders, Smiths, Engine Drivers, Machine Makers.
10. Carpenters, Joiners, Bricklayers, Quarrymen, Stone Masons, Plumbers, Glaziers, Slaters.
11. Cabinet Makers, Painters, Carvers, Gilders, Upholsterers.
12. Metal Workers, Iron, Tin, Copper, Zinc, Lead, and Steel Cutters.
13. Workers in the manufacture of raw materials of the Vegetable Kingdom.
14. Workers in the manufacture of raw materials of the Animal Kingdom.
15. Tool Makers, Mathematical.
16. Art Workmen, Moulders, Carvers, Casters, Engravers, Decorators, Designers, Turners, Embossers, Painters, Dyers, and Colour Printers.
17. Glass Blowers, Glass Cutters, Glass Painters.
18. Porcelain and other Workmen in Clay, China Painters, Terra Cotta Workers, Tile and Brick Makers.

(These are poorly and rarely provided for in Local Art Schools and Mechanics' Institutions.)

CHAPTER II.

AN EDUCATED NATION.

Systematic education in Germany.—Fragmentary education in England.—Patriotism of Germany in education.—Evils of partial education :—Corrected by complete education.—Englishmen put to the test of decision.—Shall England be well or ill-educated ?—Value of system in national education.—Education diffused on the Continent.—Education of two kinds, general and special.—The five educational periods :—Begin with the 6th, and end with the 21st year.—Education identical through all ranks of society.—Systematic organisation.—General and special education.—School in aid.—Apprentice school.—Educational organisation of military service.—Education of the third period.—Where shall general education end, and teaching begin?—When it has to end with the third period.—When it continues.—Fourth period the right beginning of technical education.—Technical college, gymnasium or classical college.—Separation into literary and technic.—Universities, literary and technic.—The two last the technic periods.—Fourth period, learned or technic : (1) The gymnasium or college ; (2) The technical college.—The fifth period : (1) The learned university ; (2) The technical university.—Table of systematic education.

Systematic education in Germany.

TWENTY years ago professional duty took me into Germany for the first time. I cannot forget my first impressions at the sight of whole nations growing up in the full enjoyment of systematic—organised—I might almost say perfect—education. I had already become acquainted with some theories and forms of education. I had read Plato's description of the perfect training for a nation. I was familiar with education in England, in Scotland, and in France; I was familiar with elementary school teaching, had enjoyed the privilege of university education, and the still higher education of the workshop. I was familiar with the systems of Bell and Lankester, having had personal acquaintance with its authors, and had myself taken an active part in schools of art and mechanics' institutions, but I confess to have been profoundly astonished, I may say humiliated, at the sight of nations whose rulers had chosen to undertake the systematic education of their people; and of peoples who had chosen to bear the burdens and make the sacrifices necessary to obtain it. I do not know to what men or class of men in Germany the forethought, organisation, and patriotism are to be attributed which made them lay aside personal ambition, political animosity, religious sectarianism, and State parsimony in order to unite all classes of the people in a unanimous effort to raise every rank in society to a higher condition of personal excellence and usefulness, and by diffusing equality of education to extinguish one of the most grievous of class distinctions.

Fragmentary education in England.

It would be hard for us now to conceive the difficulties which those men must have encountered who began that early organisation of a democracy of education in States which were political despotisms and aristocracies. An English statesman, after long residence in Prussia, once assured me that he regarded the despotism of Prussia as more absolute than that of Russia, and the high aristocracy of Prussia maintains its power to this day; yet the king consented to pave the way to democracy by universal education, and the aristocracy assisted to raise the middle and lower classes to *that* kind of social equality with themselves. There, too, as with us, religious sectarianism flourished. Catholics and Protestants, Lutherans and Calvinists, hated each other with the same cordial hatred with which we Christians in England hate one another; yet the despot, the aristocracy, the middle-class, and the

Patriotism of Germany in education.

people united in one great national act of self-culture.

Some of the evils which were foreboded came; rival sects became partisans and political agitators, and the educated democracy having their heads turned, as it was said, by an education unbefitting their rank and position, rose in rebellion, made revolutions, and enabled the opponents of education to say: "See how your system has turned the world upside down." Fortunately for the German people, the enlightened and the governing classes were not deterred by this fear of anarchy from pursuing that systematic education which teaches men to look to higher sources for liberty and well-being than to disorder and violence; they continued their efforts during eighteen years more, until they had fitted another entire generation for the duties of German citizenship, and having thus successfully educated an entire nation to intelligence, method, science, work, and war—they now show as a people who have no cause to fear the rivalry of any other race.

Evils of partial education:

Corrected by complete education.

The problem now plainly put to us Englishmen is this: Do you choose among the educated nations of Europe to remain an uneducated nation, or will you, the educated men of Great Britain—you, the political governors of England—you, the aristocracy and wealthy merchants and traders of England—will you consent and agree that the education of the rising generation shall be as good as that of any other educated people? Will you not merely agree to let it be done, but will you at once organise the ways and means of effectually doing it?

Englishmen put to the test of decision.

Now that this problem is fairly before us, and before we give our answer, it may be useful to consider what it is that we do undertake when we undertake that the

Shall England be well or ill educated?

education of the British people shall be as good as that of any other people. I therefore propose to describe the organisation by which the best educated nations of the Continent have reached their present distinction. But I must guard against its being supposed that I would recommend as the policy of this country the mere mechanical copying of the educational systems or institutions of other nations. What I recommend is not servile imitation, but intelligent rivalry and wise emulation. Let us set about the reform in our own way, only let us have sufficient forethought to make sure that the education we do provide shall not be inferior in substance, method, organisation, or completeness to the best that now exists.

Value of system in national education.

The first remarkable characteristic of continental education as distinguished from our own is its comprehensive method, its systematic development, and the admirable manner in which its details are fitted to the special aims of practical life. If I am asked whether I do not find an individual Englishman a thorough scholar, an accomplished gentleman, a well-trained, well-informed man, and quite the equal in every respect to the gentleman of any other country, I answer, certainly. But I add that I find the highest class of gentlemen of every country nearly equal. Again, do I not find British merchants or manufacturers with as wide knowledge, as shrewd intelligence, as thorough acquaintance with business as the best in other countries? I answer, yes, I find the best of them equal in all countries. And last I am asked: Where do you find a better workman than the skilled British workman? I answer that there are English working men who have educated themselves, and have

Education diffused on the Continent.

risen by personal merit to a rank which has no superior in any other country. But what I add is this: that the intelligence and civilisation which only education can give are far more widely diffused through every rank in life, stretch far wider and descend much lower through all classes of society in the systematically educated countries of Europe than in our own. It is this general high level of civilisation that gives rank to a nation; and it is this broad character of general education which forms the elevated platform from which are to spring still higher, through innate genius, the exceptional men of mark and distinction.

Education of two kinds, general and special.

The whole education of a nation may be divided into two great classes: 1. That which educates and matures the man, and which we call general education; and 2. That which specially qualifies the citizen for fulfilling that narrow round of duties which the subdivision of labour in civilised communities imposes on the individual as his special contribution to the commonwealth, and which we may call special or technical. The educational establishment of a country must, therefore, correspond to this division, and it will be complete or incomplete in so far only as it accomplishes for each man both of these objects. The first object therefore of legislation is to decide how much time in the life of a youth shall be occupied in studies that aim at maturing his powers, and how much in obtaining the special information and skill that fit him for his special place in life. The educational period of a man's life is supposed to commence with the sixth year, and end with the twenty-first. This is for the highest education, and for the lower degrees it has to end at 12, 14, 16, or 18 years, according to the circumstances and destiny of the

The five educational periods:

scholar. The endeavour is in any case not to cease his education until 16, and only hard necessity curtails it. This varying necessity gives forced variety to the system, in obedience to which the method of education has to be made flexible, even at the cost of being unsymmetrical.

Begin with the 6th, and end with the 21st year.

Beginning with the longest term of education, the complete time occupied is fifteen years. This term is divided into five periods, each of three years. The first begins when the pupil has reached his 6th year, and occupies his 7th, 8th, and 9th years; in this period he receives what is called primary education. The second period occupies the pupil's 10th, 11th, and 12th years; it may be called the secondary period, and its more advanced studies may be called secondary studies. The name for this and the other periods varies in the same country, and even in different parts of the same country, and we shall keep clear of confusion by adopting an English nomenclature and calling it the secondary series. The third period comprehends the 13th, 14th, and 15th years of the student, and his studies in this period are those which correspond most nearly to the English grammar-school or high school. The fourth period, occupying the 16th, 17th, and 18th years, corresponds to the upper forms in a public school, or to systems of education given in colleges or schools preparatory to the great universities; and the last period of three years, ending with the pupil's 21st year, is the period corresponding to our university.

Education identical through all ranks of society.

The peculiarity of this system is that it pervades the entire national education, and knows no distinction of social rank: middle-class schools, ragged schools, charity schools, are distinctions unknown. At a given age the rich and the poor receive the elements of education alike, the difference consists in the length of period during which the student or his parents can afford that he should live without earning his living, and in special cases even that is no obstacle, for the man who shows distinguished ability or special aptitude is reckoned an honour and a gain to the community: to let him stop short is reckoned a public calamity, and without coming under the burden of obligation or bending to the humiliation of charity, the distinguished son of a poor man continues his education at public cost.

Systematic organisation.

It will be readily understood that these periods of education being definitely fixed, it becomes practicable or easy to organise systematic education for each of these five periods, which shall be everywhere uniform, which the best masters shall be trained to teach in the best manner, and for which it is practicable to provide the best books and the best apparatus which the highest pedagogic skill can devise. Thus each course of three years is perfectly organised by itself, and in each period a course is begun and completed. But much more than this is necessary and practicable. Each of these periods is so contrived that it not only completes the pupil's education in what he has begun, but gives him a perfect preparation for that which is to follow. If I may say so, the successive school periods perfectly fit into each other, and so the education of life becomes an organised whole.

General and special education.

I have said nothing as yet concerning the line of demarcation which separates the general education of the educated man from the special education of the working citizen. That is a point on which the variety of the destiny of each citizen would appear to make uniformity impossible and symmetry extremely difficult. These difficulties are mitigated or overcome in the following way. To the end of the second period there is no distinction between the education of one child and another, but at the age of 12 a difference may commence. The boy may have to earn his bread, and can no longer devote his time to the studies of the third period. An expedient is provided which does for him all that these hard circumstances will admit. A school in aid, or auxiliary school, is provided for the students in this period; it occupies a limited number of days in the year or in the week, or sometimes a given number of hours in the day, which are settled by the local authorities in conformity with local convenience, and the poorest boy's education is thus continued so as both to maintain his previous acquisitions and add to them some portion of the studies of the third period. This brings him to his 16th year, in which he receives religious confirmation, and after which, if inevitable, his education may cease. This is what we will call the auxiliary school of the third period.

School in aid.

Apprentice school.

But even now at 16 this young man's education need not altogether cease. If he is to be apprenticed to a skilled trade it does not cease. There is an auxiliary school of the fourth period to aid him in becoming a skilled workman. This workman, or tradesman, or apprentice school not only keeps up his former knowledge, but helps him to go beyond it. The time so occupied is again suited to local circumstances: sometimes it occupies an hour before work in the morning and an hour in the evening, or two hours in the morning and none in the evening, or Saturday afternoon and Sunday morning; and thus, in one shape or other, all that can help him to become a good citizen and a skilled workman is accomplished, with an admirable steadfastness of purpose to the end in view and a rare flexibility in the means of doing it.

Educational organisation of military service.

This brings the workman to the end of his 18th year, and the period, it may be, of his military service. It may appear out of place that I should say here anything of the military system of Northern Germany, but I will give as my excuse the expression of a Prussian officer, who, in explaining some of its peculiarities to me many years ago, said, "You should remember that the three years of his service in the army gives our working man his university education." This I have found to be really so to an extent we in England find it hard to conceive. Their military system has all the good points of our university and public school systems, for the development of the physical powers, for the formation of character and manners. It forms habits of method and order, and lastly it is actually and practically realised as the fifth period of national education for the working man; for in the schools which are established in every military depôt the highest degree of education is afforded which their preparatory schooling has fitted them to avail themselves of.

Education of the third period.

Let us now go back to the end of the second period and follow the career of the man whose better fortune enables him to pursue his full course of study during the third period up to his 15th year. This period answers, as I have said, to the education given in our grammar or high schools. Of the boys who attend this course, nearly all receive the same education, but in it arises for the first time a serious doubt and difficulty as to the nature of the studies. It is this—

for some boys it is the last period of regular education, on the expiry of which they are to be launched into life, and the question is, shall those who are to continue their studies and those who are to end them receive identical education? And also another question—shall all those who are to continue receive identical education? On this point I may say that I find the opinions of the ablest masters divided; some are for the separation at this period of education into two kinds—technic or non-technic, and some are for its taking place later. I think that the preponderance of English opinion would agree with my own in favour of the later time for separation, and I think the preponderance of opinion of enlightened men abroad also tends that way.

Where shall general education end, and technical begin?

I will go back, however, for a moment, and follow out the career of those for whom this is the last period of education. At the end of that time they go out into trade or business, for them schooling is at an end, and until a kind of technical schooling of the fourth period was provided for them they found themselves even worse off than the poorer class. These are a kind of trade or commercial schools formed in the evenings, and also on Sundays and Saturdays. These supplemental schools of the fourth period continue the education of clerks in merchants' offices, of commercial apprentices, of boys learning their fathers' business, and in general of that class which does not aim at the higher technical or learned professions. Thus their education continues until they have learnt their business and reached the age for military service, and I may add that for this class also the military service constitutes a university education.

When it has to end with the third period;

When it continues.

I will return to the pupils who in the third period are also destined to enjoy the privilege of a fourth period. At this age it is probable that their profession is not fixed, and, as the wiser plan, let us take for granted that in this period all pass through the same course; in this case all receive equally some education in classics, mathematics, modern languages, physical science, and fine art. The fourth period is from 15 to 18, and here a separation of destinies seems to render a separation of courses of study inevitable. Everywhere in educated countries from this time forward two entirely different systems of education are provided. One in which the elements of a liberal education are given without reference to the profession or trade of the pupil, or only with reference to such as are destined for the learned professions, or for pure literature and abstract science. To this correspond two classes of schools—the gymnasium and the university. The other system of education is the strictly technical. What the gymnasia and universities are to the learned professions, the technical colleges and universities are for the modern professions.

Fourth period the right beginning of technical education.

Thus in the two last periods the division, according to the destiny of the pupil, becomes systematic and absolute. The fourth period of education therefore is double; but in its twofold character it is as symmetrically organised and complete as before. The literary pupil who goes to the gymnasium, finds that the literary education of the third period has exactly fitted him to enter on the fourth; and in like manner, the technical pupil of the fourth period finds that the scientific part of his education in the third period has exactly fitted him for entering on the technical studies of the fourth. After each has served his three years in the

Technical college and gymnasium, or classical college.

fourth period, he finds himself prepared either to enter the learned universities or the technical universities.

Separation into literary and technic.

But at this period also the education of many pupils has to be regarded as complete. None but those who court the highest degrees of learning need enter the university; and none but those who court the highest degrees of professional distinction need enter the technic university.

Universities, literary and technic.

The fifth period, or university period—learned or technical—comes in some degree in substitution for military service; but in all these countries, arrangements are made which prevent interference with the curriculum of the university, and a large portion of the military service is dispensed with, in favour of those who have taken care to qualify themselves by private military instruction.

It now appears, I hope, from what I have said, that the continental system of education is a perfectly organised system, sufficiently symmetrical to satisfy the most theoretical advocate of completeness and universality; and that, on the other hand, it undergoes periodic subdivision into branches and courses sufficiently varied to adapt themselves to the wants, conditions, fortunes and destinies of the enormously increasing varieties of occupations of modern life.

The two last the technic periods.

According to the programme given, systematic education becomes technical only in the two last periods, the fourth and fifth; and between those two periods there may be said to be a varying intensity in the degree of technicality; for in the fourth period the education continues to be a mixture, purely scientific, with the purely literary, as if the two found it hard absolutely to give each other up; and I find that by the highest authorities, the practice of keeping the two elements simultaneously alive in the mind of the pupil is regarded with favour. Eclecticism in education is, perhaps, the wisest of errors; for the final decision of life and of individual bias is not always irrevocable at 16; and it is found not unwise to retain in the technical college some features of literary culture; nor in the gymnasium do they abandon abruptly those sciences which are the best foundation of technical knowledge. In the fourth period, therefore, the literary student cultivates science, and the scientific student literature, but in the relation of predominant to subordinate.

Fourth period, learned or technic: 1. The gymnasium or college;

The whole course of the fourth period has however for its main object, preparation for the university; on the one side, classic and philosophic—on the other side, technical and practical; but even in the learned universities the possibility of use is never lost sight of. There remain three professions in which ancient languages, literature, science, theology and legislation, manifest their dominant influence over the society of our time. The theologian is but half armed, who cannot wield in his polemics the sacred records in their original tongues; and, if only for the purposes of pulpit illustration, he ought to be as wise in the mysteries of pagan theology as in the hidden meanings of modern ceremonies. The jurist inherits the weapons of his trade from Roman lawgivers, and they again from the Greeks; and thus the lawyer who would not run the risk of speaking unknown tongues, must be ready to cap his law by Greek and Latin; and as to the physician, his craft has long been kept a sealed book, and his mysteries enveloped in a tongue not common to the multitude.

These three learned professions are technical to the learned universities abroad, as to our own at home; they are so naturally bound up with the ancient tongues, that there is no reason for transplanting them to a technic university. For these three learned professions the preliminary courses of the earlier periods are also preparatory.

2. The technic college.

The technical colleges of this fourth period are strictly preparatory for the technical university only. In them the dead languages are abandoned. The living languages are sedulously cultivated; and among them those chiefly which contain the greatest quantity of special technical knowledge, or belong to countries with which trade correspondence has to be chiefly conducted. Special study is given to the pure sciences; especially to those branches of them which prepare the student for comprehending the highest principles of his art, as afterwards to be taught in the technic university. If, in the university, he is to make physical or commercial geography his special study, he is prepared for it by mastering the elements of mathematical and astronomical geography, and in short, of all the subjects which are afterwards to form his special study in their higher theoretical ranges, and in their world-wide practical applications. Thus, at the commencement of the fifth period, the student is prepared to study with advantage the highest science, the highest philosophy, and to comprehend the methods of their widest applications.

The fifth period: 1. The learned university; 2. The technical university.

It is easily understood that the fifth period completes the education of the youth, and commences the work of the man; it is plain that the technic university is as inevitably the end of education for modern life as the learned university for the three ancient professions. It can surprise none of us, that a technic training has been thought as necessary for the new professions as for the old. The wonder will soon be, how the English nation could have so long remained comfortable under the knowledge, that out of the dozen professions for which the whole of her youth were destined, there were only three for which it was thought necessary to provide methodised means of instruction. It is much to the credit of the German character, that a nation to whom we have always accorded high praise for theoretical learning and abstract philosophy, should have outstripped us by a whole generation or more in foresight and farsight; and should have taken measures to promote the application of all the discoveries of abstract science to the speediest, wisest, and most economical solution of the practical problems of daily life and business. There are now six technical universities in Germany, and not yet one in England. There are at least 100 preparatory and technical colleges in Germany, for each school or college in England having any pretension to teach the practical applications of science. Of the lower class we have scarcely any; of the higher, none.

Table of Systematic Education.

Periods.	Ages.	Schools.	
		ELEMENTARY SCHOOL.	
I. Period	7	I. Course.	
,,	8	II. Course.	
,,	9	III. Course.	
		SECONDARY SCHOOL.	
II. Period	10	I. Course.	
,,	11	II. Course.	
,,	12	III. Course.	
		HIGH SCHOOLS.	
		Classical.	*Scientific.*
III. Period	13	I. Course	I.
,,	14	II. Course	II.
,,	15	III. Course	III.
		COLLEGES.	
		Classical.	*Technical.*
IV. Period	16	I. Course	I.
,,	17	II. Course	II.
,,	18	III. Course	III.
		UNIVERSITY.	
		Learned.	*Technical.*
V. Period	19	I. Course	I.
,,	20	II. Course	II.
,,	21	III. Course	III.

CHAPTER III.

THE PRACTICAL ORGANISATION OF SYSTEMATIC AND TECHNICAL EDUCATION ABROAD AND ITS CONSEQUENCES.

Organisation abroad.—A small German kingdom.—Würtemberg, with 1,778,478 souls, one-twelfth of England — Has a technical university—A college for masters and foremen—Colleges for agriculture, gardening, forestry, farming, and farriery—Eighty-eight grammar schools and science schools in country towns—Elementary and industrial schools.—English education calculated on the same scale.—Table showing the number and nature of universities, colleges, and schools, professors, masters, and pupils in the kingdom of Würtemberg.—Organisation of technical universities, colleges, and schools:—One technical university—Seven colleges for masters and foremen—Three colleges for agriculture, gardening, and forestry—One college for animal culture and medicine — One school for art workmen — Eighty-eight high schools and science schools—Village schools.—Tables of organisation.—Practical results of systematic national education.—Character, manners, works.—An educated peasant.—A revolution among educated peasants.—An educated mob.—Common street life.—Money-making in educated nations.—Economy of public works.—Political eminence of educated nations: Prussia.—An organised democracy of educated men.—The educated citizen-soldier.—The army a university.—An educated people a nation of patriots.—Wealth in trade dependent on education.

Organisation abroad.

I WILL now proceed to develop in their practical details the organisation of the great institutions with which foreign nations have been provided by their Governments for the technical training of their youth. It will be highly instructive to notice how these great educational colleges extend over all the divisions of society, high and low, embrace every kind of occupation, and aid every branch of industry. As the example of an educated nation, I might have taken the symmetrical and perfectly organised institutions of Prussia, or those of a country boasting a personal freedom equal to, or greater than our own, like Switzerland. But I think it may be more useful to us to see how much more is done than in our country by some of the smaller unpretending States; by some one of those little kingdoms of which we English know little, care less, and rather despise. I might take Nassau for example, or Baden, or Hanover, and show how these countries have been covered by a network of institutions for the intellectual nutriment and moral training of their subjects, and how I have found in them all a degree of intelligence, culture and moral well-being, which have seemed to me admirable and enviable.

A small German kingdom.

But the nation which I select for the purpose of this Chapter shall be Würtemberg; I select it as a model nation on a small scale, and therefore more easily studied and more readily comprehended; and as it contains only a population of 1,700,000, or one-twelfth of England, or one-twentieth part of the United Kingdom, we can readily see what would be the proportion of similar institutions in England or Great Britain which should enable us to say by a simple act of multiplication, by twelve or by twenty, what would be the number of technical universities, trade colleges, and craft schools, which would provide as well for the people of Great Britain as the little kingdom of Würtemberg has already been long provided for.

Würtemberg, with 1,778,478 souls, one-twelfth of England:

These model institutions of the kingdom of Würtemberg have the advantage of great symmetry and continuity. There is at the summit for professional men:—

Has a technical university;

1. The Polytechnic University of Stuttgardt, which

is meant to educate the highest classes of professional men. Among these are the modern professions of civil engineers, mechanical engineers, and architects. There is a course for the mercantile and commercial classes. There is a course of chemistry, with its applications of the chemical arts and manufactures, and there is a course of general superior scientific and literary education for professors, lecturers, and men of leisure.

The building appropriated to this purpose forms one of the piles of finest modern architecture in Stuttgardt. There are no less than fifty-one professors and teachers, and besides the usual lecture-rooms and studies, there are a chemical laboratory, a physical laboratory, mineralogical museums, laboratories for constructive experiments, plaster-modelling rooms, mechanical workshops, wood-modelling rooms, rooms for drawing, a botanical garden, and an astronomical observatory. To appreciate the value of such an institution, and its fitness for giving in detail all the preliminary knowledge which a professional man ought to have before he becomes the pupil of the master who will introduce and train him to practical work, the reader must consult the detailed plan of it given at the end of this Chapter.

A college for masters and foremen;

2. A second, and even more remarkable educational institution, is the school for the building trades, also in Stuttgardt. It is a complaint continually made, and with justice, against these technical colleges, that the scale of education is too large, and its quality too ambitious, to form any but the highest class of members of any technical profession or trade; that the more ordinary and numerous members of these trades and professions, who equally require a thorough prac-

tical training, find themselves insufficiently educated even to enter the technical university, and without leisure to devote to it the long and continuous time necessary for its courses. A narrower course is wanting for foremen and clerks of works, and even for directors and managers of small sections of trades, and it is desirable that the humblest craftsman should be able to get such education as, with intelligence, diligence, and probity, should enable him to rise to distinction and skill in some one thing.

For these great and wise purposes some of the most distinguished directors of the technical university, after many years' experience of the value of such education to skilled craftsmen, and the incompatibility of giving the highest and broadest education, equally with the narrowest and humblest, in the same institution, represented to the Government the expediency of forming a new school, intended for building crafts and tradesmen of the rank immediately under the professional men and skilled masters of the technical university. That was accordingly established, and succeeded so quickly and so completely, that it became necessary to erect quite as large and as handsome a building, and to devote quite as large a staff to that purpose as to the original polytechnic university; it is now one of the most remarkable and meritorious schools on the Continent. The men whom it was especially designed to help in their trades were stonemasons, bricklayers, and carpenters, to be trained for future master-builders; lower class builders to be trained for master-builders, constructors of public works, subterranean works, and constructors of reservoirs; constructors of water-works, river-works and mill-works, and land surveyors of the first and second class. The general workmen whose education it undertakes are plasterers, tilers, roofers, joiners and carpenters, glaziers, turners, decorators, ornament-sculptors, modellers, engravers, smiths, gold and silver workers, gardeners, and husbandmen. Its great merit is its perfect adaptation to the wants of each separate class of persons. For young men who are much employed in winter, and less in summer, it provides summer courses of study, and gives them vacation in winter, and *vice versâ*. It has classes in the early morning, the same at mid-day, and the same over again in the evening; and the hours of the different classes are so timed, that the pupil may attend many or few hours of the day, and still obtain the studies he requires.

Colleges for agriculture, gardening, forestry, farming, and farriery;

This school is presided over by the most distinguished architect of Würtemberg, with no fewer than twenty-eight professors and masters under him. Systematic courses are provided for those who can go through the education required to obtain certificates of competence; and their estimation of its value is proved by the fact that the school is crowded by exactly that class of men whom it was intended to benefit.

3. The next class of institutions are wisely situated not in the metropolis, but in the country, and they are distributed throughout the districts. They are schools for country occupations and trades, and are called "agriculture and forestry establishments."

There is first a great institution at Hohenheim, with twenty-one masters. It is divided into the farming school and the gardening school, and special agricultural courses. It has under it three practical farming schools in three different districts, and each school has under its care 400 square miles of territory. A large brewery is attached to one of these establishments, and there are subordinate schools distributed throughout the country. There are also winter evening schools in the villages, and the practical result is, that last year, in 523 places, 12,040 persons enjoyed the privilege of agricultural instruction.

Supplementary to the agricultural education of the farmers is an institution for the study of the anatomy, physiology, training, and diseases of animals; it is the veterinary college of Stuttgardt. Attached to it are an hospital, in which last year 775 horses were treated; a cattle hospital, in which 826 animals were treated; a dog hospital, in which 213 animals were treated; a smithy, in which 4000 animals were shod.

Eighty-eight grammar schools and science schools in country towns.

With such upper schools for the technical training of the people, it will be readily imagined that there must be a complete organisation of upper and lower schools leading up to them, otherwise these higher schools could not be filled with fit pupils; and as they all require preliminary qualification, tested by an entrance examination, the preparatory schools are indispensable. There are accordingly eighty-eight colleges or public schools, separated into the two divisions of classical and of science schools.

In the classical schools there were last year 4565 pupils, and in the science schools 4734 pupils; showing how evenly the two classes of schools provide for the two classes of pupils. These are also divided into two sub-divisions, upper and lower, called gymnasiums and lyceums; and in the science schools, a school and a college, or *real* school and *science* college.

Elementary and industrial schools.

Immediately below these are the public elementary schools, and establishments for private instruction;

and, auxiliary to these, technical schools of the humblest kind, in which girls are taught their business as housekeepers, and boys are trained to the simplest duties of life.

English education calculated on this scale.

When it is considered that these establishments are for the education of only 1,700,000 people, less than an eleventh part of the population of England alone, without Ireland or Scotland, it leads to the startling conclusion that England, to supply her people with a technical education as good as that of the little kingdom of Würtemberg, should have 11 endowed technical universities, each with 49 masters and accommodation for 468 pupils, or that in all there should be in the technical universities of England more than 5148 technical students. That we should have 11 building-trade schools or colleges with 26 masters in each, and in each 587 pupils, or on the whole more than 6457 students. Of higher trade schools there are in Würtemberg 108 in 89 towns and 19 villages, so that to equal that, in England there should be higher trade schools established in 979 towns and 201 villages, making in all 1180 schools. In these schools are 6453 pupils under 17 years old, and 1811 over 17 years old, making a total of 8264 pupils. These are taught by 425 masters. To do as much in England, we should have 4675 masters, teaching 90,904 children.

To know what the enormous sacrifice is which a nation must make to accomplish this moral and intellectual revolution, be it known that the expenditure of the State amounts to 2*s.* 7*d.* per inhabitant!

Probably nothing will convince the English people better of the value of such education than to inspect for themselves the nature of that education, the numbers and classes of people who avail themselves of it, and somewhat in detail what it all costs.

The following statement has been compiled from the accounts of the Minister of Education of Würtemberg, and will, I trust, enable the Englishman to put a money as well as a social value upon the systematic education which I desire to see given to Englishmen of every profession, trade, and craft :—

Table of the System of Universities, Colleges, and Schools for Technical Education in the Kingdom of Würtemberg.

TECHNICAL INSTITUTIONS.

1. TECHNICAL UNIVERSITY IN STUTTGARDT.

This consisted, in the year 1865-66, of a Mathematical division, with two classes and one merchants' class, and a Technical division with two trade schools.

I. *Teachers:*

20 head-masters, 13 trade and assistant-teachers, 4 under-masters, 6 ushers, 6 private teachers—together, 49.

II. *Scholars and Students:*

A.—In the Winter term 1865-66, 468, of whom 163 were in the Mathematical and 305 in the Technical division. In detail there were—

	In the Trade classes.	Cl. I.	Cl. II.	Arch. Sch.	Engin. Sch.	Machinery Sch.	Chem. Sch.	Total.
Natives .	16	65	49	76	56	34	52	348
Strangers .	16	5	12	21	20	13	33	120
	32	70	61	97	76	47	85*	468

Of the 120 strangers there were from—

Switzerland, 20 ; Austria, 19 ; Bavaria, 15 ; Russia, 12 ; Baden, 11 ; Prussia and Grand Duchy of Hesse, 6 ; England, 5 ; France and Saxe-Meiningen, 3 each ; Hamburg, Holland, and Italy, the United States of America, and Java, 2 each ; Belgium, Cuba, the Electorate of Hessen, Hesse Homburg, Oldenburg, Palestria, Schleswig Holstein, Sweden, Turkey, Duchy of Waldeck, each 1.

* Remark.—Of the 85 students of the Chemical school 31 were employed in the laboratory.

According to the vocation of the fathers there were sons of—

Servants of the State	99
Other public servants	54
Followers of trade, and merchants	201
Followers of agriculture	17
Followers of other professions (artists, doctors, &c.) . .	97
	468

The average age of scholars and students was, on the 1st October, 1865, in—

The Merchants' Class.	Cl. I.	Cl. II.	Technical Division.
16 yrs. 6 m.	17 yrs. 2 m.	18 yrs. 2 m.	20 yrs. 2 m.

With regard to preparatory education—

Of the 163 scholars of the Mathematical division, including the merchants' class, there were educated—

At the Würtemberg real and upper schools . . .	114
At humane institutions (seminaries, gymnasiums, lyceums, &c.)	18
At other schools or private institutions	31
	163

Of the 305 students of the Technical division there entered—

From the Mathematical division	112
From the lower Technical institutions (out of which 40 were out of the Mining schools)	53
From the other Technical schools	27
From other institutions (real schools, gymnasiums, universities)	77
From practical professions (architects, mechanics, apothecaries, lithographers, shopkeepers, officers) . .	36
	305

B.—In the Summer term of 1866 the whole number of students and scholars was 393, of whom 149 were in the Mathematical and 244 in the Technical division. In detail there are—

	In the Merchants' Cl.	Cl. I.	Cl. II.	Archit. Sch.	Engin. Sch.	Machinery Sch.	Chem. Sch.	Total.
Inhabitants .	9	64	50	60	49	28	39	299
Strangers . .	10	9	7	16	16	13	23	94
	19	73	57	76	65	41	62*	393

* Remark:—Of the 62 students in the Chemical school, 35 were occupied in the chemical laboratory.

Of these 94 strangers there were from—

Austria, 17 ; Bavaria, 13 ; Switzerland, 9 ; Prussia, 8 ; Grand Duchy of Hessen, Russia, each 7 ; Baden, 6 ; England, 5 ; Saxe-Meiningen, Waldeck, North America, France, Java, each 2 ; Frankfort, Oldenburg, Saxe Weimar, Saxe Coburg, Hamburg, Schleswig Holstein, Belgium, Italy, Sweden, Turkey, Palestine, Brazil, each 1.

III. *Examinations.*—(Technical maturity examinations) :

Announced, 53 ; admitted, 52 ; appeared, 51	42 from the Mathematical and 9 from the Technical division.
Passed, 30.	29 from the Mathematical and 1 from the Technical division.

IV. *Prizes:*

A.—In the Mathematical divisions for peculiarly satisfactory performances in the technical maturity examinations, 1 prize.

B.—In the Technical division :

	Arch. Sch.	Engin. Sch.	Mach. Sch.	Chem. Sch.	Total.
Prize works come in . .	4	2	1	1	8
Prizes awarded	2	1	...	1	4

V.—*Collections, Apparatus, and Institutions of the Establishment,* 24.

VI.—*Economy of the Establishment:*

In the year 1865-66 the income was—

A.—The proper sources of income of the Institution for fees, laboratory, and substitute fees .	18,500 fl. =	£1,541 13 4
B.—Addition from the State	57,500 fl. =	4,791 13 4
Total . .	76,000 fl. =	£6,333 6 8

2. COLLEGE FOR THE BUILDING TRADES IN STUTTGARDT.

This school numbered in the school-year 1865-66, with five classes in eleven divisions,—

I.—*Teachers:*

18 head-masters, 6 assistant-masters, and 2 ushers,—together 26.

II.—*Pupils:*

A.—In the Winter term 1865-66, 587.

Among these were—

1. According to position : 578 ordinary, and 9 extraordinary.

2. According to home: 540 inhabitants, and 47 strangers.

   Of the 540 inhabitants, there were 76 from Stuttgardt, 172 from the Department of the Neckar, 87 from the District of the Black Forest, 110 from the Danube district, 95 from the Taxt district.

   Of the 47 strangers, 18 were from Switzerland; Baden, 15; Prussia, 4; Austria, 3; Bavaria, 3; Nassau, Thuringia, Hamburg, Lichtenstein, each 1.

3. According to their calling: 475 actual builders (among whom 333 masons and stone masons, and 142 carpenters), 61 geometrical, and 51 of other trades (plasterers and stucco-workers, decorators, millers, farmers, beer brewers, &c.)

4. According to the proficiency in trade: 63 overseers, drawers, polishers; 315 assistants, and 209 apprentices.

5. According to their preparatory education: From national schools, 267; middle schools, 18; real schools and school secretaries, 222; upper real schools, 42; Latin schools and gymnasiums, 26; technical schools and other higher institutions, 12.

6. According to age: Between 14 and 17 years, 215; between 17 and 25 years, 350; between 25 and 30, 14; over 30, 8.

   Lowest age for admission, 14½ years; highest, 37½ years:—
   Average, 18½ years.

Of the 587 scholars, the school has been visited by—

For the	1st time.	2nd time.	3rd time.	4th time.	5th time.	6th time.	7th time.	8th time.	9th time.	10th time.
Builders	168	107	102	74	20	3	...	...	...	1
Geometricians	31	20	5	2	2	1	...	...	...	...
Other trades	33	6	9	...	3	...	...	...	...	...
	232	133	116	76	25	4	...	...	...	1

Attendance at the Individual Classes.

I. Class with	2 divisions	....	76 pupils
II. „	3 „	....	220 „
III. „	3 „	....	137 „
IV. „	2 „	....	112 „
V. „	1 „	....	42 „
5 classes with	11 divisions.	Total	587 „

B.—Summer course, 1866, 115 pupils, among whom there were—

67 ordinary, and 48 extraordinary pupils.

109 inhabitants (among whom 27 from Stuttgardt), and 6 strangers; Baden, 4; Prussia, 1; Hungary, 1).

87 builders (56 masons and stonemasons, and 31 carpenters), 6 geometricians, and 22 other trades (mechanics, locksmiths, millers, lithographers, modellers, &c.)

5 overseers, drawers and polishers, 61 assistants, and 49 apprentices.

54 from national schools, 45 from real schools, 5 from upper real schools, 10 from Latin schools and gymnasiums, 1 from the Polytechnical school.

57 of from 14 to 17 years, 54 from 18 to 25 years, 3 from 26 to 30 years, 1 over 30 years.

Lowest age, 14 years; highest, 37:—Average, $18\frac{1}{2}$ years.

Of the 115 pupils, the school has been visited by—

For the	1st time.	2nd time.	3rd time.	4th time.	5th time.	11th time.
Builders	11	39	27	7	2	1
Geometricians . . .	4	2	...	...	...	...
Other workmen . .	17	3	...	2	...	...
	32	44	27	9	2	1

Attendance at the Individual Classes.

I. Class	13 pupils.
II. "	29 "
III. "	72 "
3 classes with . . .	114 "

C.—Both courses together, 701 pupils.

---

3. HIGHER TRADE SCHOOLS.

In the year 1865-66 there were in Würtemberg such schools in 108 places (89 towns and 19 villages), with a total population of 444,568 souls.

The 108 schools are divided, according to their interior arrangements, into the following groups:—

1. Finishing schools, with public rooms for drawing, in which there are Sunday and evening classes for trades (Esslingen, Ludwigsburg, Gmünd, Hall, Ravensburg, Caln, Biberach, Rottenburg, Ellwangen, Ehingen, Geisslingen) . . .	4
2. Finishing schools, with public rooms for drawing, in which there are Sunday and evening classes for trades and merchants (Stuttgardt, Ulm, Heilbronn, and Neutlingen) . .	11
3. Finishing trade schools, with Sunday and evening classes, without drawing rooms (67 towns and 14 villages) . .	81
4. Finishing trade schools with evening classes, but no Sunday classes (3 towns and 1 village)	4
5. Trade schools with Sunday teaching, but no week-day classes (2 towns)	2
6. Pure drawing schools with no further instruction (2 towns and 4 villages)	6
	108

The attendance of pupils, which in 1864-65, in 101 finishing schools, was 8100, rose in 1865-66, with the same number of schools, to 8264, among whom 6453 were under, and 1811 over seventeen years old.

The number of teachers was 425 (against 401 before 1864-65), so that on an average there is one master to every 19-20 pupils.

The entire sum paid by the State amounts to 21,243 fl. 21 kr. (=£1770 5s. 1d.), or 2 fl. 34 kr. (2s. 7d.) per head.

The subjects which most pupils attended were—

Arithmetic	with	4520	pupils.
Free-hand drawing	„	4209	„
Mother tongue	„	4068	„
Trade drawing	„	2419	„
General drawing	„	1892	„
Book-keeping	„	1202	„
Plane geometry	„	1105	„

The schools most visited were—

		Teachers.	Pupils.			Teachers.	Pupils.
Stuttgardt	with	61	1285	Kirchheim	with	3	193
Ulm	„	21	657	Geisslingen	„	6	145
Ludwigsburg	„	9	246	Ravensburg	„	7	142
Heilbronn	„	11	240	Gmünd	„	6	130
Neutlingen	„	17	209	Rottenburg	„	5	124
Biberach	„	8	201	Caln	„	6	116
Freudenstadt	„	6	201	Göppingen	„	6	112
Esslingen	„	12	196	Metzingen	„	3	105

The trade schools in Stuttgardt had—

One evening finishing school,	with	19	masters and	375	scholars.
One Sunday trade school	„	22	„	673	„
One merchants' finishing school	„	15	„	149	„
One females' finishing school	„	5	„	88	„
		61		1285	

ORGANISATION OF NATIONAL EDUCATION.

Organisation of technical universities, colleges, and schools: One technical university; One college for masters and foremen; Three colleges for agriculture, gardening, and forestry; One college for animal culture and medicine; One school for art workmen; Eighty-eight high schools and science schools.

Having now considered the general nature, number, attendance, and cost of a national system of schools in an educated country, we should very inadequately appreciate the value of such a system, unless we take the trouble of examining the nature of each of these classes of institutions, and the extent and character of the teaching organisation which is provided.

The first remarkable circumstance is the number and high qualification of the teachers.

The second is, the thoroughness and extent of the courses of education.

The third is, the extent of the material organisation for teaching, the largeness and beauty of the buildings, the nature of the museums and libraries which are attached to them, and the provisions for practical instruction in the nature of workshops, farms, hospitals, and museums.

Finally, the nature, character, business, and number of the students who attend these institutions, and their regularity and proficiency, may be to some extent gathered from the following Tables :—

TABLES OF ORGANISATION.

1. Technical University.
2. College for the Building Trades.
3. Colleges of Agriculture and Forestry.
4. Veterinary College.
5. School of Art Workmen.
6. High Schools, or Academies and Science Schools.
7. Elementary Government Schools.
8. Industrial Schools.

Organisation of a National System of Technical Education in the Kingdom of Würtemberg.

POPULATION, 1,778,478.

I.—TECHNICAL UNIVERSITY.

The object of this school is to educate future *technics.*

The instruction given is five courses of one year each.

It is divided into two branches—the Mathematical, and the Technical. The former consists of two, and the latter of three classes.

The Technical is subdivided into four schools :—

1. For architecture.
2. For engineering.
3. For machinery.
4. For technical chemistry, with the subdivisions—
   - (*a*) Chemical manufactures.
   - (*b*) Mines.
   - (*c*) Pharmacy.

(There is also a parallel class devoted to preparing pupils for being merchants.)

Conditions of entrance :—

1. A certain age.
   For entrance into the *mathematical* division, the pupil must have attained his 16th year.
   For entrance into the *merchants'* class, the pupil must have attained his 16th year.
   For entrance into the *technical* division, the pupil must have finished his 18th year.
2. In addition, they must have certificates of position, conduct, &c.
3. The necessary preparatory knowledge.
4. And, where under age, the written permission of parents or guardians to enter the school.

They must pass an examination in which, for the *mathematical* division, the following knowledge is required—

(*a*) Algebra up to equations of the 2nd degree, inclusive. Exercises in the use of logarithms.
(*b*) Geometry and stereometry.
(*c*) Principal heads of plane trigonometry.
(*d*) Correspondence in the French language, with a proper translation of a not difficult theme from German into French.
(*e*) Practice in German style—an exercise of a theme on a given subject.
(*f*) Knowledge of the principal periods and events in history.
(*g*) Knowledge of the elements of mathematical, physical, and political geography.
(*h*) Practice in geometrical and free-hand drawing.

For entrance into the *mercantile* division, the examination will include the following subjects :—

(*a*) Practice in reckoning figures, inclusive of decimal fractions, with regard to mercantile requirements.
(*b*) Familiarity with the French language, translation of a not difficult theme from German into French.
(*c*) Good German style—a theme on a given subject.
(*d*) Knowledge of the principal periods and events in history.
(*e*) Knowledge of mathematical, physical, and political geography.

In the technical division the pupils produce a certificate of competency from the schools or masters they have visited.

The fees are—

A.—In the Mathematical division—

For ordinary pupils .	50 fl. .	(4*l.* 3*s.* 4*d.*)	a year.
For extraordinary pupils,	1 fl. 30 kr.	(2*s.* 8*d.*)	the half-year, for each lesson a week.

B.—In the Technical division—

For ordinary pupils .	60 fl. .	(5*l.*)	a year.
For extraordinary pupils,	1 fl. 45 kr.	(2*s.* 11*d.*)	the half-year, for each lesson a week.

Besides this, the pupils pay 42 kr. (1*s.* 2*d.*) per half-year for servants ; and if they attend the chemical experiments, 5 fl. (8*s.* 4*d.*) for materials. In addition to this, the entrance fee is 5 fl. (8*s.* 4*d.*).

There are the following means attached to the division of practical instruction :—

The chemical laboratory.
The physical laboratory.
The arrangements for mineralogical studies.
The arrangements for constructive experiments.
The arrangements for modelling in plaster.
The mechanical workshops.
The wood pattern making.
The botanical garden.

STAFF.—*Heads and Professors.*

Director of the entire Institution.—Prof. Dr. Zech.
Head of the Mathematical division.—Rector Dr. v. Gugler.

Heads of the Trade Schools—4.

1. Architectural school.
2. Of the engineers' school.
3. Of the machinery school.
4. Of the chemical school.

There are 24 *head masters,* including those named above.
9 *under masters.*
11 *assistants.*
7 *private tutors.*

Older persons not wishing to attend regularly as students, are admitted as "listeners." They pay 3 fl. the half-year, for one lesson a week ; for two lessons a week, 6 fl. (10*s.*) ; for each further lesson, 2 fl. more per half-year.

CLASSES.

A.—MATHEMATICAL DIVISION.

First Class.

Plane and spherical trigonometry	in winter, 5 hrs.;	repetition 2 hrs.	Recapitulation of plane trigonometry, general explanation of functions, of the foundation of the right-angle co-ordinate system, polygonometry, spherical trigonometry.
Lower analysis	4 hrs.	„ 2 hrs.	Algebra, logarithms, geometrical progression, permutation, combination, interpolation, &c., &c.
Analytical plane geometry	In summer, 6 hrs.	„ 3 hrs.	Co-ordinate system, transformation of co-ordinates, lines of the 1st and 2nd order, exercises.
Descriptive geometry, I.	6 hrs.	„ 2 hrs.	Exercises on lines and planes, polygons, broken lines, planes and broken surfaces.
Plan and terrain drawing	2 hrs.		Copying plans in original and reduced size, elevation, maps with horizontals, &c.
Free-hand drawing. In 2 divisions,	each 4 hrs.		Figures from casts in outline.
German language „	„ 2 hrs.		Grammar, style, poetry, explanation of individual poems and classical works.
French language „	„ 4 hrs.		
English language „	„ 2 hrs.		
Geography „	„ 2 hrs.		Mathematics and physical geography, the principal countries, with regard to their history.
History „	„ 2 hrs.		General history, ancient history.
Religion { Evangelical / Catholic }	1 hr,		

Second Class.

Higher analysis, I.	4 hrs.;	repetition 2 hrs.	Differential calculus, fundamental functions, maxima and minima, &c., &c.
Analytical geometry of space.	In winter, 4 hrs.	,, 2 hrs.	Plane and right lines, surfaces of the second order, turning and right planes.
Descriptive geometry	4 hrs.		Sections of curved surfaces, &c., application of shadows and perspective.
Practical geometry	In winter, 4 hrs.		Encyclopædical review of plane geognosy, right-angle co-ordinates, and geometrical levelling.
General mechanics	6 hrs.		Elements of mechanics, solid and floating bodies.
General physics	In winter, 4 hrs.		
Drawing of buildings	,, 4 hrs.;	in summer, 8 hrs.	Geometrical representations of architectural objects, lectures on shadow drawing.
Free-hand drawing	,, 4 hrs.;	,, 2 hrs.	
Review of German literature	1 hr.		
French language. In 2 divisions, each	2 hrs.		
English language ,,	,, 2 hrs.		
History	2 hrs.		Universal history, middle ages and modern.

Mercantile Class.

Counting house	6 hrs.		Introduction to commerce, various kinds of trades, various manners of book-keeping, conduct of an imaginary business, various kinds of "conto" currencies.
Mercantile arithmetic	4 hrs.		Calculation of values; interest, compound and simple; exchange, &c., &c.
Mercantile geography	3 hrs.		Dependence of productiveness on longitude and latitude, on elevation over the sea, on mountains and directions of rivers. Europe and the Colonies. Lands, with regard to merchandise and commerce.

German language		2 hrs.	
French language		4 hrs.	
English language		4 hrs.	
Italian language		5 hrs.	
French correspondence		2 hrs.	
English and Italian correspondence		2 hrs.	
Introduction to the laws of exchange		1 hr.	
Free-hand drawing		2 hrs.	
Religion		1 hr.	In common with the Mathematical class.
Gymnastics for the whole mathematical division		2 hrs. a week.	

B.—TECHNICAL DIVISION.

1. *Mathematics and Mechanics.*

Trigonometry and lower analysis		4 hrs.	
Higher analysis, I.	In winter,	4 hrs.	
" II.		2 hrs.	Differential comparisons, decided integrals, &c.
Analytical geometry	In winter,	4 hrs.	
Newer geometry	In summer.		
Descriptive geometry		4 hrs.	Applied to shadow-drawing and perspective.
Practical geometry.			
Method of least squares	In winter	3 hrs.	
Analytical mechanics		4 hrs.	
Engineers' mechanics.			

2. *Natural History.*

Zoology	In winter,	4 hrs.	Universal systematic zoology, with regard to comparative anatomy, pharmacy, and agriculture.
Anthropology	„	2 hrs.	Knowledge of the construction of the human body.
Botany	In summer,	4 hrs.	Universal and special botany.
Medicinal pharmaceutical botany	„	3 hrs.	Natural families of plants.
Knowledge of plants	In winter,	4 hrs.	With regard to their medicinal qualities.
Anatomy and physiology of plants	„	3 hrs.	
Use of plants	In summer,	one afternoon.	
Use of the microscope		One afternoon.	
Mineralogy	In winter,	4 hrs.; repetition 2 hrs.	
Crystallography	„	2 hrs. lecture	The chemical and physical properties of crystals.
Geognosy	In summer,	4 hrs., with exercises.	
Petrology		4 hrs.	
Physical practice		Two afternoons.	
General and technical chemistry		6 hrs.	
Chemical practice		9 to 12	The laboratory is open from 9 in the morning till 5 in the afternoon.
Chemistry for builders	In winter,	4 hrs.; in summer, 2 hrs.	The lecture is for those who are not going into chemistry as a profession, but only in so far as it concerns their individual professions.
Analytical chemistry	„	2 hrs.; in summer, 3 hrs.	Qualitative and quantitative analysis.
The modern theories of chemistry		In winter, 2 hrs.	

3. *Technology.*

Chemical technology	In winter, 3 hrs.; in summer, 4 hrs.	Burning materials, lighting and fier. starch and sugar, vinegar, &c.
" in practice	9 hrs. private.	
Mechanical technology	4 hrs.	The metals most necessary to technics, their working; wood; visits to working establishments.
Heating	In summer, 4 hrs.	Preparation, burning materials, transmission of heat, hearths, chimneys, ventilation.

4. *Machinery.*

Preparatory course	3 hrs.	For those who have worked in the shops, but do not possess the necessary knowledge to attend the other classes. Repetition of lower mathematics, elements of analytical geometry, differential and integral calculus, mechanics.
Construction of Machinery, I.:—		
(*a*) Lecture	5 hrs.	Adhesiveness of materials, elements of machinery, water-wheels.
(*b*) Exercises in construction	6 hrs.	
Construction of Machinery, II.:—		
(*a*) Lecture, combined with practice,	7 hrs.	Stationary steam engines and steam kettles, locomotives and marine engines.
(*b*) Construction	6 hrs.	
Construction of Machinery, III.:—		
Lecture	4 hrs.	Designs for entire works (workshops), pumps and all the apparatus for works with steam and water power, with heating and lighting, disp. of machines.
Construction	6 hrs.	
Machinery for engineers	Lecture, 2 hrs.	Application of steam and water power.
Popular machinery	4 hrs.	Machinery for raising heavy bodies, machines for working by water and air, locomotives and railways.
Statistics of iron roof and bridge construction	1 hr. private	Calculations of cost.

5. *Engineering.*

Practical geometry	In winter, 2 hrs. lecture		Instru. for measuring angles, plane triangulating, trigonometric and barometric levelling.
„	In summer, one afternoon for each division		Practice at measuring and distance tables, and the theodolite, trigonometric elevations. Excursions of fourteen days.
Engineers' mechanics	5 hrs. lecture;	4—6 hrs. practice	
Winter course			Elasticity and strength of building materials, beams, ceilings, buttresses.
Summer course			Statics and dynamics of liquid and gaseous bodies, with regard to the practical work of an engineer.
Bridge building, I.	In summer, 4 hrs. lecture;	4 hrs. practice	Stone constructions, especially stone bridges.
„ II.	6 hrs. lecture;	6 hrs. practice	Wooden and iron bridges, foundations, mode of building.
„ III.	In winter	6 hrs. practice	Iron bridges.
Ponts et chaussées, and railway construction	In winter, 8 hrs. lecture;	4—6 hrs. practice	Mills, fountains, &c., railways, stations, bridges, roads, carriages, barriers, signals, telegraph stations, and telegraphs.
	In summer, 4 hrs. lecture;	12 hrs. practice	
Tracing and ("earth calculation"?)	In summer, 2 hrs.		

6. *Architecture.*

Building materials	In summer, 4 hrs.		Physical properties of mineral and vegetable building materials, &c., &c.
Construction of buildings, I.	4 hrs. lecture;	6 hrs. practice	Stone and wood buildings.
„ II.	2 hrs. lecture;	4 hrs. practice	Iron construction, and put-together buildings.
Higher architecture	2 hrs. lecture;	4 hrs. practice	Public and private buildings, designs and plans, &c.
Calculation of building costs	In summer, 2 hrs.		
History of architecture (I. and II.)		2 hrs. each.	Ancient, middle age, and renaissance.
Practice to the above (I. and II.)		2 hrs.	Graphic drawings and details of each period, with regard also to materials.

Comparative building forms	In summer, 2 hrs.	As a preparation to designing.
Designs (I. and II.)	Two successive courses, one with 4 hrs., the higher with 8 hrs.	
Artistic perspective (I. and II.)	Two successive courses, each with 2 hrs.	A subject is given to the student to finish in one day, which is judged by all the architectural teachers, and discussed with the pupils.

Drawing and Modelling.

Free-hand drawing	In winter, 8 hrs.; in summer, 6 hrs. with excursion.	Figure drawing, landscape drawing, in outline and shadows.
Ornamental drawing and modelling	In three divisions, each with 6—8 hrs.	Drawing of ornaments from clay and plaster, designs for ornaments, casts done by the students in clay or plaster from their own or others' designs.
Special drawing classes for engineers, mechanics and architects.		

General Subjects.

History of the 18th and 19th centuries		2 hrs.	
History of the last twelve years		1 hr.	
History of art in the middle ages	In winter	4 hrs.	
Dürer and Holbein	In summer	3 ,,	
Raphael and Michael Angelo	In winter	2 ,,	
Explanation of works of art in the State collection	up to	6 ,,	
Mythology of the Greeks, Romans, and Germans	In winter	2 ,,	private.
History of modern German poetry, in winter		2—3 ,,	
Principles of esthetics (or knowledge of the beautiful)	In winter	3 ,,	
Agriculture and husbandry		3 ,,	
Trades :—		3 ,,	
Borrowing money for founding a factory —by advances, shares, companies, &c. Interest on capital, premiums, dividends. Profit and loss, &c., &c.			
Laws of property		3 ,,	
Grammar of the middle ages		3 ,,	private.
Modern German grammar		3 ,,	,,
Poetry		2 ,,	,,
French language and literature		4 ,,	
English language and literature		3 ,,	
Shakespeare's dramas		1 hr.	private.
Italian—with the mercantile class		5 hrs.	
Gymnastics		2 ,,	
Fencing			private.

Workshops.

Modelling of machinery and engineering objects. Both workshops are open all day.

PLAN OF STUDY.

The plan of study for the mathematical division is given above.

In the technical division the choice of lectures is left free to the students. A plan of study is here given as a sort of guide to the subjects which are most necessary for each profession, the time which the student has to devote to it, and the proficiency or position he desires to obtain in it.

A.—*Architectural School.*

First year.—Chemistry for technic builders; mineralogy and geognosy; practical geometry, with practice; engineering mechanics, with practice; building construction, I., with practice; history of art; free-hand and ornamental drawing.

Second year.—Building construction, II., with practice; building construction, I., with practice; designs, I.; perspective, I.; free-hand and ornamental drawing.

Third year.—High architecture, with practice; history of building, II., with practice; comparative building forms; designs, II.; perspective, II.; free-hand and ornamental drawing.

Pupils who wish to go further, and become higher architects, decorators, &c., have a special fourth year's course laid out for them by their master, which will be regulated according to their special talents, the advance they have made, &c.

B.—*Engineers' School.*

First year.—Chemistry for technic builders; mineralogy and geognosy; practical geometry; engineering mechanics; construction of bridges, with practice; building construction, I., with practice.

Second year.—Bridges, II., with practice; building construction, II., with practice; construction of machinery for engineers; practice in the construction of machinery; building history, I.; free-hand drawing.

Third year.—Bridge building, III., ponts et chaussées, railways, with practice; surveying and calculations of earth works; history of building, II., with practice.

C.—*Machinery School.*

First year.—Chemistry for technical builders; engineering mechanics; construction of machinery, with practice; free-hand drawing; mechanical workshops.

Second year.—Construction of machinery, II., with practice; mechanical and chemical technology; bridge building, II.; heat.

Third year.—Construction of machinery, III., with practice; ponts et chaussées; building, II.; agriculture (political economy).

D.—*Chemical School.*

1. For technical chemists and teachers of chemistry:—

First year.—Physics for chemists; general and technical chemistry; analytical chemistry; mineralogy; construction of buildings.

Second year.—Analytical chemistry; chemical practice; chemical technology; practical physics; practical mineralogy; popular mechanics.

Third year.—Chemical practice; chemical technology; laws of property.

2. For miners:—

First year.—Physics for chemists; universal and technical chemistry; mineralogy; machinery, I., with practice; construction of buildings, I., with practice.

Second year.—Analytical chemistry; chemical, physical, and mineralogical practice; machinery, II., with practice; heat.

Third year.—Chemical practice; chemical technology; machinery, III., with practice; farming and husbandry (political economy); laws of right and possession.

3. For apothecaries. (It is a two years' course, but if the pupil has made sufficient progress, he can pass in one or one and a half years) :—

First year.—Physics for chemists ; universal and technical chemistry ; knowledge of medicine ; zoology ; general botany ; medicinal properties of plants ; mineralogy ; chemical and microscopic practice.

Second year.—Analytical chemistry ; chemical and mineralogical practice ; pharmaceutical botany ; the anatomy and physiology of plants ; microscopic pharmaceutical practice.

II.—College for the Building Trades.

I.

The object of this school is to educate technically for the following trades :—

1. *Future master builders* (masons, stonemasons and carpenters).
2. *Lower technical builders* (upper building masters, public building and foundation builders, and constructors of reservoirs).
3. *Lower water-works and mill builders.*
4. *Geometers of the first and second class.*

Besides these, individual classes can be attended by—

Plasterers, tilers, roofers,
Lower mechanics, glaziers, turners,
Decorators, ornamental sculptors, modellers,
Engravers, gold and silver workers,
Gardeners and husbandmen &c.

The classes go on the whole year round, and the course consists of five half-years, and these can be taken either all in winter, all in summer half-years, or partly in winter and partly in summer.

The pupils are of two kinds—*ordinary* and *extraordinary.* The first are such as devote their whole time to the school ; and the second such as attend other schools, studios, &c. in addition.

II.

Conditions of admission :—

In order to be admitted into school the pupils must—

1. Have attained a certain age . . . . { (*a*) For the 1st class at least 14 years. (*b*) For the 2nd, 3rd, 4th and 5th classes respectively, 15, 16, 17 and 18 years, to which exceptions are sometimes made.
2. A certificate of good conduct.
3. The certificate of the necessary preparatory knowledge (for which they must pass an entrance examination).

In cases of minority a certificate of the permission of parents or guardians to enter the institution.

III.

Divisions :—

The school is subdivided into three departments :—

1. *A building school.*
2. *A geometry school.*
3. *A school for drainage and waterworks.*

IV.—Staff.

Head : Oberbaumeister v. Egle ; Assistant Head : Professor Häberle.

Professors and head masters :

For the building trades	8	professors.
„ practical geometry and pure mathematics	2	„
„ mathematics and natural history . .	4	„
„ free-hand and ornamental drawing .	2	„
„ general education	2	„
Other teachers :—For religion, for ponts et chaussées, for languages, for caligraphy, &c., &c., &c.	6	masters.
Assistant teachers	3	„

PLAN OF INSTRUCTION IN THE BUILDING TRADE SCHOOL.

First Class.

With two parallel divisions.

Destined for such pupils as have only attended the national schools, or who, having been at a higher school, were yet not found competent to enter the second class.

German language .	. 8	hours a week.	
French	. 4	„	
History and geography	. 4	„	
Caligraphy . . .	. 6	„	
Arithmetic . . .	. 6	„	(Vulgar and decimal fractions, compound and simple interest, &c.)
Elementary geometry	. 6	„	(Plane geometry.)
Free-hand drawing	. 6	„	(Plain lines, simple leaf and contour lines.)
Geometrical drawing	. 6	„	(Geometrical construction and decoration.)

Second Class.

Three parallel divisions.

German language .	. 6	hours a week.	(Continuation of the former class.)
French	. 2	„	
Caligraphy . . .	. 3	„	(Plan drawing.)

Geometry and stereometry	8 hours a week	(Continuation and completion of plane geometry, geometry of space and cubic contents.)
Algebra	8 ,,	(Powers, roots, logarithms, comparisons of 1st and 2nd grade.)
Plan drawing	8 ,,	
Ornamental drawing	6 ,,	(Simple drawing in colour and from plaster.)

Third Class.

Three parallel divisions.

Natural history	6 hours a week	(Weight and motion of water and bodies ; heat, &c.)
Representative geometry	8 ,,	
Trigonometry	2 ,,	
Practical geometry	6 ,,	
Plan drawing	6 ,,	(Complicated architectural details—windows, portals, &c.)
Ornamental drawing	6 ,,	(Chalk and pencil drawings in outline and shaded from plaster models.)
Building	5 ,,	(Form and decorative stone work, cornices, windows, entrances, &c.)
Construction	5 ,,	(Building in stone, walls in brick and stone, brick and tile building.)

Fourth Class.

Two parallel divisions.

Mechanics	3 hours a week	(Continuous lessons on stability applicable to beams and rafters, stability and machinery with regard to the requirements of technical builders.)
Applied representative geometry	6 ,,	(Applied to stone carving, shadows, &c.)
Plan drawing	6 ,,	(Drawing in outline of whole façades, and designs in renaissance style.)
Ornamental drawing	4 ,,	(Continuation of drawings in the third class.)
Knowledge of building materials	2 ,,	(Properties of various building materials, and their adaptation for different purposes.)

Building	5	hours a week	(Decoration of buildings and dwelling houses, size and disposition of space, &c., &c.)
Construction of buildings	5	„	(Wooden posts, scaffoldings, beams, joints and suspensions, locks and roofs, &c.)
Builders	4	„	(Instructions for master builders, tools and instruments, general rules, &c.)
Heating apparatus	6	„	(Chemical constitution and heating power of burning materials, temperature of burning, length of chimneys, drawing power, calculation of sizes and construction, roasting and fire-room grates, &c., baking arrangements.)
Building style	4	„	(Sketch of architectural history,—Greek and Roman styles, sketches.)

Fifth Class.

Division A.

Ornamental modelling	4	hours a week	(Modelling in plaster and clay, generally after drawings made by the pupils; casting.)
Building construction	4	„	(More complex roofs, suspended, &c. with iron applications; carpentry and glazing.)
Designs of buildings	9	„	(Designs for simple country and town houses, parsonages, &c., &c., in sections, ground plans and elevations.)
Building styles	4	„	(Old Saxon style, Roman and Gothic renaissance, sketches and designs in each style.)
Ponts et chaussées	4	„	(Roads, wooden and iron bridges.)
Calculations of building costs	4	„	(Estimates for materials and workmen, calculation for contracts.)
Agricultural buildings	3	„	(Arrangement of space, organisation of store-rooms, barns, outhouses, stables, &c.)
Mathematical practice	4	„	(Repetition of elementary mathematics, with exercises.)

Division B.

Designs for buildings .	10 hours a week	(Designs for large schoolhouses, business and dwelling houses on a limited space, hospitals, &c.)
Designs for parts of buildings . .	6 „	(Roofs, staircases, beams, and ceilings to be drawn in large and in minute detail.)
Repetition of mathematics, physics, and mechanics . . .	6 „	
Exercises on building materials . .	2 „	
Book-keeping . . .	1 hour a week.	

GEOMETRICAL SCHOOL (for Advanced Pupils).

Geometrical construction	2 hours weekly	(Solution of problems by construction.)
Algebra applied to geometry and stereometry	6 „	(Solution of geometrical and stereometrical problems by calculation.)
German exercises . .	2 „	

Special Classes for Geometers.

Representative geometry . . .	8 hours weekly	(As in the third class of the building school.)
Natural history (physics)	6 „	(As in the third class of the building school.)
Trigonometry . .	6 „	(Common trigonometry, polygonometry, transformation of rectangular co-ordinates.)
Plan drawing . .	4 „	
Popular building and plan drawing . .	8 „	(Building, measuring, &c.)
Practical geometry—		
From the 6th Nov. to 15th March . .	6 „	
From the 16th March to 1st May . .	28 „	
Mathematical practice	14 „	

OTHER INSTRUCTION.

Machine drawing . .	8 hours weekly	(Curves and angular constructions, drawings of parts of machines.)

Entrance fees.

For participation in *one* class during the whole course :—

(*a*) In the building school, 12 florins = 1*l.*

(*b*) In the building school (on account of greater length of course), 16 florins = 1*l.* 6*s.* 8*d.*

In cases where a pupil is declared by the community to be utterly without means, and can show a certificate of industry and good behaviour, he is admitted without payment, or on part payment only of the fees.

III.—College of Agriculture and Forestry.

1. THE INSTITUTION IN HOHENHEIM.

A.—*Agriculture and Forestry Academy.*

This numbered in the year 1865-66:—

I. *Teachers' places* :—

10 regular professors (including the Director) ; 6 under-masters ; 2 ushers ; and 3 assistants = 21.

II. *Students* :—

A.—In the Winter term 1865-66, 123 ; of whom 61 were of the country, and 62 strangers. These studied :

	Agriculture.	Forestry.	Total.
Inhabitants . .	24	37	61
Strangers . . .	60	2	62
	—	—	—
	84	39	123

Of the 62 strangers, 41 were from other German places : namely, Austria, 15 ; Prussia, 9 ; Bavaria, 5 ; Holstein, 4 ; Baden and Hamburg, each 3 ; Hessen, Homburg, and Lubeck, each 1. 21 came from other countries ; as, Russia, 11 ; Switzerland, 3 ; England and Norway, each 2 ; Portugal and Brazil, each 1.

B.—In the Summer term 1866, 108 ; of whom 56 were inhabitants, and 52 strangers. These studied :

	Agriculture.	Forestry.	Total.
Inhabitants . .	18	38	56
Strangers . . .	50	2	52
	—	—	—
	68	40	108

Of the 52 strangers, 33 were Germans ; namely, Austria sent 10 ; Prussia, Bavaria, and Baden, each 4 ; Holstein, 3 ; Hamburg, 2 ; Frankfort, Lubeck, Hanover, Saxony, Mecklenburg, and Kurhessen, each 1 ; and from other countries came 19 : Russia sent 11 ; Switzerland, 4 ; England, Belgium, Portugal, and Brazil, each 1.

III. *Students' Excursions* were made (besides smaller ones) during the Summer term of 1866, to :

One Agricultural, to the Rechbergan seats, the Alb, and several estates in Upper Swabia.

One Forestry, in the hunting district Dankoltsweiler, the Forest of Ellwangen.

IV. *Distinction of Students*:—

	Husbandmen.	Foresters.	Total.
By prizes . . .	1 (stranger)	3 (inhab.)	4
By public commendation	1 (stranger)	1 (inhab.)	2
	2 (strangers)	4 (inhab.)	6

V. *Collections, Apparatus, and Institutions of the Academy*—together 18.

B.—*The Farming School.*

On the 1st of October, the number of scholars was 25.

At the close of the school year, 9 left the establishment, of whom 4 went to assist their father in his farms, 3 became stewards in the country, and 2 stewards of projects abroad.

The head-master taught field-measuring and botanising on Sundays and holidays, not counting 464 hours, of which 118 were devoted to agriculture ; farming, 81 ; geometry and stereometry, 52 ; German language, exercises, &c., 43 ; mental arithmetic, 39 ; accounts, 22 ; physics, 24 ; and drawing, 45.

The medical professor of the academy gave 37 hours lessons of instruction in veterinary surgery.

Excursions of four days were made, with the older classes, to Baden and Strasburg, besides which there were several minor excursions in the neighbourhood.

C.—*The Gardening School.*

Five pupils were entered on the 15th October, 1865, of whom, at the end of one school year, 1 remained for further instruction in Hohenheim, 1 was dismissed on account of illness, 1 emigrated to America, and 2 obtained situations as gardeners.

The instruction given by the two gardeners of the institution occupied 280 hours, of which 45 were devoted to botany, 10 to fruit trees, fruits, and the knowledge of special plants, 16 to repetitions, and 86 to drawing. The remaining lessons they share with the pupils of the schools for farming.

D.—*Special Agricultural Courses.*

1. The courses for meadow-land, and draining, and marking boundaries, could not be given on account of the non-attendance of pupils.
2. Nine attended the sheep-course.
3. The fruit-tree course, in two divisions, was attended by 29 pupils. Seven from the Neckar district, 10 from the district of the Black Forest, 2 from the Taxt district, and 10 from the district of the Danube.

4. The agricultural course for national school teachers was attended by 19 teachers.

E.—*Advice on Agricultural Matters*

was asked : about malt kilns ; on hop-drying kilns ; and on the cultivation of lupines.

---

2. FARMING SCHOOLS IN ELLWANGEN, OCHSENHAUSEN, AND KIRCHBERG.

These are adapted for 12 pupils, with a three years' course—so that each establishment has 4 pupils.

Excursions were made by the pupils with the director or another master : 5 in Ellwangen ; 2 in Ochsenhausen ; 3 in Kirchberg.

The State domains on which these farming schools are built, comprise :

In Ellwangen . . . . $394\frac{5}{8}$ miles.
In Ochsenhausen . . . . $414\frac{7}{8}$ miles.
In Kirchberg . . . . $553\frac{5}{8}$ miles.

A brewery is attached to Ellwangen, in which 1800—2000 kilderkins of beer are brewed yearly.

---

3. THE FINISHING FARMING SCHOOLS, AND OTHER ARRANGEMENTS, CLASSES, ETC., FOR THE SAME PURPOSE.

	Obligatory winter evening schools, with instructions in farming.	Free finishing schools for farmers.	Agricultural meetings.	Agricultural lecture meetings.	No. of Establishments together.
In the Neckar district	46	48	9	12	115
In the district of the Black Forest . .	90	40	12	11	153
In the Taxt district .	72	19	10	8	109
In the Danube district	97	17	15	17	146
In the whole country.	305	124	46	48	523
The attendance at these classes was :					
In the Neckar district	1500	1000	300	350	3,150
In the district of the Black Forest . .	2130	800	290	210	3,430
In the Taxt district .	1220	350	270	180	2,020
In the Danube district	1980	480	630	350	3,440
In the whole country.	6830	2630	1490	1090	12,040

So that, in 523 establishments, 12,040 persons enjoyed the privilege of instruction in agricultural matters.

The winter evening schools are the affair of the schoolmaster concerned. The instruction in the free finishing agricultural schools was principally given by the schoolmasters, and also by clergymen, veterinary surgeons, magistrates, and farmers.

In the agricultural evening meetings, the lectures were given by the schoolmasters and farmers of each district, who also superintend the reading rooms and libraries.

IV.—Veterinary College.

In the school year 1865-66, with two courses, it numbered :

I. *Masters :—*

4 head-masters, 1 assistant teacher, 1 usher = 6.

Besides these regular masters, the pupils had lessons in chemistry and botany from two other masters.

II. *Pupils :—*

57 ; among whom there were 55 regular, and 2 irregular ; 45 civil, and 12 military pupils ; 41 inhabitants, and 16 strangers (of whom, 4 were from Schleswig-Holstein, 4 from Switzerland, 2 from Baden, 1 from Hanover, 1 from Hesse-Darmstadt, 1 from Kurhesse, 1 from Oldenburg, 1 from Luxemburg, 1 from Russia).

III. *The Examination* was attended by 30 pupils, namely, 15 inhabitants, and 5 strangers :—

Of the 15 inhabitants, 1 obtained the first class, 11 the second, 2 the third, 1 no prize.

Of the 5 strangers, 4 obtained the second class, 1 the third.

IV. *Prizes were awarded :—*

In the second course, a first and a second.

In the first course, a first and two second, and besides, two "Smith prizes."

V. *Institutions :—*

1. *The hospital* had to do with—

(*a*) On the whole, 775 horses, of whom—

522 (26 more than in 1864—65), were taken into the stables of the establishment, and

253 were treated out of the establishment.

Of the 522 horses—

453 were put under doctors' care.
299 on account of interior illness.
154 on account of external illness.
69 were examined for defects.

Of those 453 which were treated, 307 were cured, 73 improved, 41 killed, 11 shot, and 21 sent away as incurable.

Besides this, there were 29 horses used for anatomical purposes, operations, dissections, &c.

Whole number of horses, 804.

(*b*) *The cattle in the hospital* and those attended in the stables of their proprietors, numbered, in the town and its eighteen suburban villages, 820 animals.

Besides this, there were 6 cows for the supply of the pock lymph for the central vaccinating doctor.

Total number of cattle, 826.

(*c*) *The dog hospital* had to do with 213 animals, of whom—
175 were handled medically, and
38 put under the supervision of the police.

Of the latter 38—
7 were killed for biting,
24 were taken up as mad, of whom 16 were shot as regularly mad.

(*d*) Of other animals with which the establishment had to do, the following are the numbers:

23 cats.
14 sheep (7 in the institution, 7 out).
40 pigs (3 in the institution, 37 out).
16 goats.

Total . . 93

Entire number of domestic animals treated by the establishment—1936.

2. *In the smithy* (in the course of the year 1865—66):—

Shoes finished . . .	2605	
Animals calked . . .	1009	Among whom, 810 were of the town, 199 from outside; 1001 horses, and 8 head of cattle.
Animals shoed . . .	4035	Of which 1948 were new, 2087 old.
Given out to do . . .	602	
Given out to pupils in the 2nd course as patterns .	70	

VI. *Collections*:—

1. Exclusive of journals and papers, the library was enriched by 47 numbers.
2. The collection of anatomical and pathological works was enriched by 57 numbers.

VII. *Opinions (Judgments) given in Court*, 10.

VIII. *The Special Course for Smiths*, which was established for the central agricultural and trade places, was attended by 8 people (4 masters, and 4 apprentices).

V.—School of Art-Workmen.

I. *Masters' Places*:—

4 principal masters and 4 assistant masters—together, 8.

(In the Summer term, 1866, an extra head master was employed.)

II. *Pupils*:—

In the Winter term 1865—66, 50 (1864—65 there were 59; 1866—67 there were 55).

Among these 50 there were:—

(*a*) 44 regular; 6 irregular.

(*b*) Würtembergers, 42; strangers, 8 (from Austria, 2; Saxony, 1; Baden, 1; Grand Duchy of Hessen, 1; Nassau, 1; Saxe Coburg, 1; America, 1).

(*c*) According to calling:—12 painters, 18 sculptors, 5 lithographers, 1 engraver, 2 wood engravers, 3 drawers, 1 decorator, 2 room decorators, 1 modeller, 1 dilettante.

Concerning the attendance at the different classes, there were:—

At the drawing and modelling after the antique	26
At the drawing and modelling after life	30
At the landscape drawing	21
At the oil painting	12
At the lessons in perspective and shading	6
At the lessons in anatomy	30
At the lessons in the history of art	9

III. *In the Examination* which was held according to law in 1866, there were 5 favourable results.

IV. Ten art pupils obtained *Exhibitions*, 5 for further instruction in the art schools of Würtemberg, 5 to enable them to continue their studies abroad. Besides this, 7 were taught free of expense.

V. *Prizes* were awarded to 10 pupils—5 first, and 5 second.

VI. *For the Exhibition* of students' works of art, which precede the examinations, 19 works in plaster were sent; among which there were 4 statues and a relief, all original, and a relief portrait; 19 drawings from the antique; and from nature:—

1 Portrait drawing.	2 Studies of animals in oils.
15 Landscapes.	1 Coloured cartoon (composition), and
26 Heads in oil.	3 Engravings on copper.

VII. 12 *Works* were bought or ordered of the best pupils, the total price of which was 1,972 fl. (168*l.* 6*s.* 8*d.*); the price of the lowest being 50 fl. (4*l.* 3*s.* 4*d.*), and the highest 580 fl. (48*l.* 6*s.* 8*d.*)

VI.—High Schools or Academies and Science Schools.

A.—*High Schools or Academies.*

1. On the 1st of March there were 88 public academies. These are subdivided into—
    - 4 low Evangelical seminaries.
    - 7 land gymnasiums, of which one is in connection with a boarding-school, Catholic.
    - 3 lyceums and one Latin school, with an upper provisional lyceum class, and
    - 73 lower Latin schools, of which two are erected provisionally.
2. The public academies numbered, on the 1st of March, 1866, together, 225 school classes, of which 7 were provisional. Of these, there were—
    - In the seminaries, as well as in the upper divisions of gymnasiums and lyceums (including 3 provisional classes), 33 classes.
    - In the middle and lower divisions of the gymnasiums and lyceums (including a provisional class), 66 classes.
    - In the 73 lower Latin schools (including 3 provisional classes), 126 classes.
        - Under the Latin schools there were 32 schools with 1 class, 31 with 2 classes, 9 with 3 classes, 11 with 5 classes.
        - The gymnasiums and lyceums numbered 23, the lower Latin schools 42, together 65 classes.
3. In the public academies there were, on the 1st of March, 1866, in all 246 definitive head-masters' places (besides 5 provisional ones). Of these, there were—
    - In the seminaries and upper divisions of the gymnasiums and lyceums, 60 places.
    - In the middle and lower divisions of the gymnasiums and lyceums (including the places mentioned above), 64 places.
    - In the lower Latin schools (including 24 assistants' places), 122 places.

4. The number of pupils in the academies was, on the 1st of March, 1866, 4565. Among these were 100 non-Würtembergers.

If, on the one hand, the pupils in the lower Evangelical schools and those of the Catholic conviction, as well as the pupils in the higher classes of the gymnasiums and lyceums, are taken under the head of gymnasium scholars, and if, on the other hand, the pupils in the middle and lower gymnasium and lyceum classes, as well as the lower Latin classes, come under the head of Latin scholars, the following numbers will be the result :—

(*a*) On the whole there were on the 1st of March, 1866 :—

1. Gymnasium pupils.	2. Latin scholars.	3. Total.
635	3930	4565.

B.—*Public Real Schools.*

1. The number of public real schools was, on the 1st of March, 1866, 76, of which 9 had special upper real classes.
2. These numbered 160 pupils' classes, of which 17 were upper real classes, and 26 assistants' classes.

These 160 classes were divided as follows :—

52	real schools	numbered each	1 class.
11	„	„	2 classes.
5	„	„	3 „
4	„	„	5 „
1	„	„	7 „
2	„	„	8 „
1	„	„	28 „

3. There were in all 169 and 143 definitive masters' places. Among the latter there were :—

18 head-masters' places in upper real schools (professoriats).
106 real-teachers' places.
19 assistants' places.

4. The total number of real scholars was 4734, of which 328 were upper real school pupils. Of these there were :—

Protestants	3715
Catholics	793
Israelites	221
Other sects	5
	4734

The schools which had the most pupils are the following :—

Stuttgardt,	with	988	pupils,	of whom	141	were upper real scholars.
Neutlingen	„	262	„	„	36	„
Ulm	„	248	„	„	16	„
Esslingen	„	224	„	„	42	„
Heilbronn	„	172	„	„	19	„

Hall,	with	172	pupils, of whom	21	were upper real scholars.	
Ludwigsburg		171	" "	17	"	"
Cannstatt	"	121	" "	...	"	"
Biberach	"	114	" "	...	"	"
Tübingen	"	113	" "	14	"	"
Gmünd	"	110	" "	...	"	"
Ravensburg	"	106	" "	...	"	"
Rottweil	"	84	" "	22	"	"
Göppingen	"	80	" "	...	"	"
Nürtingen	"	78	" "	...	"	"
Freudenstadt		71	" "	...	"	"
Kirchheim	"	70	" "	...	"	"
Caln	"	66	" "	...	"	"
Aalen	"	60	" "	...	"	"

VII.—Elementary Government Schools.

The nine towns which have elementary schools under the superintendence of the masters and clergymen appointed by the Minister for Education, and the object of which is the preparation of boys from six to eight years old for entrance into higher schools, numbered, on the 1st of March, 1806, in all, 22 pupils' classes, with 22 masters and 1006 pupils; of whom 901 were Protestants, 60 Catholics, 44 Jews, and 1 own confession.

The following are the towns, with attendance, and teachers:—

Stuttgardt	10 classes,	10 masters, and	404 pupils.
Ulm	3 "	3 "	149 "
Neutlingen	1 "	1 "	112 "
Esslingen	2 "	2 "	95 "
Heilbronn	1 "	1 "	66 "
Ludwigsburg	1 "	1 "	60 "
Cannstatt	1 "	1 "	58 "
Tübingen	2 "	2 "	47 "
Oehringen (provisional) .	1 "	1 "	15 "
	22	22	1006

An analogous arrangement exists in many of the elementary classes of the country town schools, principally in the real or lower Latin schools with one class, in which the children who attend the national schools get extra preparation for their future entrance into higher schools.

Establishments for Private Instruction.

1. Boys' school, kept by Professor Pfleider, in Kornthal, with 112 pupils; of whom 107 are Protestants, 5 Catholics, 32 Würtembergers, and 80

strangers; of whom 21 are Germans, and out of the rest of Europe, 46; Asiatics, 2; Americans, 6; and Africans, 5.

2. The educational institution in Ludwigsburg, with 59 pupils.
3. The boys' school, of Professor Close, in Cannstatt, with 42 pupils.
4. The private elementary school of Hayer, in Stuttgardt, with 136 pupils.

VIII.—Industrial Schools.

1. *In the year* 1865—66 *there were*—

In Evangelical communities—

394 schools, 32,992 girls, and 977 boys=33,969 pupils.

In Catholic communities—

504 schools, 17,544 girls, and 644 boys=18,188 pupils.

Total of all industrial schools, 1450, with 52,157 pupils, of whom 50,536 were girls, and 1621 boys.

2. *Hours of study*:—

Number of hours taught in all the schools, 266,691.

3. *Teachers*:—

(*a*) In the Evangelical schools, number of female teachers, 1210.

Their salaries together amount to 20,913 fl. (1726*l.*)—so that each mistress has on an average 17 fl. 17 kr. (1*l.* 8*s.* 9*d.*)

(*b*) In the Catholic schools, the number of teachers is 568.

Their salaries amount to 10,043 fl. 31 kr. (838*l.* 11*s.* 8*d.*) averaging 17 fl. 40 kr. each (1*l.* 9*s.* 10*d.*).

Total number of teachers, 1778.

4. *School costs*—books, heating, and working materials:—

(*a*) On the Evangelical side, 32,963 fl. 15 kr. (2747*l.*), according to which, each school averages 34 fl. 51 kr. (2*l.* 18*s.* 5*d.*).

(*b*) On the Catholic side, 15,495 fl. 6 kr., according to which, each school averages 30 fl. 45 kr. (2*l.* 11*s.* 3*d.*).

Total, 48,458 fl. 21 kr. (4039*l.* 16*s.* 8*d.*).

5. *Grant from the State for this purpose*:—

To the 560 Evangelical communities . .	7184 fl.	=	598*l.* 13*s.* 4*d.*
To the Catholic side	3936 fl.	=	328*l.* 0*s.* 0*d.*
	11,120 fl.	=	926*l.* 13*s.* 4*d.*

FINANCIAL.

In the Kingdom of Würtemberg.

I. The number of masters was, on the 1st of January, 187.

A.—*Schoolmasters* :—

1.	With incomes of	400 fl.—424 fl. (33*l.*—35*l.*)	with house	rent free,	1352
2.	„	425 fl.—449 fl. (35*l.*—47*l.*)	„	„	749
3.	„	459 fl.—494 fl. (37*l.*—40*l.*)	„	„	200
4.	„	475 fl.—499 fl. (39*l.*—41*l.*)	„	„	64
5.	„	500 fl.—599 fl. (41*l.*—50*l.*)	„	„	163
6.	„	600 fl.—699 fl. (50*l.*—58*l.*)	„	„	113
7.	„	700 fl. and over (58*l.* and over)	„	„	43
					2684
B.—*Under masters*					299
C.—*Ushers*					644
			Total		3627

II. The number of masters who taught in classes :—

1. Head masters	459	Sum set aside for their payment, 20,150 fl. (1660*l.* 16*s.* 8*d.*). Average income of each master or assistant, 36 fl. 30 kr. (3*l.* 0*s.* 10*d.*).
2. Second masters	76	
3. Ushers	18	
	553	

Practical results of systematic national education.

In England I should naturally be asked whether all this admirable and systematic organisation for the teaching of a whole people, and of which I have said I have carefully watched the progress for twenty years, has been attended with any sensible result upon the character, manners, and works of the people of those countries. I should begin by saying that that is in effect asking me—Would the people of these countries be what they now are without that education? and as the two experiments could scarcely have been tried side by side, the answer must be in some degree hypothetical. I will, however, answer this question as best I can.

I begin by saying that when I compare in the same country the persons who had attained maturity before this system was instituted, and that younger generation which has gone through it and come out into the world of practical experience, I say without hesitation that they are more civilised, and that they set about their work in a wiser, shorter, less wasteful way; but this is scarcely a satisfactory answer, for in the interval between the uneducated generation and the educated one, comprising 15 to 18 years, everything there as elsewhere has changed in the direction of amelioration.

Character, manners, works.

Perhaps, however, the best standard by which an Englishman can judge a foreign people is by comparing them individually and personally with ourselves through the medium of their character, their manners, and their works. I will begin therefore by saying that when in those parts of an educated country where I am no longer a stranger, I meet an ordinary agricultural peasant, I find him more intelligent, better informed, more able to understand my questions and to give a direct, purposelike answer, than a peasant of the same class in England. He will talk politics to me, because he has read it in his newspaper; he will talk theology with me, for he studied it at school; he will discuss the Italian question, the Austrian question, and the French question, because at school in the second period he studied their geography, because he is up in their political history, and he knows all that has taken place in his own country from its earliest invasion. I had the good fortune to assist one day in a peasant revolution, as they called it. They were 7000. We stood out in a pour of rain for two hours. The question was whether, to the number of 10,000, the people should sign a paper asking for a change of men and of measures in a part

An educated peasant.

A revolution—among educated peasants.

An educated mob.

of the country where the same politicians had governed for 25 years. The whole meeting was as orderly and quiet as a ballot for members in a Pall Mall club; the crowd was so quiet that we all distinctly heard one man speak from the platform. I discussed with some of this mob their grievances, which they stated with the greatest good humour; they were the following: That the banks and credit establishments of the district were so organised as to favour the more wealthy borrower as against the smaller landowner or manufacturing borrower, and they wanted the honest poor man to be trusted on the same terms as the honest rich man; second, they conceived that the town districts inhabited by the poor were not so perfectly cleansed and supplied with water as those inhabited by the rich; thirdly, that the character of the education given in the public schools of the second period did not prepare their children for the third period so well as it ought. As to the slightest violence, rudeness, or bad manners, these men would simply have despised any member of the meeting so vulgar as not to know how to behave himself; and I think I can say that in that mob my clothes—and I had dressed like one of themselves—were not touched by those of any other person. I must confess that I came out of that mob humiliated: the gathering corresponded to our Hyde Park meeting, for they were of the lowest class to be found in a populous manufacturing district. They were brought together by demagogues, one a barrister, another a master workman, a third the editor of a newspaper. I will add that it was on a Sunday, and that every one had on a Sunday suit, though some of these suits might have performed that function 10 or 15 years. The petition was afterwards signed to the required number, and the revolution put into due official train. Need I say that of such democrats and such revolutions one need have no fear?

Common street life.

In the daily life in a street in an educated country I see the absence of rude and rough manners, and I recognise a general aspect of superior intelligence. I call a street porter and give him a message—he sees I am a stranger, and answers me in French or perhaps in English; I intrust him with some purchases at various shops; on his return, he delivers to me a neat account like the bill of a hotel, properly balanced. One of the items in the account was the purchase of a book. Learning at the publishers that the book was out of print, he bethought him of going to a bookstall for an old copy. He brought me one as good as new for less than half-price, but never thought of pocketing the difference. Let me next take a waiter at a hotel. We were talking at table of a play by Schiller which had a French name which was announced to be played, and of which none of us had before heard: the waiter, finding he could solve our difficulty, begged pardon for informing us that he had read in the life of Schiller that the play was an adaptation from the original in French by Racine. These are the little things which in a foreign country give the stranger a truer measure of relative civilisation than more striking characteristics, but when one finds them at every turn pervading the whole structure of society—when one finds in their beer-houses, their cafés, and their dancing rooms, that with some exceptions as to clothes and tone of voice, they are courteous and well-bred, and their countenances full of intelligence and good feeling, one seeks the cause, and finds it in a superior education and consequent superior social condition.

Money-making—in educated nations.

I will now come to the practical matters which show directly the results of a technical education in the production of one of its chief objects—the creation of wealth. It is notorious that those foreign railways which have been made by themselves in the educated countries of Germany and Switzerland have been made far cheaper than those constructed by us in England; it is known that they have been made by pupils of the industrial schools and technical colleges of these countries, and I know many of their distinguished men who take pride in saying that they owe their positions entirely to their technical schools. I find everywhere throughout their work marks of that method, order, symmetry, and absence of waste which arise from plans well thought out, the judicious application of principles, conscientious parsimony, and a high feeling of professional responsibility. In the accurate cutting of their slopes and embankments, in the careful design and thoughtful execution of their beautiful but economical stonemasonry, in the self-denying economy of their large span bridges, the experienced traveller can read as he travels the work of a superiorly educated class of men; and when we come down to details, to the construction of permanent way, arrangements of signals, points, and sidings, and the endless details of stations, we everywhere feel that we are in the hands of men who have spared no pains, and who have applied high professional skill to minute details.

Economy of public works.

It is well known that many years before we would follow their example, the engineers of the German railways had introduced a system of constructing and of uniting to each other the iron rails of the permanent way, which made them cheaper, more durable and safe than those employed in England. Happily for our national reputation it was an Irishman who invented it, though its advantages had first to be appreciated in Germany before we would follow the example.

It is remarked by every traveller that the works of their railway stations are, when compared with ours, much more beautiful, convenient, and fit, both within and without; the construction of their trains, the proportions of their carriages, the fitness, convenience, and comfort of their internal arrangements, all tell to the disadvantage of ours, and the one thing in which our railways excel theirs is in high speed. Theirs, on the other hand, are economical in capital and high in revenue.

Political eminence of educated nations—Prussia.

It is now so much the practice to praise Prussia, that it is not without reluctance that I have decided to give expression to the result of twenty years of occasional visits to that country. The worship of mere success is so vulgar a feeling that I would not willingly add my voice to that chorus, but what I now say, I have been saying any time for these twenty years. When first I knew her she was a very poor country. Territorially she was weak, consisting of scattered patches of land isolated from one another, and surrounded by nations neither loving nor helpful, and even the feelings of the different portions of her own community were anything but cordial to one another. The taxation, as compared to the revenue, was enormous, and the tax in person paid by the compulsory and universal service in the army weighed heavily on the people. The length of frontier to be defended was so great that every working man in the kingdom was compelled to do his work as it were with tool in one hand, and musket in the other. It was difficult for an Englishman to see how such a country could be tied together and acquire unity, and nothing but a careful study of their institutions could enable him to do so. In the end, however, I came to see the importance, in a political point of view, of the highly-organised system of education which, pervading all ranks, has succeeded in producing two generations of educated men. This education was the same in all parts of Prussia, but by no means the same as in the surrounding portions of Germany. That first gave her an intellectual unity. Another remarkable institution, co-ordinate with this, was the political organisation, that, like the education, was of one uniform system through all the parts of the kingdom and through all degrees. I do not think it is very generally known to Englishmen that Prussia is an organised democracy, and is not, as we imagined, governed by the King and an aristocracy. She is governed by an educated democracy, who come indifferently from every rank of society, who receive the highest education the country affords, who are selected entirely by the distinction attained in their technical and learned universities, and who thence rise to fill all the high offices of the State, except those personally surrounding the King, or forming the political government of the time. All the executive government is democracy, educated and organised; everywhere, in the highest offices, exercising the highest responsibilities, are found men of the humblest origin, owing their position entirely to education, ability, and long service. This same civil executive extends through every department of the country, and has its representative even in a small agricultural village. This is another element of homo-

An organised democracy of educated men.

geneity and unity; it is a system, however, quite foreign to our notions, for it makes a centralised unity of the people and the Government, which, with our unsystematic notions, we detest and vilify with the names of "centralisation and bureaucracy," forgetting that there is another name equally appropriate, namely, "organised education and intelligence;" for it is not possible to conceive a more admirable method of diffusing civilisation and order throughout a whole people, than to plant in every community, and even in every little village, a civilised, educated man, charged with the single duty of promoting the welfare, education, and order of that community.

The educated citizen-soldier.

The next institution which forms part of the education of the people, and tends to build up the unity of the nation, is that we have already referred to—the perfect training of every citizen to carry arms as a skilled soldier in defence of his country. I have shown how it acts as a direct instrument of education, from the fact that the army possesses an organised system of schools, in which both men and officers find the means of a finished education. But I have not mentioned the influence of that system on the health, constitution, civilisation, and good manners of the people at large. Side by side, in the barrack, in the field, the peasant private soldier and the peer private soldier serve as daily comrades on a perfect level, enjoying the amenities of life and roughing it together. All that we claim for our public schools on the ground of manliness, physical strength, good carriage, manual dexterity, habits of method and subordination, flows equally from the three years' education and discipline of the army, which is thus entitled to be called a university for the people.

The army a university.

But the indirect effects are perhaps greater than its direct influence, for each of these instructed men carries back into the narrow community of his village or town, and into his family, all the civilising influences of this education.

An educated people—a nation of patriots.

The last social result of systematic organised education which I will indicate is its effect in imbuing a whole people with a profound spirit of patriotism. I have never seen patriotism more profound or unselfish than in educated Germany and in educated Switzerland; here and there and everywhere are to be found individuals conspicuous for large self-sacrifice for the public good, but I am not now speaking of conspicuous persons. What I mean is this: that in those nations the whole mass of the people are individual patriots; personally, they are most industrious, but they will spare any time required from their occupations for the public good, without payment or grudging; personally, they are extremely frugal and economical, but for the common well-being of the community—of the State—of the city—of the village, they willingly impose upon themselves contributions from their hard-won earnings; and, what is perhaps a still higher measure of patriotism than money, men of strong wills, clear views, and energetic personality are ready to sacrifice their own views, preferences, and prejudices to that social organisation by which alone unity of action and efficiency is to be obtained for a nation or a community.

That this patriotism is the result of their large education and systematic training I cannot doubt; and I will venture to say that if the governing statesmen of any people desired to secure to their body permanent confidence, fidelity, and attachment, there is no way of implanting these sentiments so surely as by the conviction that the Government had watched over their infant years, had provided for their youth the invaluable blessing of high education, and had never withdrawn its wise solicitude until it had sent them out into life, educated, trained, useful members of society.

These remarks apply rather to the quickened intelligence and raised character of the people than to their material advantages. But I may add that in every country where technical education has taken root, and had time to bear fruit, I also find unquestionable proofs of the rapidity with which increased intelligence and enlarged knowledge bring increase in employment and remuneration. From my personal experience I may say that within the last twenty-five years I have seen large branches of commercial trade leave one country and plant themselves in another because the workers of the one were educated and those of the other uneducated; and I have watched nations rising into importance and power in Europe by education, and by the order, organisation, and efficiency which education bestows; and other nations lagging behind and losing their place by reason of their unwillingness to educate either the higher or the lower classes of their people. But these material considerations find a better place in the following Chapter than here.

Wealth in trade dependent on education.

CHAPTER IV.*

TECHNICAL EDUCATION A NATIONAL WANT.

Educated, helpful, patriotic citizens the real wealth of a nation.—Knowledge helps work, hinders waste.—Educated skill a way to wealth and well-doing.—English aversion to technical education.—General belief in England's perpetual supremacy :—A national error—Its correction.—National lessons:—Lesson I., 1851.—Lesson II., 1855.—Lesson III., 1862, humiliation.—Lesson IV., 1867, reformation, education.—Practical examples of benefits arising from organised technical education:—In iron manufactures—In iron armour and ships—In artillery—In railway plant—In manufactures of machinery—In quality and price—In intelligent workmanship—In the English specialty of steel work.—Results of a generation of foreign technical education.—One generation of education, fifteen years, lost to England.—Testimony of technical men to our national want of technical education :—Jurors—Government reporters — Government Commissioner — Working men.—I. Jurors.—Schools Commission.—II. Report of Government Commissioner.—III. Reports of workmen.—Workmen on technical training:—A chair-maker—A hosier—A stonemason—A china-painter—A wood-carver—Birmingham artisans.—Summing up the evidence.

Educated, helpful, patriot citizens the real wealth of a nation.

If I have heretofore insisted more on the value of systematic national education for moral purposes than as an instrument of material and pecuniary personal and national wealth, I have done so because of the faith which I profess that the wealth and greatness of a nation consist, to my mind, much more in the multitude of good citizens than in the multitude of good dollars. And by good citizens I mean men of good breed, strong-handed, warm-hearted, clear-headed, well trained in arms, deeply imbued with a Christian spirit, patriots, refined and educated human beings. A small

* A portion of this Chapter formed the substance of an article by the author on Technical Education, published in Macmillan's Magazine.

country, thinly peopled with such citizens, is, to my mind, a nobler sight than a crowd of luxurious capitalists, wallowing in the wealth of luxurious capitals, or than a huge bank cellar stored with hoards of coin.

Knowledge helps work—hinders waste.

If, however, I have dwelt rather on the intellectual, moral, and social wealth, which are the immediate results of the wide education and wise training of a nation, it has not been because I neglected or wished to undervalue the direct and immediate consequences which inevitably flow into trade, commerce, and art, from the employment of an intelligent, educated, and trained people. It seems to me almost an axiom that intelligent men must do better work than boors; that trained, skilled men must do better work than clumsy and awkward ones; and that the more any man knows of the objects and methods of his own work, and of the work of all those who around him are engaged in co-operation, the more likely he is to do his own part well, and so as to make it exactly fit into and form one with his neighbour's work. Thus I think that an intelligent community of workmen will get through their work quicker, will fit its parts more nicely, will finish off everything more sharply, will waste less material by trial and error, and so give higher value as well as quality and durability to all their work, than ignorant, unrefined, ill-educated men.

Educated skill a way to wealth and well-doing.

I believe, therefore, that it is the function of those who educate a nation with the intention merely of improving their character, their intelligence, and their ability, without taking any steps for the material object of making them wealthy, nevertheless to accomplish that feat also, largely and inevitably. But there is the second order of education, which I have called the narrow and the technical, and which we may also call *special*, by which every individual in a nation shall not only be cultivated into an able man, and trained as a good Christian, but shall, in addition, have a training in the peculiar knowledge and the specific skill of that narrowest routine of duty with which each citizen in a civilised State is necessarily called upon to occupy himself, and is expected to acquire higher skill in performing than other citizens around him. This special duty, craft, cunning or trade, by which he becomes habitually a mason, carpenter, joiner, plumber, smith, builder, architect, engineer, mechanic, ship-builder, naval architect, parson, pedagogue or philosopher—each of these duties must be learned by some one citizen, over and above and in addition to all that he knows in common with others. And as it is plain that the work of each citizen will have value in exact proportion as he can do it better than other citizens can, so it is obvious that the aggregate work of all the citizens will have greatest value in proportion as each has been best trained in his own department. In short, the highest value in the world's markets will be obtained by that nation which has been at most pains to cultivate the intelligence of its people generally, and afterwards to give each the highest education and training in this special calling. In other words, the value of the nation's work will vary with the excellence of the national system of technical education.

English aversion to technical education.

All I have said above seems axiomatic. To me it *is* so, but I trust the reader will not be offended if I am obliged to treat it quite otherwise. The English people do not believe in the value of technical education. Still less do they believe in the value of a national system of universal education. And still less in the duty of the Government, the Legislature, and the educated part of a community, to undertake the education of a whole people. I am therefore compelled to prove, as mere matters of fact, that which the accomplished scholar, or observant traveller, takes as an axiom on which argument is wasted. It is the object of this Chapter to prove that technical education has brought good of a material and commercial kind to those who possess it; that the want of it is attended with pecuniary loss, and that there is social danger to the community in our continued neglect of it.

General belief in England's perpetual supremacy:

Of late years a series of great public events have been taking place, which have been of great national value in serving to awaken the British people from that lethargy of supreme satisfaction with which they have so long continued to regard themselves as the most skilled, accomplished, and successful manufacturing people in the world. For half a century they had been enjoying the fruits of the inventions of a few men of genius who had created the whole system of modern manufacturing machinery, and Providence had also endowed them with the accumulated wealth of countless centuries stored up in the bowels of the earth, in the shape of coal and iron, ready to be used or wasted and worked out in this manufacturing century. The genius of a few men having set coal and iron to do the manufacturing work of mind and man, the citizens of England had begun to think that it was they who were superior in intelligence and civilisation to the un-coaled, un-ironed, un-engineered nations around them. For half a century nothing occurred to awaken them from this dream, and for that half century the works of English engineers and English iron and coal bore the highest reputation, and earned the highest prices in the world.

A national error—its correction.

The last eighteen years have seen a series of events, slowly, regularly, and disagreeably awakening the nation from a pleasant belief, once reality, now a dream. Eighteen years ago there began a series of competitive trials of intelligence and skill between the citizens of the different civilised nations of the world. Adam Smith's views of the wealth of nations were to be put to the new trial of competitive examination. The scene of the first trial was in London, in 1851. It was the famous Universal Exhibition of the Industries and Products of all Nations. In that great school the civilised nations of Europe had their first lesson in technical education. There they were able to see in how many things England retained her hereditary excellence; and England was there able to see in how many branches of taste and skill other nations possessed qualities in which she was wanting. But in that competition she had no cause for humiliation. The genius of Paxton would alone have sufficed to rescue the skill and the manufacturing industry of England from humiliation. For in the building of the Crystal Palace in Hyde Park was exhibited an entirely new and highly skilful system of modern architecture, in which iron and glass, great staples of English manufacture, and of modern invention, formed the sole materials of construction of the largest building of the world, and within which could be seen assembled at one time 100,000 of the people of every nation of the world, surrounded by the products of every clime, and the works of every tribe.

National lessons—Lesson I., 1851.

This was England's first great lesson on technical education; the second was the similar Great Exhibition held in Paris in 1855.

Lesson II., 1855.

Nothing was more striking than the enormous progress nations had made from their first lesson. Some members of each group of human inventions and skill had felt their inferiority, and vigorously set about its redress. England had been struck by the amazing superiority of some continental nations in the beauty and grace of design, which sufficed to convert the rude and nearly worthless materials of clay and flint, which are to her even more abundant than to other nations, into valuable and invaluable works of art, in earthenware and glass. She had occupied the four years' interval under the auspices of the Prince Consort—the real author of these international lessons—in collecting and diffusing through the manufacturing counties the best models of the best masters, in establishing for the potteries and glass works schools of design, and in training teachers for art workmen. These young institutions already bore fruit in 1855, and England was no longer outstripped in pottery and glass. It is curious, but instructive, to notice that the Exhibition of 1851 had disgusted the whole nation with its blue earthenware plates, cups and saucers, borrowed from the 2000 years' tradition of China, and with its huge lumps of glass, called decanters and glasses, cut or moulded into hideous distortions of form.

The largest shopkeepers of London will tell you that ever since that date the old patterns are worthless, save for export to barbarous countries—that all England has learnt a lesson, and made a revolution in taste for these common things.

The lessons which French and German nations had learnt were of another sort. They had felt their inferiority in the great objects of manufacturing and constructive skill, in which, in 1851, we held supremacy. They were happy in having princes or sages as wise as our own, who saw that the great manufactures of England were iron and steel, the great instruments of skill, industry, mechanical power, and transport. They saw that the profusion of our raw materials gave us vast advantages in time and money. They were discriminating enough to see also that in mere raw material, mere mechanical power, and mere brute labour, competition with us was hopeless. And they argued thus: the one thing we can set against the English wealth in raw material is greater skill in using what we have. The way to compete with them in mechanical power is to apply higher science in the treatment and application of it; and the way to compete with them in iron and skill is to buy of them the unwrought material, which they will sell us at nearly cost price, in consequence of their free trade and close competition, and then to apply the skill of our own artisans, highly educated and trained, to construct out of these raw materials all the higher kinds of tools, instruments, and machinery, in those forms and applications which enhance to the highest degree the value of the material.

In 1855 we saw that the French and the Germans had already advanced far into our own provinces of iron, steel, and metal manufacture. We found that they had already established schools in every metropolis, large town, or centre of industry, for educating professional men and masters, for training foremen and skilled workmen, and for educating apprentices. What we saw in 1855 was instructive to the clear-sighted and the thoughtful, but it was not humiliating to the mass of the English visitors, and it did not alarm the English manufacturers. Therefore, unhappily, they did not take warning in time. They merely committed the common blunder of despising their rivals. When they saw the enormous progress of the French in steam machinery, and its metal products occupying a huge annexe, they merely said: "Look! they have been imitating us; but never mind, these are mere *tours de force* got up under the patronage of the Emperor to make a show at his Exhibition. They serve to gratify the vanity of the French nation, but they can never compete with us in quality, quantity, or price."

This self-satisfaction was a huge blunder. The progress of the French and German nations has shown there was an ominous reality.

Lesson III., 1862: Humiliation.

The third lesson was our own Exhibition of 1862. It was the first Exhibition humiliating for us. Our administration of that Exhibition was humiliating, for it was a grand administrative failure. The building itself was to us, as an intellectual, mechanical, and artistic nation, an abject humiliation. Hideous on the outside, without unity or effect as a whole; inconvenient in the inside, ugly in its details, crowded and unseemly in the distribution of the objects exhibited, with but a single portion of it serving rather to exaggerate than redeem the effects of the other—an admirably arranged, lighted, and ventilated picture-gallery. Paxton was still alive, and also the distinguished men who, allied with him, had created the Exhibition of 1851, and had afterwards transported it to form the Crystal Palace on Sydenham Hill, there to serve as an enduring monument of our first great national lesson in technical education, and as a permanent institution for the refinement of the taste and culture of the people. Though Paxton was still living, his genius was not permitted to serve the nation, and that nation felt that the quickest way to spare itself from perpetuating its own disgrace and humiliation was to sweep off the face of the earth this disgraceful monument of its want of foresight, design, and organisation.

Thus disgraced by the edifice itself, there was little to be seen in the interior to give an Englishman cause for self-gratulation. Switzerland had there her wonderful aniline colours, the discovery of her distinguished chemist, Schönbein. Prussia was there with her huge ingots of Krupp's steel—already beginning to displace on English railways the finest qualities of Yorkshire iron. America was there with some of her exquisite machinery for economising labour. Italy was there with her already reviving manufactures of classic earthenware, her decorated glass, and her Etruscan gold. France had been diligently following up her determination to equal us in our great staples of machinery and iron manufacture, and the stately steam-engines she then produced as examples of her ordinary work in the steam-ships of her navy and mercantile marine sufficed to show us that her progress was true, and that we had been mistaken in calling her triumphs of 1855 *tours de force*. All around us in that Exhibition were proofs that every nation had begun to rival us in some one of our great specialties; and if we were not instructed we were at least sufficiently disgusted with that Exhibition to feel and to express a very pervading conviction that for our part we would cease to repeat Exhibitions which failed to mark any progress of ours, and only served to advertise to the world the more rapid progress of rival nations. That feeling of disgust was the first wholesome symptom, but it did not at that time mature itself into any conviction of the necessity of any great national exertion to advance the manufacturing skill of the English people. We had exhibited a sufficient number of new iron Armstrong guns, and models of iron and iron-coated men-of-war, to make us feel that in all things we were not yet distanced.

Lesson IV., 1867: Reformation—education.

It was the Exhibition of 1867 in Paris which gave the nations, and especially England, a final lesson. By that Exhibition we were rudely awakened and thoroughly alarmed. We then learnt, not that we were equalled, but that we were beaten—not on some points, but by some nation or other on nearly all those points on which we had prided ourselves.

Practical examples of benefits arising from organised technical education:

I shall shortly sum up the practical conclusions which I myself and the most eminent of my colleagues arrived at. We were sent by the British Government to serve as jurymen in adjudging the awards of the Exhibition, and to report to the Government the practical facts of national importance which we might there observe. In the great manufactures of iron men-of-war, with their huge steam-engines, ponderous wrought-iron armour, we found ourselves equalled if not beaten. The large marine engine of Dupuy de Lôme neither excelled the English marine engine in exquisite truth of workmanship nor in high finish, for I have elsewhere said that the English workman's conscientious pride in his work is not to be excelled by that of the workmen of any other country. But the design of the French engine showed so much forethought, practical wisdom, and provision for economy, as left no doubt that it would consume less fuel, do more work, endure longer, and run less chance of accident than our own engines; all of these being qualities heretofore constituting our own superiority.

In iron manufactures;

In iron armour and ships;

Next in iron armour. Their ships carried iron armour as thick and as strong as our own, and they were armed with guns and supplied with ammunition which could just penetrate that armour, but which that armour was just able to prevent from piercing. And their ships presented arrangements for securing all the advantages of simultaneous firing in every direction which we had claimed for ours, with this additional advantage, that the French had attained that which we had at enormous expense tried but failed in obtaining—efficient breech-loading guns, which enable them effectually to deliver 17 shots to our 10. **In artillery;**

Thus our naval supremacy was shown to be ended, so far as the manufacture of *matériel* and mechanism is concerned.

Coming to land-machinery and structures, we found in the French department of the great building a multitude of steam-engines of French manufacture, and even from distant provinces, distinguished by our own perfection of mechanical execution and high finish, but distinguished also beyond any of our own for the elegance and perfection of their mechanism and arrangements for economy. With the French, fuel is dear; they find it worth while to fetch it from England and pay the freight, but they have set their minds to compensate this inequality by their superiority of design and contrivance. So they not merely invented boilers well calculated to endure, keep clean, and extract the largest quantity of heat out of the fuel and to make with it high and strong steam, but they also contrived the engines in such a manner as to turn that steam to better account than in our engines, so as to get more power out of a given quantity of fuel, in a higher proportion even than the greater cost of our own fuel exported into France. A clear triumph of forethought and ingenuity over wasteful, unthinking wealth.

There was but one steam-engine which rivalled them, and that was more the contrivance of the American than of the Englishman whose name it bore.

In railway plant;

But perhaps the most remarkable group of all the exhibitions in Paris, was the group of large manufactures in iron which showed the products of the furnaces, forges, and iron-mills of France, Germany, and Belgium. Everywhere in rails, railway-wheels, railway tyres and axles; in large wrought-iron beams for housebuilding, in iron plates and bars, and frames for iron ships—in these, which were all our own, we found ourselves rivalled, excelled, in size and quality, and competed with in price. On land, therefore, as well as at sea, our mastery of the iron trade seemed to have disappeared.

In manufacture of machinery;

In smelting, mining, locomotive building, and the great branches of commercial machinery, a single great establishment in France, called Creusot, appeared like a chivalric knight to issue a challenge against all England.

In quality and price;

Creusot possesses the natural advantages of England, inasmuch as under its own soil it has the iron, the coal, and other minerals, in the same abundance as ourselves. But Creusot, under the wise direction of President Schneider, was endowed with an advantage which we have neglected—the possession of a systematic organisation of technical schools. Creusot has a generation of workmen schooled and trained on the spot. The schools are a model which we shall long emulate in vain. It will take us twelve years to overtake Mr. Schneider. He imports his locomotives even into England; and all round the coasts of France, and round her inland borders, Schneider serves with locomotive engines, iron plates, and forgings, customers who used to come to us for these commodities. It is not in price merely that he competes with us. It happened to me to be professionally occupied in a foreign country where the iron for a large engineering undertaking was about to be contracted for. Competitive tenders were obtained from some of the best works in England, and from Creusot. The prices were so near as to have little influence on the result, but they were slightly in favour of the English manufacturer. The contract was given to Creusot, and when I inquired officially the reason which had sent the contract to France, I was informed that they could more perfectly rely on the uniform excellence of the quality of the iron from Creusot than from England—a result to an English engineer sufficiently humiliating. I asked the value of this character in the opinion of the buyers, and was answered that they considered it equivalent to more than five per cent. in favour of France.

In intelligent workmanship;

Another fact of the same sort in the same place expressed the same conviction. The large iron forgings which were imported for the same work, came from France, not England. The answer received this time was that the large forgings were cheaper in England than in France, but that in France the forgings were so much better formed to the finished shape as to be worth more than the difference in price.

In the English specialty of steel work.

I have dwelt on these instances mainly because they are in departments in which I can venture to express a professional judgment. In the Prussian department were triumphs of technical skill, palpable to all observers. Steel cannon more powerful than any of our own, carrying larger shot with heavier powder charge. Large ingots of steel, of magnitude and quality unequalled by any nation. Tyres of locomotive wheels, which, imported into England, supersede our own highest qualities of iron; and complicated members of machines forged by Krupp out of a single piece of steel so as to be equivalent to eight or nine of the old pieces, formerly fastened imperfectly into one. These were some of the triumphs hastily exhibited by Prussia, even at the end of her costly war.

Results of a generation of foreign technic education.

I will not weary the reader with further observations of my own.* I have said enough to let him understand how the Exhibition of Paris startled a thinking Englishman, and ended by convincing him that England had been asleep, and that a whole generation of wakeful, skilled workmen had been trained in other countries during the interval between 1851 and 1867. Fifteen years is the time necessary to train a generation of skilled men. Some nations had already possessed that time and turned it to that account, with the results we then saw in Paris.

One generation of education (15 years) lost to England.

That is a lesson on no account to be lost. It is the crowning lesson of the series begun in '51, and it is the intention of the following evidence to impress on Englishmen, from the legislator to the craftsman, the great fact that we have let one generation grow up uneducated and untrained, and that no question now remains for us but this: shall we now allow a second generation to grow up equally untrained, unskilled, and left behind in the race?

* The reader who desires more information than is given in this Chapter, will find it not only in the works themselves from which the following extracts are made, but in the reports of the Juries and of our own Government reporters, which are published in a separate volume.

I now, therefore, proceed to give the opinions of qualified men, who have, with extraordinary pains, gathered the lessons and moral of the Exhibition of Paris for the benefit of the English people: A new organisation was provided, of which we can scarcely imagine the full value to have been apprehended at the time it was initiated. There were, of course, the usual reports of the jurors and the prizes which followed their awards; but awards and medals became so profusely showered that their number nearly neutralised their value. Besides, and, we may say, above and beyond the jurors, was a higher series of reports prepared by Special Commissioners sent to report on the results of the Exhibition, with reference to national interests, and the large number of their reports have already been printed and have already appeared in a series of 'Kensington Blue Books.' A second series of reports of a still more strictly technical nature was elicited by the Commissioners of Schools, who had ascertained that many of the reports on the French Exhibition appeared to throw the blame of certain cases of inferiority on the lower technical education of the British people, and the Commission issued a series of inquiries of which they then published the report.

Testimony of technical men to our national want of technical education:

Jurors;

Government reporters;

On this report the Government, having taken alarm, sent abroad a Commissioner, if not officially, at least *officieusement*, to ascertain by personal inquiry whether the alleged defects of our systems of education and our inferiority to some other countries in some sorts of technical skill were real or imaginary; and we have in the report of Mr. Samuelson to the Vice-President of the Council of Education, the views of a practical manufacturer concerning the previous statements. All these sources of information agree on three points,—on

Government Commissioner.

the great practical value of education to a people; on the admirable organisation provided by the Governments of other countries for giving to their people systematic and universally-diffused technical education; and, thirdly, on the deplorable neglect of such measures which has characterised our own Government and people.

Working men.

But in my estimation there is a collection of documents of far more importance than all these put together, which has just been published in an unassuming form by the Society of Arts, and issued from their rooms in the Adelphi, at the small price of half-a-crown. I doubt whether the Society itself clearly saw what it was about when it undertook the harmless, beneficent duty of offering to pay the travelling expenses of such English artisans as wanted to study their own departments of trade in the French Exhibition, and could not afford the cost; and when in return for this benefit it imposed the modest condition that they should report in writing on what they had seen and learnt. Out of this simple act has grown a collection of reports, 689 pages of closely printed matter, full of subject for the gravest thought—treating, in fact, the whole question of the social condition, moral and religious education of the workman, and of the duties which various Governments have either neglected or performed, in giving or withholding from the youth of a nation that intelligence, skill, and taste which they unanimously declare education can promote and develop if it cannot create. It is the quiet, reasonable, practical, and moderate tone in which all this has been investigated and set down which renders this volume the notable contribution to social science in 1867.

Of all these four separate sources of knowledge I should wish to convey to my readers the aim, the substance, and the conclusions. I fear I shall not be able in one chapter to overtake all of them, for the field is both wide and prolific, covering nearly all the branches of human industry.

I. Taking up first the 'Report relative to Technical Education by the Schools Enquiry Commission of 2nd July, 1867,' I find the Commissioners issuing a request for information to some eminent jurors and others as to the truth of certain 'evidence considered to be afforded by the International Exhibition at Paris of the inferior rate of progress in manufacturing and mechanical industry in England compared with that made in other European countries;' and they add, 'it has been stated to us that this alleged inferiority is due in a great measure to the want of technical education, and we have therefore thought it desirable to ascertain from many eminent English jurors in this department whether they agree with this opinion, and we think it expedient at once to report to your Majesty the answers which we have received to our inquiry on this point.'

The gentlemen whom they consulted, and whose answers they have printed, were: Dr. Lyon Playfair, F.R.S., Professor Tyndall, F.R.S., Dr. David Price, J. E. McConnell, C.E., James Young, chemical manufacturer, J. Scott Russell, F.R.S., Captain Beaumont, R.E., Robert Mallet, C.E., Rev. Cannon Norris, M.A., Professor Frankland, F.R.S., John Fowler, C.E., Warington W. Smythe, F.R.S., E. Huth, Peter Graham, A. J. Mundella, W. Spotten, thus representing many of the most important departments of our educated profcssions, our applied sciences, engineering, education, and Jurors.

Jurors. manufactures. I shall content myself with giving the essence of these opinions.

Dr. Lyon Playfair gives as the result of his own inquiry as a juror, and of those of other jurors: 'A singular accordance of opinion prevailed that our country had shown little inventiveness, and made but little progress in the peaceful arts of industry since 1862. . . Out of ninety classes there are scarcely a dozen in which pre-eminence is unhesitatingly awarded to us. . . The one cause upon which there was most unanimity of conviction is that France, Prussia, Austria, Belgium, and Switzerland possess good systems of industrial education for the masters and managers of manufactories and workshops, and England possesses none.'

Professor Tyndall says: 'I have long entertained the opinion that in virtue of the better education provided by continental nations, England must one day, and that no distant one, find herself outstripped by those nations, both in the arts of peace and war.'

Mr. Huth writes: 'I am sorry to say that although we may still be unsurpassed in many of our productions, we no longer hold that pre-eminence which was accorded to us in 1851. . . The enormous strides that have of late been made by our continental rivals in France, Belgium, Prussia, and Austria will make it daily more difficult for our woollen manufacturers to hold not only their former prominent position, but even to maintain their present one. . . I found that it is the want of industrial education in this country which prevents our manufacturers from making that progress which other nations are making. . . I found both masters and foremen of other countries much more scientifically educated than our own. . .

The workmen of other countries have a far superior education to ours, many of whom have none whatever. . . Their productions show clearly that there is not a machine working a machine, but that brains sit at the loom and intelligence stands at the spinning-wheel.' Jurors.

Mr. McConnell says: 'In the class for which I was juror for England, I made a very careful examination and comparison of our locomotive engines, carriages, railway machinery, apparatus, and *matériel* with those exhibited by France, Germany, and Belgium. I am firmly convinced that our former superiority, either in material or workmanship, no longer exists. . . Unless we adopt a system of technical education for our workmen in this country, we shall soon not even hold our own in cheapness. . . It appears to me, Government should take the matter in hand. . . There should be mining schools in South Wales, Staffordshire, and Durham; and machinery and engine schools in Manchester, Glasgow, &c.'

Professor Frankland says: 'As a juror in Class 44 of the Paris Exhibition, I was not only forcibly struck by the want of evidence of progress in the different branches of chemical manufactures carried on in Great Britain, but still more so by the great advances made by other nations, especially Germany, France, and Switzerland, in respect of such manufactures, since 1862, when, as a juror in the corresponding Class, I had also an opportunity of comparing the chemical manufactures of different nations. . . In the Polytechnic schools of Germany and Switzerland the future manufacturer or manager is made familiar with those laws and applications of the great natural forces which must always form the basis of every intelligent

Jurors.

and progressive industry; it seems that at length this superiority in previous training is more than counterbalancing the undoubted advantages which this country possesses in raw material.'

Mr. Mallet says, 'I fully agree that a better system of technical education for all classes connected with industrial pursuits has become a pressing necessity in Great Britain, and that immediate steps ought to be taken for organising and procuring legislatively such a system;' he has been long convinced that 'unless checked by a vast improvement in our own educational system, general and technical, the preeminence of England must decline with a rapidly accelerating pace.'

Mr. David Price says, 'What is really wanted for this country, and is of vital consequence to our future prosperity, is a higher scientific culture of those who are likely in the natural course of events to be master manufacturers; so that when discoveries are made they may fructify, and not stagnate or decay, as has too often been the case, for want of intelligence on the part of those who command capital and works, to see their merits.'

The evidence given by other jurors is not less strong, but I can only spare room for one more quotation, that of Mr. Mundella:—'The branch of industry with which I have been connected for thirty years, is the manufacturing of hosiery. I am the managing partner, employing 5000 workpeople; with establishments in Nottingham, Derby, and Loughborough, employing 4000, and with branches at Chemnitz and Pausa, in Saxony, employing about 700 persons. I have for four or five years past been increasingly alarmed for our industrial supremacy, and my experience of the Paris Exhibition has only confirmed and strengthened my fears. . . . I am of opinion that Englishmen possess more energy, enterprise, and inventiveness than any other European nation. The best machines in my trade now at work in France and Germany are the inventions of Englishmen, but are there constructed and improved by men who have had the advantage of a superior industrial education. At the largest establishment in Paris these machines are constructed and improved on thorough scientific principles, under the superintendence of a young man, who, I was informed, took high honours at the school of the Government in Paris. . . . Precisely the same thing is taking place in Saxony ; but the Saxons are, in respect of education, both primary and industrial, much in advance of the French, and in my branch they are our most formidable rivals. . . . The contrast betwixt the workpeople of Saxony and England, engaged in the same trade, is most humiliating. I have had statistics taken of various workshops and rooms in factories in this district, and the frightful ignorance they reveal is disheartening and appalling. . . . In Saxony our manager, an Englishman of superior intelligence, and greatly interested in education, during a residence of seven years has never met with a workman who cannot read or write—not in the limited and imperfect manner in which the majority of English artisans are said to read and write, but with a freedom and familiarity that enables them to enjoy reading, and to conduct their correspondence in a creditable and often superior style. Some of the sons of our poorest workmen in Saxony are receiving a technical education at the Polytechnic schools, such as the sons of our manufacturers cannot hope to obtain. . . . I am of opinion that the English workman is gradually losing the race,

Schools Commission.

through the superior intelligence which foreign Governments are carefully developing in their artisans. . . . The education of Germany is the result of a national organisation, which compels every peasant to send his children to school, and afterwards affords the opportunity of acquiring such technical knowledge as may be useful in the department of industry to which they are destined.' His concluding sentence ought to carry great weight.—'If we are to maintain our position in industrial competition, we must oppose to this national organisation one equally effective and complete; if we continue the fight with our present voluntary system, we shall be defeated, generations hence we shall be struggling with ignorance, squalor, pauperism, and crime; but with a system of national education made compulsory, and supplemented with art and industrial education, I believe within twenty years England would possess the most intelligent and inventive artisans in the world.'

II. It is no wonder that with such a report made to her Majesty from such a Commission as that of which Lord Taunton is chairman, the Committee of Council on Education should have thought it necessary to obtain some little information as to what other countries were doing for the technical education of their people. They solicited through our representatives abroad such printed papers as the various Governments could give them regarding the organisation of technical schools, and we learn that they are translating some of these for public use. They also requested Mr. Samuelson to visit, or accepted his offer to examine (for it is not quite clear which), manufacturing industry abroad, in its relation to technical schools; and the result is a letter addressed by him to the Vice-President of the

Committee of Council on Education, moved for by the House of Commons, and printed in November last.

II. Report of Government Commissioner.

Mr. Samuelson, M.P., travelled in France, Belgium, and Germany, examining as he went the most famous manufacturing establishments on the Continent, which stand in direct rivalry to our own. He found everywhere in these establishments men of all ranks better educated than our own; working men less illiterate—foremen and managers well educated, and masters accomplished, well-informed, technical men. He traced out the pupils of technical schools to their practical and successful results, as the superintendents of large works, and he sums up the results of his examination in a paragraph which appears to confirm all the reports made to that Commission, which was the origin of the inquiry.—'I have attempted to show, by examples, what is the condition of some of the leading industries in these countries (France, Switzerland, and Germany). I do not think it possible to estimate precisely what has been the influence of continental education on continental manufactures. . . . That the rapid progress of many trades abroad has been greatly facilitated by the superior technical knowledge of the directors of works everywhere, and by the comparatively advanced elementary instruction of the workers in some departments of industry, can admit of but little doubt. . . . Meanwhile we know that our manufacturing artisans are imperfectly taught, our agricultural labourers illiterate; neither one nor the other can put forth with effect the splendid qualities with which Providence has endowed our people. Our foremen, chosen from the lower industrial ranks, have no sufficient opportunities of correcting the deficiencies of their early education; our managers are too apt, in every case of novelty, to proceed by trial and error, without scientific principles to guide them; and the sons of our great manufacturers too often either despise the pursuits of their fathers as mere handicrafts, unworthy of men of wealth and education, or else, overlooking the beautiful examples which they afford of the application of natural laws to the wants of men, follow them solely as a means of heaping up more wealth, or at the best for want of other occupation: to the evils of such a condition not only our statesmen, but also our people, are rapidly awakening, and the disease being once acknowledged, I believe the remedy will soon be applied.'

III. Reports of workmen.

III. In the two preceding sections we have been occupied with what we may call the upper side of the question, that is to say, we have seen it from the master's point of view, and we have also seen how it is regarded by men of science, of education, and of distinguished technical skill. Let us now see how the questions of technical education and manufacturing supremacy are regarded from the workman's point of view, and so try to understand the under side of the question.

What do our technical workers think of their own skill, intelligence, taste, judgment, knowledge, culture, refinement? What do they think of their education, of their school training and apprenticeship? What do they think of the opportunities provided for the matured workman, who wishes to study, to copy, to increase his stores of science, and rise to higher grades of skill? What do they think are the duties of Government to him and his fellows? Do they think foreign Governments wiser in their care for their working people than ours? Do they think the systematic education of their people to be waste of pains or wise foresight? In short, do they find in the institutions of any other country any social amelioration which they would wish to introduce into their own?

On all these points, and a great many more, we have the evidence of fifty-five witnesses, all workmen, most of them evidently superior workmen, and who are entitled by their acquirements to be termed at least self-educated men. Among so many witnesses, we cannot call up all; but as we have enjoyed the pleasure of reading the whole book, we will only call such witnesses as appear to have made a special study of each point.

Workmen on technical training: A chair maker.

1. *On Early Technical Training.*—Mr. LUCRAFT, the chairmaker, says—'Seeing some lads at work with the men in the carver's shop, I went to the bench of one about fourteen—he was carving a chair-back, of a mediæval form, from a working drawing. I expressed my surprise that one so young was found capable of carving so well, and was informed that boys at school are specially prepared for the trade they fancy, so that a boy about to be apprenticed to learn carving is instructed in ornamental drawing, modelling, and designing.' . . . Further, 'I am bound to repeat that in the race we are nowhere. . . . Without the least doubt or hesitation, yet with the most profound regret, I say that our defeat is as ignominious, and I fear as disastrous, as it is possible to conceive. We have not only made no progress since 1862, but it seems to me we have retrograded.' He adds that the mere mechanical workman stands not the slightest chance with the workman of a cultivated taste . . . 'The art-workmen of France have a great advantage over us in England; in Paris they are surrounded by works of taste which none but the most obtuse can

long remain uninfluenced by; their museums are central and numerous; they are surrounded by works they venerate and love, and their very nature gets impregnated with them. . . . Something must be done, or the working classes will be grievously wronged, and the whole nation suffer.'

The lacemakers of Nottingham say—'We are unanimous in opinion that French laces display a decided superiority in design and quality of material over the English goods.' They express the hope 'that the time is not far distant when some national system of compulsory education will be brought into existence to lessen the ignorance amongst us, and place our country on an equality of intelligence with other nations.'

A hosier.

Messrs. KENDAL and CAUNT, hosiers, say—'We observed, as a rule, that the French people did everything with the greatest ease and tact, and without much labour, and always made a good finish of what they took in hand, so that nothing could be much improved after they had done with it. . . . On the whole, we are of opinion that the French have made great progress of late years, and that they are continuing to progress; and there can be no doubt that the superior education that is given to the working classes on the Continent gives them an advantage in some respects over Englishmen; but there are no workmen so quick and so inventive as our own, as far as we are able to judge.'

A stonemason.

Mr. CONNELLY, stonemason, says—'The Frenchman's familiarity with art, and his early training in its principles, enables him to outstrip us; and as every building in Paris is more or less decorated with carving, you are at a loss to know how they get all their art-workmen; but the difficulty would not appear so much if you could read the large placards in French which are posted up at the ends of the bridges, and other public places, informing workmen where they can be taught drawing and modelling every evening free of expense. That he outstrips the Englishman in this respect does not, I feel certain, arise from the possession of an especial art genius, but because whatever of it is in him is fully developed, and encouragement is given to its practice; and if English workmen are behind in this respect, it is not because art genius is deficient in our nature, but because it is not developed and encouraged sufficiently. . . . It is impossible to estimate the loss which is entailed upon England through the neglect of art culture in every department of our industry; through it we are reduced to mere "hewers of wood and drawers of water" for other nations. The bulk of our manufacturing population is engaged in manufacturing goods to be sold cheap, or in producing raw materials for other people to work. . . . On a ton of iron, for the labour of which we get less than 1*l.*, they are sure to put 100*l.* of labour before it leaves their hands.

2. *Artisans' Opinion on the Responsibility of a State for the Technical Education of its People.*—Mr. Randall, china painter, says—'When we come to high-class ornamentations in iron, earthenware, china, or glass, the superiority of French art is obvious. As long as we confine ourselves to geometrical forms in hammering, pressing, turning on the lathe, or printing on the surface, we have no difficulty in holding our own; but where an intellectualism is concerned, or a free educated hand is required in decoration, our deficiencies become apparent. The fault is less our own than our rulers, who have denied us education, or who

A china painter.

have at least given us nothing to fit us for our destination in life, but have left us groping in the dark, for ever feebly attempting to overtake lost opportunities. . . . As we heard an English workman in another branch of trade observe in Paris—there is much more credit to an English workman if he is clever, for a Frenchman has so many advantages, that if he only has moderate talents, he can scarcely help but be a good workman. He has excellent schools to give him a primary education, and, go where he will, there is something to educate his eye and elevate his taste. We have been groping our way in ignorant and bigoted security, and quarrelling in which way education should be given, or denying it altogether, while other nations have been getting before us; and if this Exhibition have no other effect in England than to convince us of our deficiencies, it will have had its mission—so far as we are concerned. The present prosperity of this country is so unmistakeably interwoven with its manufactures, and the pre-eminence of these depends so much upon new adaptations, discoveries, and improvements, as to demand for the workers in iron, china, and other departments, the readiest and best educational training and enlightenment this nation can give them. It is not only idle, but suicidal, to dream of remaining where we are. We must strike out in new paths. We must advance with the world, or lose caste and trade together. How many men know anything at all of the materials with which they work? Yet such knowledge would sweeten daily toil, would open the treasure-house of thought, enable a man to convert to new uses elements of force by which he is surrounded, and enrich the nation by adaptations and modes of economising means now in use. Every man ought to have the means within his reach to enable him to become master of his art. With how many would a knowledge of geology, chemistry, geometry, drawing, and mechanics, smooth the path of daily toil, and render labour pleasant! Why should not the miner find compensating pleasure for the darkness and drudgery of the mine in a knowledge of the gases by which he is surrounded, and of the minerals he is extracting from their long resting-place in their subterranean storehouse? Let him know something of their history, of the changes and natural processes to which they were subject to bring them to their present state. How cheaply purchased is the pleasure of astonishment with which he might go on reading the hieroglyphics and paintings of Nature in the mine, interpreting at each stage the emblems of earlier states and existences. Such an education would tell in many ways. All that we ask for is, that the State should fulfil efficiently unquestionable and admitted duties rather than disputed ones. We have no wish for interference in a way that may weaken in the least a proper sense of individual responsibility, that may lessen the slightest individual energy, or offend the sensibilities of the strictest advocates for economy in the resources of the nation. Government for the future will—if there is any meaning or force in the late political changes—be more than ever the delegated power of the people to execute its will in legislating upon the admitted "Benthamite" principle of the greatest happiness to the greatest number; and whilst doing so, it will undoubtedly seek to carry out the injunctions of the wise in all ages from Solomon downwards, and supply education to those who are supposed to be deficient of the will or the means of obtaining it. What we complain of, and what the country raising the taxes to support the present system complains of most, is that, being in the hands of the clergy, and under inspection by men drafted from them, it is used as a proselyting scheme, rather than an engine for fitting children for their duties in life. They are crammed with catechisms, Jewish pedigrees, with things pertaining to the past, which have no relation whatever to their future modes and pursuits of life, without being taught at all the means by which their own wonderful and diversified faculties might be made to bloom in profitable fruition, so that both the individual and the State itself should be compensated—each having its positive welfare secured thereby.'

Mr. Winstanley says: 'I should like to see a number of institutions—they might be called colleges, or any other name. I would have them fitted up with a number of workshops for different trades, and one large room to be used as a lecture room, and for periodical exhibitions. I would have lectures delivered twice a week, by the best professors, upon different branches of art manufacture. There should be a well-stocked library and reading room, all on art manufacture. There should be schools attached, for drawing and modelling. Why I propose workshops is, because working men in large towns have a great difficulty in finding convenience to do anything for themselves by way of improvement. . . . I would also have a committee or council established by Government, or the Society of Arts, that should receive working men presenting certificates for examination in their different branches, and grant them certificates according to their merits.'

A wood carver.

Mr. Mackie, wood-carver, reports: 'I visited the Ecole Impériale Spéciale pour l'Application des Beaux Arts à l'Industrie. On that occasion there was an exhibition of the works of the students, and the number and variety were considerable and interesting. Conspicuous among the exhibits were some large models in clay. The Minister of Instruction had dictated the subject, and the following were the particulars given. A somewhat large tympanum of a pediment, to have the head of a bull for a centre, resting upon a shield, with accessories of boys and festoons of fruits and flowers. The best was a very successful interpretation of the order given. These studies were little more than good sketches in clay, but it was evident that the students were learning a most useful lesson, that would stand them in good service when they went forth into the world. . . . It seemed abundantly clear that the system pursued was simple and rapid, and that the teaching and practice produced valuable results. It seems to have great vitality, never being without deep and varied interest to the student, features that should distinguish every school, and without which they will assuredly fail in accomplishing the objects sought to be obtained. A visit to the exhibition of the works of the students of the Ecole Impériale Spéciale de Dessin pour les Jeunes Personnes, showed that the young ladies practised the same system with very profitable results. I am informed that the fees are little more than nominal, the main expense of the schools being borne by Government.'

Mr. Whiteing, in his special report, says on the subject: 'The notion of the functions of Government entertained in this country would not be tolerated for a moment across the Channel, and it may be doubted whether our dislike to what is called special legislation —to legislation, that is to say, which proposes as a direct aim the improvement of the social condition of our people, has not its weak as well as its strong side. The constant difficulties experienced by individuals struggling alone to effect social reforms, often never aided by Government till the necessity of all aid has passed away, would seem to indicate that it has. From the view of the obligations of Government taken by the French people, it necessarily arises that instruction, both superior and elementary, has long held that recognised position under the protection of the State, which it is only just beginning to have here. A due provision for art education, for instance, is no favour on the part of the administration, but one of the conditions of its existence. In every town of any importance in a manufacturing point of view, in every district of all the principal cities, there is to be found the art school, just as there is to be found the church or the baker's shop. . . . It is not denied that similar institutions are to be found in our own country, but among us there is a very perceptible want of Government responsibility for the welfare of the schools, and they are not placed under the direct patronage of the officials of the district, who in France commonly attend to give a solemn character to the distribution of the awards. . . . In France the Minister of Instruction has confided to him, as it were, a nation in a certain state of knowledge, and he is expected when he resigns the seals of office, to show that under his care that nation has steadily progressed; he may demand certain aid from the Government; his claims have a recognised place in the budget, and he is entitled to speak by the admitted importance of the interests over which he presides. It would be well, if with us some such system could be devised, in place of that which gives us an irregular and spasmodic support to art, on the part of our public representatives, and which too often leaves its fate in the hands of only one or two well-meaning members of parliament. . . . What is above all wanted, is Government countenance, as well as Government aid. In France, as we have seen, the distribution of prizes, the opening of schools, is always made more or less a ceremony; the whole population of the district in which the school is situate cannot fail to hear of what is going on. Publicity and *éclat* are given to all the proceedings, and the school immediately reaps the benefit. Of course it is not to be inferred that the Government of France does everything for art education, and private individuals nothing. There is a considerable amount of private patronage, though to nothing like the same extent as among us; but it is always desirable to substitute for the irregular action of individuals, however well disposed, the order, economy, and persistent effort of an efficient body. . . . Let us now consider what the State does for education in France, both for primary instruction and for the special training required later when an art or trade has been chosen. The system of primary instruction so very much resembles our own, both in the nature of the instruction given, and in the mode in which support is obtained, that no detailed account of it will be necessary. . . But it is in the facilities for the higher education which ought to follow this primary teaching, where the inclination exists, that the great divergence between the English and the French begins. The ease with which a poor boy may obtain an entry to one of the imperial lyceums, or large public schools, which prepare for the universities, and thence go up to the universities, which very properly are in the capital itself, and are all free, is something marvellous, and is only equalled by the excellent facilities of a like kind which exist in Germany. . . . The technical education of French workmen is of two kinds, elementary and advanced. In the first, the child having been early destined to a particular trade, is placed in an institution, where he serves a kind of preliminary apprenticeship to that trade, and where primary instruction goes hand in hand with the special training requisite to give him a more enlarged knowledge of his business. These technical schools for children are, however, only just beginning to be established, but the results in the last of which accounts were published, were in the highest degree satisfactory. The children are occupied in all about nine hours of the day. . . . In the morning they receive instruction of the ordinary kind, which is also given for an hour in the evening, and during the day they work in every respect as if they were apprenticed to private individuals, only that a certain portion of the time is devoted to teaching them the rationale of their art. . . . It has been stated that at present these institutions are very few in number, as hitherto they have only been regarded in the light of an experiment, so that only a very limited number of trades can be taught in them, but there is little doubt that as an experiment they have been successful, and that when their success shall have obtained general recognition, the Government will take measures for establishing them in all the principal towns.

An equally important tentative effort in the way of technical education has recently been made in the establishment, under Government patronage, of an institution for the higher technical training of youths—that is to say, for the union of the highest theoretical with the best practical teaching in the manufacturing arts. This institution is somewhat in the nature of the Ecole des Arts et Métiers, only it is not so exclusively theoretical as that, but aims at supplying a want long felt in France, namely, that of skilled foremen competent to superintend, or at least fully understand all the operations of a large manufactory.

Birmingham artisans.

Mr. AITKEN, of Birmingham, in his introductory report, which heads the reports of the Birmingham artisans, says: 'Industry, formerly unaffected by foreign rivalry, contended only with small producers of its own nation, and then the competition was small. But free trade has thrown down the barriers, and the world is now one mighty, universal market. To be successful in this competition, our nation (England) must, therefore, put forward all its energies to educate in technical and other schools the present and coming generations; this was anticipated and clearly seen. Humboldt, many years ago, foresaw and predicted "that the time was not far distant when science and manipulative skill must be wedded together; that national wealth and the increasing prosperity of nations must be based on an enlightened employment of natural products and forces." Justus Liebig said: "The nation most quickly promoting the intellectual development of its industrial population must advance as surely as the country neglecting it must inevitably retrograde." Peel saw this when he uttered the memorable words, "If we are inferior in skill, knowledge, and intelligence to the manufacturers of other countries, the increased facilities of intercourse will result in transferring the demand from us to others;" and England's noblest Prince foresaw in International Exhibitions (which he was the first to inaugurate) the coming activity in things industrial;

and in order to provide for the coming competition he inaugurated ere his lamented death a system of industrial education. . . .

In France, Prussia, Saxony, and the small State of Würtemberg, &c., trade schools, in addition to others of a higher class, are in existence, and furnish the connecting link between the man of science who discovers and the superintendent who is the medium, and who, educated in these schools, aids by his instruction and advice the workman in bringing into visible shape the discovery of the man of science, rendering practically useful that which existed as an idea only. If then industrial and technical training has benefited other countries and states in their industrial progress (which no doubt it has), it becomes the duty of every Englishman to see to this important point.

Summing up the evidence.

It is impossible to go through the evidence of the eighty-six representatives of the skilled workmen of England without sharing their profound conviction: 1st. Of the pressing peril of the nation in regard to manufacturing pre-eminence. 2nd. Of the culpability of the educated classes and of the executive Government in having neglected the education of the people. 3rd. That it is satisfactorily proved by these reports that the reluctance of the working classes to receive superior technical education, to bear taxation for that purpose, and to accept the active agency of Government institutions and officials (which reluctance has been put forward as an excuse for this neglect), has no existence in fact, and that it is therefore the negligence, apathy, and reluctance of the governing classes and the Government which have hitherto alone prevented the organisation of systematic technical education. 4th. It appears that until the mission to France of the

English artisans in 1867, they, the working men of England, were not aware that the Governments of other countries had organised complete education in all trade crafts, from the lowest mechanical labour to the highest professional skill. 5th. Throughout the whole of these Reports there runs a feeling of profound admiration for the system of education given in France; but they were evidently not aware that the educated men and statesmen of France had themselves become conscious that their system was far below the level of excellence of the educated German nations; that a royal commission, under the presidency of M. Béhic, formerly Minister of Commerce, had recently been occupied with that subject, and had arrived at the conclusion that the technical education of France, which our artisans admired in Paris, was, as a national system of technical education, extremely defective; and the investigations of this Commission prove that if England is the worst educated of the first-class Powers of Europe, France is the second worst. 6th. There runs parallel with these convictions a consciousness that the English workman is by nature the best of workmen, and that with systematic education their works would excel those of competing nations.

In conclusion I have to state my deep conviction that the working men of England expect and demand of their Government the design, organisation, and execution of systematic technical education, and there is urgent need for it to bestir itself, for other nations have already five-and-twenty years' start of us, and have produced one or two generations of educated workmen. Even if we begin to-morrow the technical education of all the youths of twelve years of age who have received sound elementary education, it will take seven years before these young men can commence the practical business of life, and then they will form but an insignificant minority in an uneducated mass. It will take fifteen years before those children who have not yet begun to receive an elementary education shall have passed from the age of 7 to 21 and represent a completely trained generation; and even then they will find less than half of their comrades educated. In the race of nations, therefore, we shall find it hard to overtake the five-and-twenty years we have lost. To-morrow, then, let us undertake with all energy our neglected task; the urgency is twofold,—one half of our youth, let us say, has received elementary, but no technical education: for that half let us at once organise technical schools in every small town, technical colleges in every large town, and a technical university in the metropolis. The other half of the rising generation has received no education at all, and for them let us at once organise elementary education, even if compulsory.

CHAPTER V.

THE TRUE WAY TO EXCELLENCE IN WORK AND EXCELLENCE IN WORKMEN.

The same education for masters and men.—Mutual good understanding.—Separate education of ranks in society an evil.—Leads to misunderstanding and estrangement.—The master ceases to unite and lead his men; the men seek other leaders.—Estrangement of masters from men deteriorates both.—The master descends from skilled leader to become mere middle-man.—With the master the work also loses caste.—The skilled master gone, the skill of foremen and men goes also.—Excellence ceases to be the aim of work.—Cheapness is installed lord of work.—The building trades:—Conditions of excellence—Causes of decadence.—The unskilled master-builder:—Unskilled in workmanship—Unskilled in materials.—The master-workman's functions resigned to middle-men.—These causes lead to the degradation of character, in work and in workmen.—Ugliness, untruth, and unsoundness of work.—Skill disappears under the reigning maxim of "cheap work" to be sold "dear."—The old way to wealth, by good work at fair prices.—The new way to wealth, by bad work at low prices.—The remedy for degradation of work and workmen.—Equality of education will redress extremes of earnings—Will raise the rates of wages for skilled labour—And diminish the extremes of social inequality.

The same education for masters and men.

An important but perhaps not an obvious result of the systematic technical education of men of every class trained together in the same schools, colleges, and university, would be a transference of the same organisation from the school to the workshop, and an amount of good understanding between all fellow-workers which cannot fail to lighten individual labour, to save much waste of pains, materials, and thought, and to give great unity and perfection to the work done. The master being only a degree better educated and instructed than his foreman, it is plain that less pains will be required to make him understand what he is to undertake and do, and how he is to set about and do it; and thus the master's work will be all the easier, and his anxiety about its satisfactory execution all the less. Next, the foreman or leading workman will be only a little more able and better informed than the men under him, and only a little less skilled than his master, so that he can easily make his wishes known to those who have so much knowledge in common. The men, on the other hand, are perfectly prepared by their education and skill to comprehend the aim of their work and its relation to the materials and the processes of which they are masters.

Mutual good understanding.

Here, then, is produced by community of education that unity of co-operation by which the greatest and noblest works can be executed in the best and highest way.

Separate education of ranks in society an evil:

Where, on the contrary, workmen, superintendents, masters, have all received independent training, and come from classes of society kept apart from each other, even in their elementary education, the workman more or less illiterate, the master perhaps a scholar, but unskilled in work, it is plain that for some time at least they will be kept far asunder by want of common ground for sympathy. To remedy this evil the workman should have had a higher education, the master a more technical training; but in the absence of these, what generally happens is a cure which perpetuates and exaggerates the distance between them. A middle-man steps in between the two—sometimes he is a contractor for the labour of the men—who says to the master, "I know the nature of the men and their work, give me the money you have set aside, and I will see that they do the work, and undertake that it is done for the money." He takes care, of course, that he himself is well paid. The wider the distance between master and men, the larger the margin for his profit; it becomes his interest that this margin shall grow, hence his skill is devoted to diminishing the wages of the workman and the profits of the master: to the men he complains that the master is a screw, to the master he complains that the men won't work. Thus, between uneducated men and unskilled masters, a breach is made, ever growing wider and deeper. At the root of much of the system of combination of men against masters, will be found to lie this primary incongruity of knowledge and ignorance, skill and unskill; and from it an alienation of interests ever growing, and always fostered by meddling middle-men, who at last become an indispensable but baleful element—beginning with conciliation, and ending with alienation. It matures into class distinction of the worst sort, continually deepening into class antipathy.

Leads to misunderstanding and estrangement.

Now let us follow a little from these early beginnings what this want of common understanding and sympathy must inevitably lead to. The men, cut off from their natural leader or master, come by-and-by to select leaders out of their own class. Those with whom they are on terms of friendly intercourse, and with whom they co-operate for the benefit of their families and for their own social preservation, are the natural substitutes for their masters; and the secretary and president of their trades' union, the treasurer of their society, the leader of their public-house club or committee, and the Potters and Beales' of their combinations, step into the place of leaders, obtain the confidence of the men, and fulfil the offices of counsel, co-operation, mutual help, and leadership which the masters have left vacant. Henceforward, between

The master ceases to unite and lead his men; the men seek other leaders.

masters and men there is no co-operation, but contract and bargain—how to get most out of the men becomes the ruling principle on one side, and how to get most out of the master the ruling principle on the other side. The man's pride in doing a good day's work, which the Englishman used to feel entitled him to self-respect, to the respect of his fellows, and in which his master used also to take pride: that craftsman charter is gone, and instead of it what have we got?—a combination to settle: how little can be done for a day's wages, how long a day's work can be dawdled over, or, if on piece-work, how cleverly the work can be scamped so that the badness cannot be detected.

Estrangement of masters from men deteriorates both.

But, on the other hand, the deterioration of the class of masters is not less in degree, not less rapid in degradation, nor less fatal to the interests of both. The master, trained without technical skill, has, as we see, become alienated from his workmen—and no wonder; if he walks through the workshops and ventures to address his men, very few words suffice to make them understand that in talking of their work he merely shows his ignorance, speaks with an air of authority of that of which he knows nothing; and, when he is gone, if not sooner, the men shrug their shoulders, and say, "What a fool!" and are, for the moment, reconciled to the middle-man, who, though he may grind and pinch them, is yet skilled enough to know a piece of good work from bad, and to discriminate between an adroit workman and a bungler. It is plain that such visits do not encourage the master to return, since he feels he can neither understand work nor workman, and so he too gets to be grateful to the middle-man, who saves him humiliation, though at heavy cost. Thus, gradually, the master is led to abandon all personal care and responsibility for that part of the work which is of the deepest importance to his personal interests, full of grave consequences to the whole community of working men, and which seriously endangers the supremacy of his nation in those fields of industry in which the skilled nations are now battling in rivalry.

The master descends from skilled leader to become mere middle-man.

But let us speak of its bad effects upon the master himself. Alienated from his men, exiled from a close and critical interest in the quality of his work and its workmanship, he has to give up all endeavour after the skill of a craftsman, or the knowledge of a master, and descend to the level of a mere buyer and seller of other men's work ; a mere speculator in raw materials and finished goods; a mere packer and retailer of other men's wares ; a vehicle of communication between a distant or foreign buyer and the producers in a manufactory which he merely owns, but neither directs nor governs. He has become middle-man to his own middle-man—he has ceased to be pilot or captain of his own ship, and has degenerated into what his men do not fail to call him, a "figure-head."

But, it may be said, this man has only changed his profession: instead of craftsman he has become merchant and shop-keeper, and what harm? From this will be seen to grow much harm. When he who should have been skilled master has turned out mere buyer and seller, what becomes of his wares? Who now takes pride in their excellence, their beauty, their perfection of finish, their solidity of character, their endurance of wear and tear? Who looks after the work of the shop being a credit to the workman, and a reputation to the shop ; and who looks to it that no single piece of work shall leave the shop which shall not sustain and enhance the reputation of British wares, and carry the name of an old firm with honour round the world? The truth is, that these things cease to be cared for; the skilled master's place is left vacant—the middle-man or the foreman is incompetent to fill it, even if he cared to do so; and, moreover, the unskilled master, who cannot judge between a skilled and an unskilled workman, ceases also to be judge between a good and a bad foreman; the smooth-tongued, obsequious, pleasant middle-man is preferred, and the rugged, plain-spoken man, who blurts out the homely truth, is distasteful to the merchant master. What he now comes to want is, that the work shall be done *cheap*: *well* has become a second consideration. His account with his banker is the subject of much greater pride than his work and workshop. If the work goes faster; if the returns come quicker, and the balance at the banker's swells; and if the master sees and feels no difference in the quality of the work, he is content, and thinks himself well served. Later he may find out that the work he sold as good has turned out bad; that goods stamped with his name are either returned on his hands, or sold for less than the invoiced price. But for that evil he has again a mercantile cure; he may still further cheapen the cost of production, doing the goods in greater haste, and putting into them less valuable materials; and he can console himself with this consideration, that, by cheaper production, he has more than covered the cost of insurance against goods turning out bad. For a time, also, the old name of the firm may carry him through, and thus he may, for a time, make a profit by selling both the name of his firm and the name of his country. Moreover, the skill and dexterity, which he did not

With the master the work also loses caste.

acquire in doing the honest and truthful business of good work, he is becoming gradually able to compensate by the skill he has acquired in mercantile, financial, and banking affairs. What if his goods be sometimes returned—his bills are not returned; his friends will smile on him, and on 'Change all will go well; if he is not a manufacturer of sound goods, he becomes a manufacturer of sound bills.

The skilled master gone, the skill of foremen and men goes also.

It is easy to see that with the day of decadence in skill of the master, begins the decadence of skill in foremen; and when workmen have ceased to find their skill valued, their work appreciated, there remains nothing but their self and their mutual respect, to encourage them to maintain a high standard of excellence in workmanship, or to desire to raise it higher. We, in England, have had much occasion recently to notice how undiscriminated, unappreciated skill tends to descend to the low level of mediocrity, so that, in the end, men cease to care for excellency or sufficiency of work. They end by treating with mercantile masters for mercantile terms; they say to him, who cannot appreciate good work, "You shall pay us all alike;" and they are right, for where men are paid unequally by the mere favour of a foreman, middle-man, or manager, or by mere whim of an unskilled master, promotion is but another name for favoritism, and is most unjust to the best men. But this forced equality reacts again upon skill, and takes away all direct encouragement to personal superiority.

Excellence ceases to be the aim of work.

Observe, moreover, that in this way the business of a man's life has ceased to be his pleasure, the way to a personal career and distinguished technical excellence is closed, the pleasure of work is ended; henceforth the aim of this combined mass of equal men, equal in skill or in unskill, is how to get most money out of the moneyed man, their master, and how to take least out of themselves in the way of work in return; in short, they apply to the master his own maxims of merchandise, namely, to buy in the cheapest and sell in the dearest market.

Cheapness is installed lord of work.

The building trades—conditions of excellence;

I have taken one example from the crafts which belong to the manufacturing or mercantile type, and I will now take another from a higher craft or profession, not at first sight likely to come within the sphere of mere mercantile or shopkeeping considerations. The construction of buildings has been for ages one of the highest crafts—high in aim, in methods of work, in the display of profound science, consummate skill, and refined taste. Masons, smiths, joiners, and all the crafts connected with the building of temples, churches, palaces, town-halls, universities, schools, homes, have always been among the highest class of skilled craftsmen, and received, during the middle ages, a technical education superior to that of their fellow workmen. The master craftsman of those old days was the most skilled in his trade, and had risen by merit, slowly through successive grades to his high position. He who examines an old building will find in every toolmark on the stone the records of a man who knew what he was doing, was proud of his work, and who knew that one day a judge of work would come who would say of him, 'that man knew what he was about.' A group of workmen on the same building were a group of critics, of masters and of scholars, alternately teaching and rivalling each other, and a shop was an organisation of skilled men, each knowing the exact measure of the other's worth, and giving to the other that rank and precedence in work which formed, in fact, an aristocracy of workmen. No wonder then, when every man did his best, and had a better man above him, that the ancient architects and middle-age workmen produced works which we with difficulty attain to understand and despair to rival.

Causes of decadence

Such were the results of an organisation of skilled men,—let us look at the modern substitute for it. The chief builder is no longer, or but rarely, a skilled workman; for the most part he cannot handle a tool, and therefore cannot teach the men under him; he neither knows bad workmanship when he sees it, nor if shown to him, can he teach how to do it better. Under the skilled master every blunder was a lesson how to do better next time, but under the unskilled master blunders pass with impunity, and are paid as well for as true work. Truth and perfection therefore cease to be aimed at and achieved, because they cease to be perceived and valued. Gradually the master mason ceases to deserve the name of master or of mason, neither understanding the craft of masonry nor of being master to his masons. What then does he become? A mere picture maker of buildings; a mere getter-up of pretty drawings on paper; sometimes no better than a respondent to advertisements in newspapers for competitive designs. Thus the master mason disappears and the draughtsman takes his place.

The unskilled master builder:

Let us watch the effect produced by this unskilled master—this picture-drawing architect—this seller of designs by competitive auction, first, on his work, second, on his men. Between the drawings of the master and the work of the men there remains a huge void. His plans have ceased to tell the men how he means them to do their work, for he had himself but dim notions of any way of doing it; and as to his drawings, they have left the work to be done anyhow; and so, if the men had nothing more to guide them, they would have to do it anyhow, or nohow. This is the state of things which inevitably led to the final seclusion of the working man from his so-called master mason by the introduction of a middle-man, who should translate the unintelligible pictures of the craftless architect into the language of stone and mortar, chisel and trowel, intelligible to the workman. This gap filled, the distance between master and man was destined to grow wider; relieved from the labour of practical plans his drawings grow fainter and feebler, and soon cease to be intelligible to the middle-man or skilled foreman, and thus a new middle-man is wanted, and between them comes in a learned clerk, skilled in interpreting his master's hieroglyphs, which it is his business to make intelligible to the foreman, in order that in his turn he may translate them to the men, Thus the modern master is placed two removes off from his men, but this is not the end.

Unskilled in workmanship;

Unskilled in materials.

A master who knows so little of his men and their work is likely to know less of the nature, qualities, and worth of the materials of their work; hence it comes that he can no longer be entrusted with the expenditure of the money necessary to find the materials, to work them, or to place them. A new middle-man comes in to stand between the architect and his work: this man is the contractor, or bargainer for other men's work. He knows where to find bricks cheap, cement cheap, concrete cheap; stone, timber, lead, glass, iron, all cheap, very cheap—cheap, that is to himself, for he is of the merchant class, and has learned to buy in the cheapest and sell in the dearest market. The materials thus procured cheap by the middle-man have next to be sold dear to the buyer or owner, and it is the business of this middle-man to know as well the trick of selling dear as of buying cheap—and indeed this latter part is the easier of the two, for the man who has made the pictures which have pleased the eye of the owner, is but a sorry discriminator of the worth of bricks, the strength of mortar, or the history, stratification, durability of stone; and, to do him justice, the contractor has chosen a stone which shall look as nice and work as smooth, and seem as durable, as though it were the true stone for which it is the make-believe; and so the owner, believing in the skill of his architect, is handed over to the tender mercies of the bargaining middle-man.

The master workman's functions resigned to middle-men.

We can easily predict the fate of such work, and must pity the victim of such malorganisation. For the pretty pictures he pays the architect that sum of five per cent. on the whole cost which was really meant to procure him the services of the most skilled man and the use of the best materials, disposed in the wisest way; but instead of this, he has to pay much more than an additional five per cent. to a middle-man as contractor, who finds him bad materials and sells them for good, and he has moreover to pay middle-man clerk of works, and middle-man foreman No. 3, for putting the translated hieroglyphs into working shape. No wonder then that he complains of architects who don't know their work, and middle-men builders who do.

Thus we see how technical disorganisation leads to moral disorganisation, and we need no longer wonder at bricklayers and masons who combine against financing contractors, picture-architects, and their employers, and who merely follow their superiors in the practice of their mercantile maxim,—buy the cheapest, sell the dearest. Who can wonder that enters a house built by this class of men, under this class of architect, if, after due time has passed, the paint of the doors peels off—the wood of the panels shrinks and cracks—the varnish, adulterated with rosin, sticks to the clothes—the half-zinc lead pipes of the cisterns leak, and the stone of the mullion windows crumbles and goes to powder through the frost and rain? "What matters it?" say the architect, the contractor, and the builder; "we have got our money, he has got his house. Houses don't last for ever; send for us, we will put it in order, and you shall have the pleasure of paying us all over again."

These causes lead to the degradation of character, in work and in workmen.

Ugliness, untruth, and unsoundness of work.

Of the truth of the lamentable picture just drawn everyone who knows the thousands of villas which stud the environs of London with samples of the "grand works" of London architects and their financial contractors, will be able to give strong confirmation. Acre after acre of open ground disappears from the face of the green earth, under millions of smoked bricks and miles of hideous street. Comeliness seldom greets the eye,—symmetry and proportion are generally hideous, and the workmen who have been employed to scamp their work rejoice that now-a-days no man is obliged to stamp his name in testimony of his responsibility for that which was once an Englishman's pride—honest, lasting work.

Skill disappears under the reigning maxim of "cheap work" to be sold "dear."

These are among the penalties we are now paying for having earned, and gloried in the distinction, that we are a nation of shopkeepers. Under this influence talent and skill have to succumb to political economy—to the laws of price—to the doctrine of free trade—to the doctrine of unlimited competition—to the doctrine of buying everything, including body and soul, in the cheapest market, and selling everything—labour, skill, knowledge, principles, morals—in the dearest market. This is the social problem we are working out: need it be wondered that since masters have declared their principles, and opened their shops everywhere to dear selling and cheap buying, their men should also open their shop to easy earning and dear wages, in that they have no choice left them but to strike or starve; and so we are busily working out the race of misery—who shall strike hardest and starve longest.

The old way to wealth, by good work at fair prices.

It is true there are quite other doctrines for human society, but they are called the "doctrines of enthusiasts, philosophers, theoretical men; doctrines fit for an ideal world, but not for practical life in England in the nineteenth century." There is such a doctrine as buying and selling at a fair remunerative price, and no other; of making goods to seem what they are, instead of manufacturing lies in matter, to be sold as truths; there is the old-fashioned workman's way of giving a good day's work, and the old master's of not grudging a fair day's wage; there is the old chivalrous feeling, that the man's honest work is his highest claim on the esteem and regard of superiors—equals—inferiors; there is the old craftsman's pride in the name and handiwork of his firm. It is also quite possible to get public edifices built without public tender, by taking the trouble to pick out the man who loves his profession for its own sake, and who loves his work for its truth and excellence; to select men for its execution, who love their work and take pride in its truth, honesty, beauty, endurance. It is possible to select good stone from bad, and buy good materials instead of bad, if it be understood that the principles of selection are to be, excellence with fair price. There is the old doctrine, to live and let live, and still continue to live and prosper. But in order to do this, to accept these ancient exploded doctrines, we must agree to shut up the ways to sudden wealth, and we must also agree not to value a man by his wealth, but to weigh much more the way in which he got it than its quantity. A short and sure way to wealth is, secretly to invent, and suddenly to make a large quantity of some commodity, which is in appearance that which it merely shams to be, and so rapidly to inundate the markets with it that it shall be all sold and paid for before it is found out. The inventor may then retire to his country seat, be elected high sheriff of his county, and be duly returned to serve in parliament. On such a man, and on all his class, we must learn to look down with contempt, and hold them up to execration. The "honest skilled poor man" must become a title to honour and respect; the "sudden rich" must be suspect; not till sudden wealth brings suspicion of dishonour, and meritorious poverty is encouraged to hold up its head, can we escape the misfortune of having our national name and fame dragged in the dirt, and the name of a "nation of shopkeepers" applied as an epithet of reproach.

The new way to wealth, by bad work at low prices.

That systematic education would lead to greater equality in the distribution of wealth, to a true appreciation of each man's worth, and to a deeper interest of each man in his neighbour's well doing, is not difficult to recognise. First, by equality of education, inequalities in birth and fortune are in some measure equalised. Second, when all men of the same district and of the same age have been trained up in the same technical schools, even though some have enjoyed a

The remedy for degradation of work and workmen.

longer period there than others, it will follow that their talents and characters are known to and appreciated by their comrades, and the place of each man in the rank and file of society is felt and conceded. The fool cannot set up as master, nor the ignorant man as foreman; neither would it be permitted that without merit one man should monopolise a large portion of the joint earnings. The master's merits will be valued on some such principle as the men's merits, and the share of the joint produce to which a master may be fairly entitled, would be subject to the same appreciation as the earnings of each man. Capital would still be entitled to interest, and labour to wages, but why capital should absorb the profits of labour would be a question as open to debate, as why one man should reap the crop which another had laboured. In actual trade a very common practice is, that capital shall not merely have interest, but shall in addition put a large quantity of wages into the pocket of the capitalist, to which he gives the name of business profits, and that of course is so much subtracted from the wages of the men who do the work; but when education has given to each man a knowledge of all the branches of his work, and there remains no difference of rank, excepting superior skill and intelligence, then each man's individual work will be weighed in the balance, and the true share of his merit will be appraised in the scale of wages. The question will be, how much in that scale the true earnings of one man outweigh those of another. Under the present system, the master of 1000 men may pocket in the shape of profits, one half of the whole earnings of all the men, or he may pocket only a sum equal to the wages of a hundred men, but it will then be a matter for consideration whether one

Equality of education will redress extremes of earnings:

Will raise the rates of wages for skilled labour;

man in the same trade, possessing skill of the same sort, can really be entitled to a just charge for his services of ten or a hundred times the wages of his skilled and educated fellow. It is plain that under such a scale of estimation these unequal proportions would be likely to diminish, and in the end that would be considered great merit which should give a man not only the honour of leading his fellow craftsmen, but also the advantage of double wages; the idea of giving him tenfold or a hundred fold would have disappeared from the catalogue of possibilities. The education of the future will, therefore, lead to a great reduction of masters' wages or profits, to a fair fixed remuneration for capital invested, and to a fair division of the earnings for work among those skilled men who execute it, in some recognised proportion to the contribution which their skill makes to the common work. Equality will be then, as now, impossible, but the scale of each man's life may be one of steady, continual, meritorious rise.

And diminish the extremes of social inequality.

CHAPTER VI.

THE TWO SORTS OF EDUCATION—GENERAL OR GYMNASTIC—SPECIAL OR TECHNIC.

Education, technic and non-technic—Non-technic or gymnastic.—Technical education.—Nature of technical training.—Value of a national system.

Education—technic and non-technic;

"WHAT do you mean by technical education?" was the question put to me by a distinguished member of the Legislature, who has long taken an active part in the administration of education. I found the answer less easy than I had anticipated.

The difference between technical and non-technical education is radical and important. A large school of thinkers in this country have been continually asserting the aim and end of education to be, intellectual gymnastics—not knowledge, or at least that gymnastic is the primary, and acquisition only the subordinate object of education. They say that the discipline of the school and the university has for its object to train and send into the world able men of matured intelligence and ripened powers, good for all the avocations of life, and prepared to enter upon its duties with sound bodies, developed ability, and formed character; but that it is no part of their business to communicate any of that special knowledge, or develop any of that peculiar skill which fits a man to excel in the one calling of his life, or in the one profession which he will have to select. All this, they say, may be the work of the city, the State, the manufactory, the workshop, or the world at large, and life in general, but it is not to be expected from the school and the university.

Non-technic or gymnastic.

This I will venture to call the gymnastic theory, and I use the term as an appellation of honour, not of discredit, for I am myself much of this mind up to a certain point. Large education, broad development, general training, are the best possible foundations of useful after life, but they are only the foundations of knowledge and training. For the uses of modern civilised life, the promising youth, who is good for everything, is in fact good for nothing; the first class university man who has taken honours, is scarcely worth the pay of a day labourer beyond the walls of his university: for the uses, duties, and aims of civilised life, his education has to begin. Take the highest class examination passed, and we shall see that the man who has best solved this problem is as yet fitted for no one of the stations of life. That I call a non-technical education.

Technical education.

By a technical education, I mean that special training which renders the talents of the educated man directly useful to that society in which its youthful member is destined to pass his life. We English live in the midst of an energetic rivalry of competing nations. The aim of our national life should be to do the work of the world better, more ably, more honestly, more skilfully, and less wastefully than the skilled men of other countries. If we are less skilled or less honest than others, we are beaten in the race of life. To the national welfare and success, it is therefore necessary that the young race of men who are to do the work of England shall not merely come of a better breed, grow up with more developed bodies, enjoy sounder constitutions, and have passed through a better gymnastic training than the youth of other nations, but that each individual shall in his own special profession, occupation, trade or calling, know more thoroughly its fundamental principles, wield more adroitly its special weapons, be able to apply more skilfully its refined artifices, and to achieve more quickly, perfectly, and economically the aims of his life, whether it be commerce, manufactures, public works, agriculture, navigation, architecture.

Nature of technical training.

This, then, is what I mean by a technical education: that which shall render an English artilleryman a better artilleryman than a Frenchman; an English soldier a better soldier than a Prussian; an English locomotive builder better than a German; an English ship builder better than an American ship builder; an English silk manufacturer superior to a Lyons silk manufacturer; an English ribbon manufacturer superior to a Swiss ribbon manufacturer. I want to see English iron bear a higher value, and English steel a higher character than French and German iron and steel. I want to see the steam engines built in England possess the reputation of doing a greater quantity of useful work, with less waste of fuel, greater durability and smaller repairs than the steam engines of any other country. I want to see the railways that are made by English engineers exhibit a more skilful selection of route, a less wasteful employment of materials, and a more perfect application of financial resources to economical results than those constructed by the engineers of any foreign country. What I call technical education is that kind of training which will make the new generation of Englishmen excel the new generation of foreigners in this coming rivalry of race and nation.

Value of a

Whether such a system of national technical educanational system.

tion can be devised as shall render this service to the nation is the question which I shall now proceed to discuss, for there are still many who believe that an Englishman is born with the innate technical superiority which renders a special training unnecessary, and that the average Englishman need only be thrown into a workshop, an office, or a manufactory, rough and unprepared, in order to come out a cunning craftsman of unrivalled skill, an accomplished merchant, and a consummate mechanician. If this heaven-born training be a fact, we have only to leave the next generation alone, and hug ourselves in the belief that English supremacy in arts, trade, manufacture, and commerce, is now and must remain unquestioned ; but if, as I believe, the days of this national hallucination are passed, we may at once consider what it is necessary to do in order to secure the interests of the generation that is about to take our place.

CHAPTER VII.

PRESENT STATE OF TECHNICAL EDUCATION IN ENGLAND.

Five millions of Englishmen.—Two millions and a quarter boys.—One million and a quarter lads.—Three millions and a half males requiring education and technical training.—Teaching wanted.—Schools wanted.—Classification of schools and scholars.—Technical schools and science teachers wanted.—Technical schools and science teaching given.—State of English technical education.—Good education for the rich:—Individual universities, schools, and teachers of the best sort.—Wants expansion, organisation, system.—Conditions of an organised system for England.—Examples of good technical institutions in England:—School of Mines—College of Chemistry—College of Naval Architecture—King's College—University College—Owen's College—Agricultural College—Diocesan School of Chester—Engineering College, Putney—Birkbeck and Mechanics' Institutions.—These institutions only educate 25,000 out of 1,260,000 youths.—Estimate for the better teaching of English youths in the period of science and technical instruction.

THE wants of the people of England, to make them the best educated nation in Europe, are as follows:—

Five millions of Englishmen have boys and lads of the following educational ages:—

I. Elementary school period, 7 to 9 . .	840,000 boys.
II. Upper elementary school period, 9 to 12.	780,000 ,,
III. High school or science school period, 13 to 15	720,000 ,,
IV. Apprentice and technical college period, 15 to 18	660,000 lads.
V. Apprentice and technical university period, 18 to 21	600,000 ,,

or,

School-boys	2,340,000
Apprentice lads	1,260,000
	3,600,000

The three first periods are what we may call general periods, because the training of these is required equally by all intelligent human beings. The two last are the special periods, because the technical destiny of each lad should determine the sort of special training he ought to receive to fit him for the duties of his occupation in life.

Or, thus :—

School-boys .	I. and II.	Elementary schools .	1,620,000
School-boys .	III.	High schools and science schools . . .	720,000
Apprentices .	IV. and V.	Apprenticeship and technical colleges .	1,260,000

If the boys are to be educated in science in the third period, we must have :—

III. 2000 schools, with an average of 360 scholars each.

Schools wanted.

If these apprentices are to be provided with technical education in technical schools and colleges, either during apprenticeship, or preparatory to it, we must have :—

IV. 2000 Apprentice schools, with 330 students in each.
V. 2000 Technical schools, with 300 students in each.

Such is the problem of English education if all that should be done were done, and every lad were to be provided with education up to the period of manhood.

Classification of schools and scholars.

But it is said that all these future Englishmen do not want superior education—that it will be enough if the children of skilled men get technical education to fit them for the places their parents now fill; that, therefore, it is only necessary for the children of skilled parents to have technical education, and of unskilled parents to have merely elementary education. Thus the number of pupils would drop off gradually, as follows :—

III. This period being halved on account of the uneducated parents' children being excluded, would be reduced to 1000 schools, with an average of 360 scholars.

IV. This period may be quartered, on account of the reduced number of highly-skilled parents :—

500 schools, with an average of 330 students.

V. This period may be reduced to one-eighth, from the small number of highest skilled men :—

250 schools, with an average of 300 students.

Even with this reduced scale of education, we get :—

III.	1000 schools	. 360 scholars	. 360,000
IV.	500 schools	. 330 students	. 165,000
V.	250 schools	. 300 students	. 75,000
	1750 schools.		600,000

If, then, we allow to each science and technical school only six teachers, we have to provide 10,500 superior teachers and professors.

Technical schools and science teachers wanted.

To sum up the needs of the English people :—

Science Schools.	Technical Scholars.	Technical Teachers.
1750	600,000	10,500

The supply of these needs, under the Science Department of the English Government, is :—

Schools having some Science pupils.	Science Scholars.
300	14,600

Here, then, we come to the humiliating conclusion, that of 1,260,000 of the English youth, of an age to receive science and technic education, the English Government takes care of less than one in 700. And, further, that out of 600,000 youths, whose destiny of life is special skilled technics, Government takes an interest in less than one in forty.

Technical schools and science teaching given.

But the "science education" given under the auspices of the English Government to this small number of persons is deplorably deficient in quality and quantity.

Sum paid by the Science Department for the scientific education of the English nation :—

Number educated.	Value of Education given.	Total.
14,600 scholars.	15*s.* 7*d.* each.	£7,976.

It is officially announced that ten per cent. is to be added to these payments in future!

So much for English scientific technical education under the Government Department of Science in 1868!

State of English technical education.

How, then, are the English people educated? The answer is, they are not an educated people. They are, at least, an ill-educated people. They educate themselves as best they may. The blind lead the blind. They have been neglected by their governing powers. They have fallen behind their rival nations. They have been abandoned to their fate, and they suffer.

The simple fact about English education is one on which it is desirable there should be a clear understanding. Its fault is utter want of general systematic organisation.

Good education for the rich :

It would be absurd to say that there is not good education to be got in England. That would be a libel on our admirable universities, on our many excellent colleges, on our public schools, so well endowed, so efficiently taught. There are many private schools that have conferred nameless benefit on multitudes of grateful pupils, and there are endowed schools, and schools of religious sects, which give to many pupils a superior education.

Individual universities, schools, and teachers of the best sort.

It is also right to admit that a man of leisure, wealth, and perseverance, can find in England every kind of instruction he can desire. If he knows thoroughly what he wants—if he can choose one university for one branch of knowledge, another for a second, go to a private school where something is well taught, and to some college where another happens to be well taught, he may pick up an effectual technical and professional education here and there! Leisure, money, and foreknowledge, will enable the man who can help himself to get helped—and so in England the man who can help himself always gets help.

But the growing youth, who has everything to learn, and no help, how is he to find fit education and training for his work in life? For the ordinary English lad, education must be pre-planned, prepared, brought home to him, to his father's home, to his master's workshop. He cannot seek education. We must seek him.

Wants expansion, organisation, system.

Education, then, excellent of its kind, is to be found in England. But in fragments, here and there; not organised; not made easy; not brought home.

The organisation it wants is:—

Conditions of an organised system for England.

1. That it be uniformly diffused among the people near their homes.

2. That it be ordered so that one school rise above another in orderly rank.

3. That the teaching be regulated in such wise that the pupil who has to leave one place and seek another shall find there the same things taught, the same way, from the same books, to pupils of like age.

4. That the teaching in each rank of school shall so fit the next, that the scholar of the lower is fitted for the higher before he leaves; and that the studies of the higher follow directly on from the studies of the lower, and fit on to them.

5. That masters of these schools shall not have to teach more pupils, or more matters, than they can well teach. That, in elementary schools, a master teach

never more than fifty pupils; that different masters teach different subjects.

6. That the payment of a master shall not depend on the number of his pupils, nor on the wealth of their parents, but that the payment be made according to the excellence, experience, and knowledge of the man who teaches. It would never do, in the teaching of a nation, to let the poor and the many have bad teachers, and to keep the good teachers for the few and rich.

English education, therefore, is inadequate in quantity, fragmentary, not organised, not distributed, not wisely paid for, not brought home.

Examples of good technical institutions in England:

Of the fragments of an organisation for technical teaching, there are some that eminently deserve notice. But it will be found that most of these we owe to the isolated efforts of individuals.

School of Mines;

The School of Mines, in Jermyn Street, London, is the work of the late Sir Henry Delabeche. There is much in this institution which admirably fits it for a place in a great system of national education, but its sphere of usefulness is sadly narrowed by the facts, that it has neither the advantage of technic schools, which lead up to it; of co-ordinate institutions, that educate analogous professions alongside it; nor anything above to which it leads up. It is a lone school, of the advantages of which our millions of technical folk cannot possibly avail themselves, save by a passing visit, or a rare holiday, or a rarer attendance on a lecture. But it is a valuable institution, taught by eminent men, with excellent material collections; and the possible nucleus of a larger, better endowed, collegiate organisation.

College of Chemistry;

The College of Chemistry is a similar institution, the creation, as I believe, of Prince Albert and of

Professor Hofmann. It has already demonstrated the advantages of special training by having sent out many pupils, who have become ornaments of British chemistry. It also should form part of a large organisation of technical teaching, instead of being left an isolated fragment.

College of Naval Architecture;

The College of Naval Architecture is another successful technical school, but it has been created by the force of private individuals, and has the misfortune to occupy an isolated place, instead of forming part of a great technical organisation. It was created, many years ago, by the energy of some naval architects, allowed to exist for a few years, then extinguished by the English Government. Some time later it was resuscitated, re-established, and, after a few years, was once more stamped out of existence by uneducated or jealous members of the Admiralty. In 1863 it was again urged on the attention of the English Government by naval architects who loved their profession, was aided by Sir John Pakington while in opposition, and passed by the Whigs while in power. It is now a third fragment in the technical education of Englishmen, is well organised, and ably superintended. It is one of the proofs to Englishmen that technical education of a high class is possible—even in England—if only the Government will do its duty.

King's College; University College;

King's College and University College, in London, are, to some extent, technical colleges. They both have done good to the community by giving considerable facilities to students preparing to become civil and mechanical engineers. They both suffer from the want of sufficiently numerous and sufficiently well endowed professorships. They both require large sums of money for enabling them to supply the material means of education—museums, collections, galleries, laboratories.

Owen's College; In the provinces there are few colleges or technical schools of any distinction. Owen's College has earned for itself a distinguished place in Manchester. It is a technical college and science school of great excellence. It is a proof of how much good moderate endowments, well administered, will accomplish. But it is hindered by inadequate buildings. It should have Government salaries for a large number of professors. Those now there are inadequately paid, and it well deserves to have larger sums at its disposal for the material mechanism of teaching — instruments, collections, museums, workshops, buildings, and grounds. The College is an honour to Manchester, but its usefulness is greatly hindered by want of schools below to lead up to it, or anything beyond, for the pupils that have passed through its curriculum with success.

Agricultural College; The Agricultural College at Cirencester is an example of a college for technical education which has contrived to prolong an existence under great discouragement. It only wants incorporation into a general system of national organised education, and the endowment of professorships and scholarships on a sufficient scale, to become of inestimable benefit to the country.

Diocesan School of Chester; The Technical Diocesan School of Chester is an example of a science school, established by enlightened local energy, which has been allowed to die a lingering death by Government apathy and neglect. I do not know if it be yet possible to resuscitate it as a local technical college for Cheshire.

Engineering College, Putney; The Engineering College at Putney is another instance of the meritorious attempt to perform Government duty by private effort. It, too, has died out, and is now beyond recovery.

Birkbeck and Mechanics' Institutions.

Of technical and science schools there are a few which prosper, or suffer, by individual exertion, and do good in a narrow circle. There is a trade school in Bristol, a trade school in Hulme, at Manchester. Special schools are growing at Halifax and Huddersfield. Leeds and Bradford are moving. There are mechanics' institutions which do some teaching, beginning with their parent institution, the Birkbeck Institution, in London. But they nearly all languish for want of good endowed professorships and efficient organisation of schools above, below, and around them, to co-operate in training and forwarding prepared pupils.

These institutions only educate 25,000 out of 1,260,000 youths.

I do not propose to make an inventory of schools in which some science is taught. I have shown that a little has been done in England—enough just to show a deep feeling of want—enough just to show a melancholy result of inadequate national teaching—an exhibition mostly of that which is *not* done.

Of the 1,260,000 young lads in the apprentice period of education, now, throughout England, we may possibly say that some education in science is given to 25,000, and we know that to 14,600 of these the value of that national technical education is 15*s.* 7*d.* per head!

Estimate for the better teaching of English youths in the period of science and technical instruction.

When the State shall have founded in England—

One great Technical University with 100 chairs,
Fifteen local Technical Colleges with 25 professors,
300 Science and Trade Schools with 5 to 25 teachers each,

it will have provided only for the teaching of 250,000, one quarter of a million, out of one million and a quarter of the youth wanting knowledge and skill.

In order to do this limited work well, one million per annum is necessary, or 4*l.* per head per annum from Government, in addition to local aid. With the aid of this million, and no less, technical teaching may be fairly begun.

CHAPTER VIII.

A TECHNICAL UNIVERSITY ABROAD.

English impressions of a foreign university :—In Berlin—Carlsruhe—Stuttgardt—Austria—Hanover—Switzerland—Zurich.—Swiss public education.—Swiss patriots and statesmen—Their technical university in Zurich.—Zurich a model for England.—The patriotism and liberality of Swiss citizens in matters of common good.—The technical university of the Swiss nation, Zurich :—Government of the university—List of professorships and courses of instruction—Free choice of courses, subjects, and professors—Organised curriculum for special professions—Eleven modern professions.—The eight divisions of Zurich.—Organisation of time and place.—Plan of hours in the architectural division.—Material apparatus of education.—Observatory of practical astronomy.—Laboratory of practical chemistry.—Museum of engineering works and drawings.—Museum of engines and machinery.—Laboratory for chemical research.—Museum of architecture.—Antiquarian, zoological, botanical, and geological collections.—English teaching deficient in material apparatus, from poverty ?—Criticism of Zurich.—Due mixture of practical work with theoretical study—Avoiding the danger of cram.—Conclusion.—Cost of the university.—Practical results of education in Zurich.—Criticism.

English impressions of a foreign university :

A TECHNICAL university abroad was to me a surprise, a profound lesson, and a delight. It was a dream of my youth suddenly embodied in living substance ; and, unlike other realised dreams, the reality excelled the fiction. It was one of my early dreams, that highly-educated men should engage themselves in teaching skilled workmen the profound philosophical principles which underlie all material work ; and, I hoped, so to make their work their pleasure ; excellence their ultimate aim ; truth of execution, and perfection of finish, their highest ambition. But I had not then dreamed of that still higher kind of teaching, which should do the same thing for philosophers, statesmen, professors, and men of all functions in life which require scientific training. I was myself member of a profession for which there existed no teaching, every member being self-taught ; that is to say, being either born by nature with special endowments, or surrounded from his birth by special conditions and circumstances, which made of him a man different from others. Indeed, it might be said that teaching him was impossible, because of his profession nothing was known, and it had got to be spun out of his own head. Hence there was an impression regarding that, and all the other modern professions, that fitness must be a natural gift, or a personal inheritance; that you could no more make a man of ordinary talent an engineer, or a practical chemist, than you could make him a fish or a bird; and that he could only be taught his profession, as in England we are taught to swim, by throwing him in to sink or thrive.

This was the prejudice in which we were all brought up ; and I much fear it is the prejudice which still governs the old-fashioned among us. Great, therefore, was my surprise, when one day, some twenty years ago, I found myself introduced, by a professional brother in a foreign country, to a full-grown and mature institution, in which all the members of the higher and modern professions were systematically taught and trained in the duties of those professions, the same as any common carpenter or smith might be taught the duties of his trade, and the mysteries of his craft.

I say, mysteries of his craft, for at that time it was mostly reckoned politic and wise, that what knowledge a professional man had, he should carefully keep to himself as his capital in trade—sedulously avoiding everything which should give another man insight into those cunning mysteries which it had cost him so much to find out or create; and specially concealing those simple maxims and rules, which, once found out, would enable anybody else to be as wise as himself.

Amazing, then, it was to find here a public institution in which all these mysteries were unveiled, all this secret knowledge made public property, and all the cunning of each craft publicly displayed on black boards, and eloquently explained by experienced practical men. In my country, many lucrative professions were still the craft of mystery-men. In London, the ambitious youth who aspired to professional distinction had still to pay to the mystery-man a fee of 100, 200, 300, 500 guineas, in order to be initiated into all the secrets of his profession; and here I found them all taught, and better taught, for the enormous sum of 60 thalers a-year, or less than 10*l.* per annum.

Perhaps it is not wonderful that members of professions, who make large profits by the education of private pupils, should be averse, as they very generally are, to new institutions destined to supersede their personal labours, to challenge their right to the exclusive possession of profitable secrets and mysteries, by which they earn fortune and fame; and to make these palpable to all the world. Perhaps, also, it is not unnatural that men like ourselves, who are self-taught, and therefore, I might say, half-educated, should be slow to encourage the development of a race of young educated men, whose criticism of their vaunted works might be just, severe, and unpalatable. This was then nearly universally, and is still, to some extent, the state of professional feeling in England;

but there are, happily, many exceptions among the younger and better-educated members of the profession.

To our English notions and prejudices, therefore, this foreign technical university was an outlandish and ungenial phenomenon.

In Berlin;

Here, in Berlin, I found a large and handsome building, close by the king's palace, in one of the best parts of the town, and this was called, at that time, a "Gewerbe-Schule," or royal school for trade teaching. This very humble designation did not lead me to expect the high scientific education and training which was there provided for the young professional men of Berlin. The truth is, that in Berlin, everything but the three learned professions, law, medicine, and theology, were still called trades, and not yet admitted to the rank of professions, just as, in our country, the time was when Brindley, the canal engineer, was still reckoned a sort of superior ditch-digger, and George Stephenson a sort of superior engine-driver. The tradition had still enough influence in Berlin to call a technical university for the modern professions, a "trade school."

Since that time, the dignity of the "Gewerbe-Schule" has been recognised. Its buildings, its endowments, the rank and salaries of its professors, the number and preliminary qualifications of its pupils, have all been raised. It has now the recognised rank of a technical university, with professors of equal dignity, and degrees of equal weight.

Berlin being the first technical university with which I became acquainted, and also one of the earliest, I should naturally quote, as an example of a "technical university abroad," this Gewerbe-Institut, or Gewerbe-Academie of Berlin. I recommend those of my countrymen who care for such things, to visit that institution, which is admirably conducted, systematically organised, and a great boon to the professional men of Prussia. They will find that it in every way lends itself, by means of evening as well as morning lectures, by trade associations connected with it, by free libraries and museums, to the education not merely of the higher professional men, but also of the working men who have leisure and disposition to desire high trade knowledge.

In very many respects, therefore, I consider Berlin a model technical university. I do not quote it, however, as my type of what such a university might be, because it labours under some traditional and local disadvantages, which somewhat narrow its sphere, derange its symmetry, and cramp its development. It is not symmetrical in the highest degree, because in Berlin there had already existed, before it attained its present growth, surrounding institutions, which had monopolised a portion of its ground.

Kindred academies, institutions, or universities, had already provided education and training for some of the arts and professions which a more isolated university would have systematically included in its curriculum; and which it was, therefore, unwise, unnecessary, or inconvenient, to include in the new organisation. Precisely, therefore, because the Berlin Gewerbe-Academie fits its place, and answers its special purpose, it is less fitted to serve as a type of a symmetrical institution than some others of more recent growth, more remote from the overshadowing influence of rival and more ancient institutions. For similar reasons, I do not propose to select the highly practical

Carlsruhe; Stuttgardt; technical university of Carlsruhe, or the admirably taught technical university of Stuttgardt, as models for our imitation; although in both there is much that is well worthy of emulation, and although I have had the opportunity of studying both, and have adopted, in what I propose for ourselves, many of the best features of their excellent organisation. Of the technical universities of Austria and of Hanover I have also been induced to form a very high opinion, from the accounts of them which I have received, both from students who have enjoyed the great advantage and privilege of studying in them, and from professors and engineering friends, who have been good enough to communicate to me all the information I desired regarding institutions which I have as yet unluckily not been able to visit.

Austria; Hanover;

Switzerland: I select, for the practical purpose of serving as a type to ourselves for the constitution and organisation of our English technical university, the technical university in Zurich, and I do so for the following reasons:—That technical university was created under somewhat similar circumstances to those under which we must create our own. Zurich is, like ourselves, a commercial and manufacturing State; it is the Lancashire of Switzerland. Switzerland, like ourselves, is a free country, a religious country, and, consequently, embarrassed, in action and organisation, by the desire to abstain from interference with personal liberty of action and liberty of enterprise. It is encumbered, also, in its initiative by the same sectarian hatred which sets Catholic Christians against Protestant Christians; High-Churchmen against Low-Churchmen; and orthodox folk against heretics of all sorts. These prejudices or principles, equally in Switzerland as in

Zurich.

England, made men jealous—especially churchmen—of all other education than that bestowed by the universities of the Church; and offered a dogged resistance to the establishment of universities, which were designed to fit men rather for their destinies in this world than in the next; to inculcate upon them quite other doctrines than those of Grecian heathens and Roman pagans, and to subject the doctrines of the future to the dogmata of the past.

Swiss public education.

These prejudices, in which we share, caused educated Switzerland to remain in arrear of educated Germany in this matter of technical education of the highest sort. But she had already shared with them, and even anticipated them, in some of the advantages of the humbler sort of technical education. The famous Pestalozzi, the patron saint of pedagogues, was a Swiss and a Zürichois; his spirit still reigns in the elementary schools of Zurich, and his disciples are the schoolmasters of the Zürichois. They had long, in their teaching, substituted the teaching of thoughts and *things* for the teaching of *words* merely; and their aim has never been to train their scholars in those tricks which dazzle the eyes of parents and inspectors at school examinations, but rather to make them know thoroughly that which is most necessary to life, and to teach them to think soundly and speak truly. The schools of Zurich were already schools of real life, and not merely abstract science; and science, applied to the practical business of life, had already, for more than a generation, been taught in the Real and Gewerbe schools of Canton Zurich.

Swiss patriots and statesmen.

It happened however, about fifteen years ago, that the government of Zurich was in the hands of wise, educated, and patriotic statesmen.

These men clearly foresaw the enormous material benefit which would accrue to Switzerland, and especially to Zurich, from the training of the more highly educated youth to the practical business of life, by means of a university, in which everything that was most valuable in the sciences, arts, and manufactures of all other countries, should be taught by the most distinguished men imported from all nations for that purpose, in the best manner which their wisdom could organise, and with all the practical means of learning placed at their disposal which could be invented or bought.

Their technical university in Zurich.

Switzerland accordingly, and Zurich especially, set about this task with a zeal and self-sacrifice well worthy of our imitation, even if quite beyond all hope of our rivalry. The town and canton of Zurich were lavish of all the wealth necessary to raise their university on a prominent eminence, the most beautiful site near their city for the foundation of this national institution. The city and the State competed with each other to tax themselves, in order to endow worthily this new university of the nation. The State charged itself with the organisation of the curriculum, the selection of the teachers, and the provision of adequate salaries; and it also voted then, and has continued to vote ever since, large contingents for the enlargement of its observatories, laboratories, museums, libraries, and art collections. The Swiss are true patriots; and having once ascertained that their national system of education was defective in the great element of modern practical science, they determined to do, in the most thorough, systematic, and comprehensive way, that which they felt they had been wrong in so long neglecting.

It is the great extent, completeness, and symmetry everywhere apparent in the organisation of this great technical university, which make it pre-eminently a model for us; not to copy or imitate merely, but to excel and go beyond. We must determine as they did, not merely to copy some local institution in another country, which had to be fitted into the existing institutions of an entirely local character, but to supply, in a symmetrical and complete manner, every existing deficiency in the whole national system of higher education. The founders of the Swiss Polytechnicum did not therefore ask themselves the question: What is the smallest and least costly scale on which we can begin to make good a few technical deficiencies ?—but they asked themselves this other question: What is there in the science, the philosophy, the learning, the art, and the practical skill of modern times, which can be learned and taught, or which has been taught or learned in any other school of knowledge, but for which there is no adequate provision already made for teaching to our own students in the university of the land ?—and those things we will see to having thoroughly taught. They soon found that the German universities had long been in the habit of teaching far deeper science, far larger philosophy, and far profounder art, than the Swiss in the isolation of their mountains had ever dreamt of.

Zurich a model for England.

They found in the manufactories of Prussia, Belgium, France and England, structures, machinery, and manufacturing processes utterly unknown to the skilled men of Switzerland. What the Swiss did not already know, it was quite plain they would be unable to teach to the young generation; and so the Zurich

Polytechnicum had to become, and is, a cosmopolitan establishment. The founders and governors of that institution discarded at once the vulgar and pestilent notion of patronage.

There were no places in that university to be given away. What they did, on the contrary, was to search the annals of pure philosophy and applied science, for the names of those men who were best known for science, skill, and the love of teaching; and these men from every country they selected, and entreated to come and teach their children, considering only how they could best make it agreeable and convenient to them to become the teachers and patterns of Swiss youth.

The patriotism and liberality of Swiss citizens in matters of common good.

When I say that the Swiss were profuse of their wealth for the foundation of this cosmopolitan university, I say a great deal more than these words will seem to imply, when they are read in England. We are a wealthy, profuse, and even, as some think, a wasteful people. The Swiss, on the contrary, lead a hard-working but sparing life—frugal even to the extreme—we might call them niggardly or penurious; but though their personal wants are so easily satisfied, such is their patriotism, and such their love for the well-being of the community in which they live, that to a stranger's eye they might seem extravagant or wasteful. Their common schools are mansions; their academies have the air of town halls. The Polytechnicum at Zurich is larger than Buckingham Palace; the apartments of students and professors, the lecture halls and museums are large, lofty, well-aired, well-lighted. The building itself is the *chef-d'œuvre* of a German architect; and certainly, if we judge it by its fitness for its purpose, rather than by profuse decoration, or lavish embellishment, it is an admirable structure.

Even physically therefore, or materially, it is a model institution, while morally it teaches us this lesson: that there is one nation in the world sufficiently disinterested and patriotic to save money by extreme self-denial, in order to lavish it with profusion upon the intellectual training of the rising generation for the practical duties of citizenship.

This self-denial, generosity, and large wisdom, have been fully rewarded by the issue. The youth of the country have flocked with avidity to Zurich, and the young men thus trained are, with equal avidity, taken out into the public works and manufacturing institutions of Switzerland; and whether it arise from this cause or some other, it is an astounding fact that the Swiss, remote from the sea—that highway of merchandise; remote from coal and iron—those staples of our manufacturing industry; the Swiss in their far valleys are rapidly growing a dexterous and successful manufacturing people.

From us they have taken away our Coventry ribbon manufacture; from Lyons they have appropriated a large portion of their famous silk weaving; in watches and clocks they have long kept the rest of the world going; and their intelligent, educated, skilled men are prized all over Europe.

250 Swiss avail themselves of the advantages of their technical university.

But it will be thought a far higher proof of the value of such an institution when I add, that it has attracted students from nearly every civilised country in Europe; and that, of the 589 students who frequent its halls, 250 are Swiss and the other 339

English, Americans, French, Germans, Poles, Hungarians, Russians, Italians, Dutch and Belgians.

The technical university of the Swiss nation—Zurich.

This technical university is governed by a permanent council, consisting of president, vice-president, three councillors, three substitutes, and a secretary ; and they have immediately under them an executive chosen from among the professors. The president Kappeler is the real governor of the institution. He represents also the central Government of Switzerland, by whom he is named; and it is on his firmness as a ruler, on his wisdom in the selection of professors and teachers, and on his tact in the management of professors and of students, that much of the success of this institution has depended. He happens fortunately to have a rare instinct for the discovery of ability in men—especially in young men; and he is continually making search in foreign universities for the rising professor who has not yet obtained adequate distinction at home. He has accordingly surrounded himself with teachers who unite the enthusiasm of youth in teaching, to full knowledge fresh from the fountain of learning. It is one of the evils, however, of this system, that the school becomes a sort of nursery for professors, and that the other technical universities are much given to filching away from this, its young and rising men. The system, however, on the whole, works admirably, for there is by this means a continual infusion of young blood to maintain the circulation of fresh thought, and the attractions of the university itself are strong enough to retain in the list of professors men whom the well-informed among ourselves will at once recognise as the most distinguished men of their profession.

The vice-president of this institution is Dr. Alfred

Escher, a statesman of large views and unquestioned patriotism, who may be regarded as, more than any other individual, the founder of this national institution; while the others are men who have attained the highest distinction in the Canton they represent, some of them well known in England.

GOVERNMENT OF THE TECHNICAL UNIVERSITY.

Government of the university.

A.—Swiss School Council.

President	Mons. C. Kappeler.
Vice-President	Dr. A. Escher.
Members	Professor Dr. Bern. Studer.
	Councillor Aug. Keller.
	Professor Pictet de la Rive.
Deputies	Director Aimé Humbert.
	Councillor A. v. Planta.
	Choirmaster Jos. Ghiringhelli.
Secretary	Mons. J. G. Baumann.

B.—Committee.

Director	Mons. E. Landolt.
Deputy	Dr. Gustavus Zeuner.
Secretary of Committee	Mons. J. Rudolf.

The teaching of the university is the work of thirty-one professors, of ten assistant professors, and sixteen private teachers and lecturers.

List of professorships and courses of instruction.

Each of these gives several courses of lectures or of private instruction, and the whole number of subjects taught or courses of lectures this year is 145, exclusive of a large number of additional or extra subjects, which do not form essential parts of the regular curriculum of instruction. These 145 subjects of instruction are comprehended in the following list:—

PROFESSORSHIPS AND COURSES OF INSTRUCTION.

Prof. Arduini	1. Storia comparata della lingua e dei dialetti italiani. 2. Scrittori d'arte e artisti, il Cellini et il Vasari. 3. Il Machiavelli. 4. Esercizi varg. di lingua.
Prof. Dr. Behn-Eschenburg	5. The English historians. 6. Shakespeare's "King Lear," translated and explained. 7. English exercises and grammar.
Prof. Dr. Böhmert	8. General economy. 9. Finance. 10. Lectures and discussions on political economy.
Prof. Dr. Bolley	11. Technical chemical practice. 12. Bleaching, printing and dyeing. 13. Manufacture of chemical products. 14. Glass and pottery.
Prof. Dr. Cherbuliez	15. Political economy. 16. International law. 17. Free trade, exchange, and protective duties.
Prof. Dr. Christoffel	18. Differential and integral calculus. 18*a*. Examinations. 19. Theory of equations. 19*a*. Examinations.
Prof. Dr. Cramer	20. Elements of botany. 21. Universal botany. 22. Microscopic observations.
Prof. Culmann	23. Earthworks, stone bridges and tunnels. 23*a*. Repetition. 24. Practical construction. 25. Roads and canals.
Prof. Dufraisse	26. Droit civil. 27. Droit administratif. 28. Droit forestier. 29. Droit commercial.

Dr. Egli (private tutor) .	30. Physical geography (inorganic). 31. Examinations. 32. Drawing for historical, geographical, and economic studies. 33. History of geology. 34. Geographical phenomena: Abyssinia, Gulf-stream, Nile, Canal of Suez, &c. 35. Palestine—geographically and archæologically.
Prof. Escher v. d. Linth .	36. General geology. 37. Technical geology.
Dr. Fehr (private tutor) .	38. Exposition of sculpture in the archæological museum.
Prof. Dr. Fiedler . .	39. Representative geometry, with examinations. 39*a*. Exercises in two groups, each 1 hour. 40. Plane geometry. 41. Elements of the theory of determinate and rectangular co-ordinates. 42. Geometry of curves of the third order.
Prof. Dr. Frey . .	43. Zoology. 43*a*. Examination.
Mr. Fritz (private tutor).	44. Technical drawing (preparatory course). 45. Technical drawing (first and second course of the chemical technical division). 46. Elements of machinery. 47. Machine drawing. 48. Lectures on machine construction.
Dr. Geiser (private tutor).	49. Introduction to synthetic geometry. 50. Selections from the higher parts of geometry.
Prof. Gladbach . .	51. Construction of buildings. 52. Plan drawing. 53. Engineering plan-drawing.
Mr. Harlacher (private tutor)	54. Theory and construction of girders. 55. Manufacture of wrought-iron and cast-iron girders.
Prof. Dr. Heer . .	56. Pharmaceutical botany. 57. The plants of geology. 58. On fossil insects.

Mr. Hug (private tutor) .	59. Differential and integral calculus.
Prof. Keiser . . .	60. Practice in modelling ornaments, and in stone carving.
Prof. Keller . . .	61. German language.
Prof. Dr. Kenngott . .	62. Mineralogy. 62*a*. Examination. 63. Characters of minerals. 64. Museum of mineralogy.
Dr. Kinkel . . .	65. History of ancient art, from Egypt to Pompeii. 66. History of renaissance art (architecture and sculpture).
Prof. Kopp . . .	67. Encyclopædia of forestry. 68. Theory of climates. 68*a*. Examination. 69. Excursions and practical experiments.
Prof. Kronauer . .	70. Mechanical technology (spinning, weaving, paper making, &c.)
Prof. Dr. Kundt . .	71. Technical physics. 71*a*. Examination. 72. Theory of light. 73. Experimental physics.
Mr. Künzler (private tutor)	74. Mechanics. 75. Differential calculus. 76. Technical mechanics.
Prof. Landolt . . .	77. Theory of forestry. 78. Foresters' duties. 79. Forestry (trade). 79*a*. Examinations. 80. Excursions and practical applications.
Prof. Lasius . . .	81. Construction of buildings (second course). 82. Construction of buildings (third course). 83. Plan drawing and perspective (second course).
Prof. Ludewig . . .	84. Construction of machinery. 84*a*. Examination. 85. Chapters from the history of mechanical construction, with practical examples, &c.
Dr. Mayer (private tutor)	86. Palæontology.

Prof. Mequet	87. Differential and integral calculus (pupils of the first year). 87*a*. Examination. 88. Differential and integral calculus (pupils of the second year).
Dr. Merz (private tutor)	89. Pharmaceutical chemistry. 90. Examination in inorganic chemistry. 91. On scents and perfumes. 92. On alcohols.
M. Mösch (private tutor)	93. Geology of Switzerland, with regard to its influence on trade, &c. (gratis).
Prof. Dr. Mousson	94. Experimental physics: first half. 94*a*. Examination in French. 94*b*. Examination in German. 95. Chemical physics. 95*a*. Examination.
Prof. Orelli	96. Differential and integral calculus (school of architecture, first course). 97. Mathematics (preliminary course), algebra, geometry, &c. 97*a*. Exercises. 97*b*. Examination.
Prof. Pestalozzi	98. Construction of streets and canals. 99. Practical geometry (in German and French).
Dr. Piccard (private tutor)	100. Inorganic and experimental chemistry. 100*a*. Examination in groups. 101. Toxicology. 102. Pharmaceutical chemistry.
Prof. Dr. Prym	103. Analytical geometry of the plane, with exercises. 104. Introduction to the theory of functions.
Prof. Rambert	105. Histoire littéraire, Corneille et Racine. 106. Exercices supérieurs pour les élèves français. 107. Exercices supérieurs pour les élèves allemands. 108. Exercices élémentaires. 109. Langue française (preliminary course).
Prof. Dr. Reye	110. Introduction to the theory of numbers. 111. Analytical mechanics.
Prof. Dr. Rüttimann	112. Swiss federal constitution and rights.

M

Prof. Dr. Scherr . .	113. Twelve literary world-known characters—Homer, Æschylus, &c., &c. 114. Lessing, Göthe, Schiller, their lives, works, and companions. 115. History of the nineteenth century.
Prof. Dr. Semper . .	116. Comparison of styles. 117. Designing.
Dr. v. Seckendorff (private tutor)	118. Taxes and revenues of woods and forests.
Mr. Stadler (teacher) . .	119. Ornamental drawing, decoration, colour, &c. 120. Decoration of private and public buildings.
Prof. Dr. Städeler . .	121. Experimental chemistry. 121*a*. Examination. 122. Selections from chapters on chemistry. 123. Practical chemical experiments.
Prof. Stocker . . .	124. Geometry of space, algebra, trigonometry. 124*a*. Exercises. 125. Mathematics of forestry.
M. Stutz (private tutor) .	126. History of the Creation, with regard to the Bible.
Prof. Ulrich . . .	127. Landscape drawing in pencil, sepia and water colours.
Prof. Veith . . .	128. Pumps, turbines, and water wheels. 129. Construction of machinery.
Prof. Vögeli . . .	130. History of Switzerland, 1474—1515.
Dr. Weith (private tutor).	131. History of chemistry. 132. Review of inorganic chemistry according to modern principles. 133. Groups of Cynaus. 134. Chemistry of animal bases and acids.
Mr. Werdmüller . .	135. Figure drawing.
Prof. Wild . . .	136. Topography. 137. Geodesy. 138. Plan drawing. 139. Map drawing.

Prof. Dr. Wolf.	140. Astronomy. 140*a*. Examination (for the engineering division). 140*b*. Examination (for pupils of the sixth division). 141. Elements of astronomy.
M. Wolfensperger (musical director)	142. Harmony.
Prof. Dr. Zeuner	143. Technical mechanics. 143*a*. Examination in groups. 144. Theoretical mechanics (heat and steam—steam engines). 145. Theory of insurance (calculations of probability and mathematical statistics).

In addition to these there are assistants.

Free choice of courses, subjects, and professors.

In running one's eye over this large list of teachers and subjects to be taught, the eye of the English parent or guardian would find itself hopelessly overwhelmed with *embarras de richesses.* But such a contingency has been foreseen, and admirably provided for, even without encroaching on that perfect liberty of the individual of which we English think and talk so much. The student of the Polytechnicum is at perfect liberty to attend what courses he pleases, and to neglect all he does not like. He may go to the Polytechnicum either for business or pleasure; either to qualify himself for some special duty in life, or to study things in general, and thus far our notions of liberty are here realised.

But in this free manner of study comparatively few students enter themselves. Out of the whole number of 762, only 173 are free students—the remaining 589 prefer to study, according to rule and method, for some specific aim in life.

Organised curriculum for special professions.

There is an organised curriculum, prepared by the governors and the professors, which affords the parent or the pupil all the best advice of matured wisdom as

M 2

to the course of study which the student should pursue during the three years of his university career. These studies are parcelled out over a period of three years, and each year is divided into two courses—the summer and winter half-year. The student is further assisted by being told what are the subjects with which he should be acquainted before entering the university, so as best to avail himself of its advantages; and there is this further kindly provision made for him, that if he is unfortunate enough to have been badly prepared in any of the essential points of preliminary study, a special series of preparatory studies are provided as an aid to make good his defects and bring him up to the level of better prepared pupils. This is a department well worthy of our attention in England; for, from what I know both of the successes and failures of attempts made there to introduce some technical education, the great hindrance to good technical teaching with us is want of good adequate preparation. A preparatory or strengthening division will therefore, I fear, be for a long time a very important part of our universities. I am, however, able to give the comfortable assurance, that in a country where technical education has once taken root, this retrospective educational division gradually diminishes both in the number of the pupils and the extent of the reinforcement they require; and I know one or two technical universities in which they have represented to their governments the expediency of discontinuing this division, for the admirable reason, that so good an education is now afforded everywhere in the subordinate technical colleges or Gewerbe-Schule which lead up to the technical university, that no other measure of preparation is necessary than simply to send back the pupil for another term to the preparatory college. It will, however, be long before we reach this stage in England.

I have already said that the organisation of a technical university on the Continent has inevitably taken much of its character from the nature of those institutions by which it was preceded, and from the organisation of the institutions by which it has been surrounded. And it must be further noticed that each different country will have some branches of science which are of far greater value to that country than to some other, and *vice versâ*. Thus, in an inland country, remote from the sea, we should scarcely find naval architecture, ship-building, or what, in the large sense, we call commerce, holding any important place. A school of naval architecture, or a naval college, could scarcely be expected to find a place in Würtemberg, Saxony, or Switzerland, while forestry, which in Germany is a great science, would occupy a very subordinate position in England, inferior, probably, in rank to gardening; and while in Prussia, which is famous for its mines, we should expect schools for mining and metallurgy to have an equally prominent position to that which they should hold in England, we should imagine that a country formed chiefly of valleys, lying between granitic ranges, would not be likely to count any considerable number of its inhabitants as miners, unless, indeed, its granite were fortunate enough to be richly studded with gold, as in California and Australia.

Looking, however, at the ground which is occupied by all the technical universities now existing, we may regard the following table as giving the heads of a complete course of higher technical education, and forming what we may call a model of a technical university :—

Eleven modern professions.

1. School of Civil Engineers.
2. School of Architects.
3. School of Machinists.
4. School of Manufacturers.
5. School of Miners.
6. School of Naval Architects and Sailors.
7. School of Merchants.
8. School of Agriculturists.
9. School of Political Economists and Statesmen.
10. School of Modern Languages and Literature.
11. School of Professors and Men of Science.

The professions which are omitted, even from this large list, are those which in every country have from time immemorial been provided for by ancient universities and schools. Divines, doctors, lawyers, soldiers, which we may call the ancient and learned professions, do not ask a place in our modern university—will probably be jealous even of our existence, and therefore will feel no wrong in being omitted from our list.

Besides these fifteen professions, we might quote others commonly ranked with them, but for the most part these may be reckoned as branches of the fifteen.

The technical university of Zurich, one of the most recent and complete, provides, as we have seen, 145 courses of instruction, and leaves pupils perfectly free to select their own studies—a liberty which most of them think undesirable. For the most part they follow the map of discipline which has been placed before them by the government of the university as that which will give them the most speedy and effective training for the duties of life.

The eight divisions of Zurich.

The university constructs a programme of methodical study which divides these 145 courses into eight groups or divisions of study. 1. A course of architecture and building; 2. A course of civil engineering; 3. A course of mechanical engineering; 4. A course of mechanical chemistry; 5. A course of agriculture and forestry; 6. A course for men of science, professors, and teachers; and 7. A general course of philosophy, statesmanship, literature, art, and political economy, meant for men of no profession and of every profession, who desire a cultivated intellect and a refined taste. There is an eighth division, which is the preparatory or supplemental division I formerly mentioned, for bringing up pupils who are behind their contemporaries, especially in geometry, algebra, elementary, physical, and chemical science, drawing, and languages.

ORGANISATION OF TIME AND PLACE.

How to divide these 145 courses of study among 681 pupils in such wise that no pupil and no professor shall be required to be in two places at one time is a matter requiring great skill and organisation. **Organisation of time and place.**

Luckily, early hours are still a feature in German university life. In the columns of daily work, the hour of 7 A.M. is remarkable; and as there is no breakfast-hour till 12, there are five hours of good study before breakfast. Into these five hours it is desirable to compress most of the hard work of the day, leaving the lighter work for later hours. How much pains and trouble this organisation costs, and how it is possible for student and professor to meet once or twice a day without cross purposes, will best be understood by giving the "time and place-plan," or organisation of a day's work in one of the departments. It will be seen that it is as complicated, but as exact, as a page of Bradshaw. **Plan of hours in the architectural division.**

Organisation of the Architectural School.—Time and Place-Plan.

SUMMER COURSE.

1ST DIVISION—ARCHITECTURAL SCHOOL.

Head Professor, DR. SEMPER.

SUBJECTS.	Number of hours per week.	Place—Number of lecture-room.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
1ST YEAR.								
Differential and integral calculus	5	9 b.	...	9 to 11	10 to 11	9 to 10	...	9 to 10
Representative geometry (lecture)	4	6 d.	10 to 12	11 to 12	...	10 to 11	...	...
Exercises and repetition	5	19 b.	2 to 4	...	...	11 to 12	...	2 to 4
Architecture	3	15 c.	...	...	...	8 to 9	...	10 to 12
Architectural drawing	4	15 b.	8 to 10	...	8 to 10	...	...	...
Composition	4	15 b.	...	2 to 4	...	...	2 to 4	...
Ornamental drawing	4	16 b.	...	...	...	1 to 5	...	...
Chemical technology of building materials	1	6 d.	...	...	7 to 8	...	...	...
History of art in the middle ages	4	7 d.	7 to 8	7 to 8	...	7 to 8	7 to 8	...
*Landscape drawing (4 hrs.)	...	19 c.	2 to 4	...	...	...	...	2 to 4
*Modelling (9 hrs.)	...	15 a.	8 to 11 / 2 to 5	...	...	...	8 to 11	...
2ND YEAR.								
Comparison of styles	4	9 b.	...	4 to 6	...	...	4 to 6	...
Designing	4	14 b.	...	2 to 4	...	...	2 to 4	...
Mechanical architecture	3	2 d.	8 to 9	...	11 to 12	...	8 to 9	...
Architecture	3	1 d.	9 to 11	9 to 10	...	...	...	...
Architectural drawing	4	14 d.	...	7 to 9	...	7 to 9	...	...
Perspective { Lecture	1	7 d.	7 to 8	...	...	...	...	...
Perspective { Exercises	2	14 d.	...	...	8 to 10	...	...	...
Construction of streets and canals	2	2 d.	...	...	7 to 8	...	7 to 8	...
On building materials	3	26 c.	4 to 5	...	10 to 11	...	10 to 11	...
Figure drawing (9 hrs.), obligatory	6	19 c.	...	...	...	...	...	7 to 12 / 2 to 6
Laws affecting buildings	1	2 d.	...	...	4 to 5	...	...	...
3RD YEAR.								
Comparison of styles	4	9 b.	...	4 to 6	...	...	4 to 6	...
Designing	4	16 b.	...	2 to 4	...	...	2 to 4	...
On manufactories	1	2 d.	...	...	10 to 11	...	...	...
Architectural drawing	4	16 d.	...	7 to 9	...	7 to 9	...	...
Ornamental drawing (decoration and colour)	4	16 b.	...	...	...	1 to 5	...	...
Building laws	2	10 d.	4 to 5	...	11 to 12	...	...	...
*Painters' perspective in sketching from nature (4 hrs.)	...	excursion.	...	...	...	...	...	...

The subjects marked thus * are not obligatory.

Material apparatus of education.

In addition to this vast living organisation of professors, masters, and tutors, the Zurich University is rich in an element of secondary importance, but of unquestionable usefulness. The apparatus of teaching, or the material elements of it, have been studied and improved in Germany to an extent of which our universities and schools have inadequate, if any, conception.

Observatory of practical astronomy.

1. Attached to the department of physical science is a large astronomical observatory, set on a neighbouring hill, and attached to the university as a place of instruction, much in the same way as if the building of Greenwich Hospital were transformed into a technical school, and Greenwich Observatory attached to it as the astronomical class room, with Professor Airy and his assistants turned into professors of our school! This forms what is called the collection or museum of stars of the university.

Laboratory of practical chemistry.

2. The next building of the same sort is a large chemical and mechanical laboratory, forming also a separate structure, removed away from the building of the university, and forming by itself what we should consider a large school-building. This building may be called the "College of Trial and Error," for it is here that men are allowed to make their successes and blunders; it is the college of discovery. A young chemist, who fancies he has discovered a new gas, or wishes to try a new mixture of old ones; a young mechanic, who wishes to try an extraordinarily high pressure of steam, or to drive a steam-engine by the explosion of gun-cotton, or to use carbonic acid gas as a reservoir of power for propelling steam-engines, and who in the course of these experiments will probably blow his apparatus to pieces, or set fire to the building,

is here placed in what is called a cell of safety, where he is surrounded by the apparatus necessary to protect himself and his neighbours from the evil consequences of his mistakes; and where, if he set fire to the building, he is supposed to be sufficiently far from the university for it at least to be saved. This may be called a fortified outpost of scientific education.

Museum of engineering works and drawings.

3. Inside the university there is a large collection of drawings and models, on a large scale, of every kind of engineering work for the use of the civil engineers.

Museum of engines and machinery.

4. Next, there is a similar collection of all possible engines and machines, exhibited either full-size or in model, or in large drawings on a uniform scale and systematically arranged; and this collection is in continual increase by the arrangement of the university, which permits a student who has finished his career to remain in the university to prosecute further studies or original researches, and also employs those who have a peculiar gift to make new engines, models, and drawings, for the uses of the students. This collection is rapidly growing.

Laboratory for chemical research.

5. In regard to the chemical laboratory for the ordinary purposes of teaching, I need say little, excepting this, that in Zurich, as in Berlin, Carlsruhe, and Stuttgardt, chemical laboratories have become palaces of science, of which anything called chemical laboratory in our country is but the threshold or outer porch. I will use no words to describe what a chemical teaching laboratory is, but I will merely say that their extent and organisation is amply warranted by the enormous value of chemical manufactures, and the wisdom of their creation is justified by the extent to which their pupils afterwards use the

knowledge acquired there in improving, to a high point of excellence, the chemical trades on which they enter.

These laboratories of the university are the models on which the pupils afterwards construct their laboratories of life industry.

6. A large series of models of architectural constructions and beauties, and a collection of drawings and sculpture, form the legitimate accompaniment of this school of architecture, over which that distinguished architect, Dr. Semper, well known in England, presides. And it is agreeable to be able to say, that some of the most beautiful buildings which decorate Zurich have come from the hands of Semper and his pupils; for it is one of the peculiarities of an educated community that science and practice are married, instead of being regarded as with us, an illegitimate connexion.

Museum of architecture.

7. A large zoological collection;
8. A large entomological collection;
9. An antiquarian collection;
10. A geological collection; and
11. A botanical garden,

Antiquarian, zoological, botanical, and geological collections.

are all adjuncts of the university, and have been provided, either at the cost of the Confederation, of the individual State, or of the city of Zurich.

In regard to the whole of this material apparatus of teaching, I think it necessary to say, that we English are even more niggardly and negligent in the provision of that, than of the living element of teaching. In truth, we want to spend as little as possible, both of pains and money, upon the subject of teaching; and whenever I have represented to members of our Government teaching department, the inadequacy

English teaching deficient in material apparatus—from poverty?

of the material element, I have been silenced by the answer: "Oh! our House of Commons grudges us already the little we ask, and were we to ask for more it would only be refused." This too, from a House of Commons which grudges 1,000,000*l.* for education, and gives without stint 25,000,000*l.* for future war, and 25,000,000*l.* for the debt of past war.

This is a terrible mistake, for the material elements of education enormously accelerate the progress of the pupil. The two words "look there," are often more valuable than an hour's lecture. The pupil takes into his mind the form, colour, meaning, of the thing itself, which no words could give him; and in good collections of this sort, the insides of things are shown him as clearly as the outsides; so that the pupil's knowledge is thorough instead of merely skin deep. It should also be remembered, that education by the eye is as fertile in fruit as education by the ear; and that merely to familiarise men with the sight of things made as they should be, is the most effectual teaching to avoid and dislike what is inferior or wrong. The material element of teaching is therefore secondary only in value to the living element.

Criticism of Zurich.

The reader will have noticed, that in the Swiss university there are wanting some of what I have reckoned as the essential elements of good technical teaching. The school of merchants, the school of naval architects and sailors, are not to be found in Zurich University. But that, I have already explained, is not so much a defect as a local adaptation to Zurich, which has neither an ocean nor colonies, nor, in the world-wide sense of the world, commerce. Nevertheless, as Zurich University is acquiring world-wide reputation, and draws pupils from all the quarters of the globe, and all the countries of Europe; and as science and art are of no country and of no place, I shall not be surprised, if some day they complete the symmetry of their institution by the addition of these wanting courses, for the sake of their foreign pupils. Moreover, the commerce of Switzerland, and especially of Zurich, spreads daily more and more widely, and demands from its merchants and manufacturers larger requirements for its growing fields of industry. There are other defects in this technical university for which I have heard its former pupils blame the authorities; but I think that, probably, many of our English technical men will be on the side of the university, rather than that of its critics. Other technical universities have real actual workshops for the manufacture of machines, and matters of commerce as part of their university organisation. This the university of Zurich has not; and this the university authorities discountenance. They assert that the workshop and the university should be kept entirely distinct; that the three years of technical university study should come either after or before the apprenticeship of the workshop, or initiation into the profession. The truth to my mind is this: It is not necessary that workshop, office, or counting-house should be in the university, but it *is* necessary that they should be closely united to it in time; and the only question is, how best to effect the combination. I know three ways effectual in practice. The first way is, to give the practical training in the office or the workshop immediately before or immediately after the technical education in the university. The second mode is, to give half the practical training before the university course and half immediately

Due mixture of practical work with theoretical study.

after. The third method is, to lengthen out the university period of education to the same number of years as the practical workshop training or apprenticeship; and to spend one half of each year in the university, and the other half in the workshop or office, and complete both together.

I will not dogmatise on the question, which of these is the best; I have seen them all tried, with a high measure of success. My personal prejudice is entirely in favour of the last. The alternation between work and study makes each a bodily and mental recreation for the other. Moreover, it has this direct superiority, that during each working half-year you may learn and make practical application of the principles learnt in the previous half-year; and this further good, that in the working half-year you will find a multitude of things in practice, of which you are unable to understand the nature and reasons, and these you will be anxious to learn and delighted to have made plain to you in the following year of college or university education. My own observation is, that you make far more progress in a given time by this alternate method than by any other. The first method has this fault for many professions, that before the university period you are too young to complete the workshop, and afterwards too old to begin. But there is another kind of mixture which remedies this, and that is the second; and it partakes of the advantages of the third, because, in the first half of the workshop period, the want of technical education is felt by the learner, and afterwards supplied in the university, while the last period shows the practical application of those higher principles which have already been taught in the university. This alternate creation of a want and its supply, forms an admirable element in systematic teaching.

Avoiding the danger of cram.

Finally, I must admit that there is too much variety in the individual circumstances of technical students, to encourage the hope that a plan equally useful to all shall be adopted in any university. I have known many young men who have come to these universities from a distance, from a foreign country, and even from the antipodes; there they had ample means of learning the practical part of their business, entirely before or entirely after the university period; and for them it might be inconvenient as well as useless to mix both. For them the best plan is that in Zurich, of giving the whole university course at once without interruption. The danger in that case is, that the student may work too hard, and that his university teaching may degenerate into a process of undigested cramming.

My recommendation therefore, to the authorities of the Zurich University would be, that they should give serious consideration to the question, whether they should not advise their pupils to alternate the practical training of the workshop with the theoretical studies of the university, wherever that may be practicable, either by taking half the workshop training before, and half after the university period, or by interpolating alternate years and half-years of work and study, in conformity with the individual opportunities or convenience of the student.

Conclusion.

In conclusion, we have only to say what this vast engine for the improvement of the Swiss people costs the Confederation.

The Englishman who studies these figures should remember, that it is the provision made for a population of only 2,500,000; for the most part only agricultural peasants, inhabiting a mountainous and comparatively sterile country. In measuring the expense we should also bear in mind, that francs go as far in Zurich as crowns in London.

Cost of the university.

To the foundation of the Polytechnical University the Federal Government contributed 20,000*l.* and the canton of Zurich 136,000*l.* The annual expenses and contributions of the students are :—

BUDGET OF THE POLYTECHNIC SCHOOL OF ZURICH.

Income.

1. Loan from the State treasury	£10,000
2. Loan from the Canton of Zurich	640
3. Pupils' fees	2,653
4. Loan from the Canton and State of Zurich for the collections and museums	166
Total income	£13,459

Expenses.

1. Government of the University	£1,680
2. Salaries of professors and teachers	9,500
3. Collections and museums	2,146
4. Prizes	40
5. Furniture, &c.	93
Total expenses	£13,459

Practical results of education in Zurich.

Such is our model university; and I ought not to leave it without testifying to its perfect success. My first acquaintance with this university arose out of the incident of a young relation of my own happening to desire to obtain an education in a branch of civil engineering, and finding it impossible to obtain that education in England. Fortunately for him, an Englishman of science, well acquainted with foreign education, recommended to him the technical university of Zurich. He went there : he passed through its courses; returned to England; entered himself in the usual manner as a learner in the works of an eminent engineer. Here the advantages of Zurich soon showed themselves unmistakeably; his superiority was so evident, that he soon rose over the heads of much older men, and long before his apprenticeship expired, he had already been entrusted with heavy responsibilities and important duties, which could not be entrusted to men much older and more experienced, but less skilfully trained, and less highly educated.

Criticism.

This youth was a standing example of the practical excellence of Zurich. This was the incident which afterwards induced me to study carefully the organisation of that institution, with the determination to do my best towards obtaining for young Englishmen equal privileges in their own country; and I may say, that the result of a practical acquaintance with that institution, and of personal intimacy with many of those who have been its pupils, is to satisfy me that this Swiss university is a noble proof of the wisdom of her patriots and statesmen—of the enlightened generosity of the countrymen and citizens of Zurich; and that the institution they have founded is in its aim, its organisation, and its practical effect, well worthy of the study and the rivalry of any statesmen and any citizens, who do not believe their countrymen unworthy of high intellectual cultivation, and sound technical training for life.

CHAPTER IX.

THE TWO LEARNED UNIVERSITIES OF ENGLAND—GYMNASTIC AND NON-TECHNIC.

The word "gymnastic."—Our universities eminently gymnastic.—Gymnastic education preliminary to technic.—Modern technical occupations:—The statesman—The divine, doctor, and lawyer—Soldier, sailor, architect, &c.—The learned universities technical for the divine, lawyer, and doctor.

The word "gymnastic."

THE term gymnastic is so well understood in its common application to bodily exercise, that we have almost lost sight of its original and more orthodox application to the systematic exercise and symmetric development of mental power. In Germany, as in Greece and Rome, a school for mental training, such as we call a college or university, is still called a gymnasium; and it will be convenient for us to employ the term *gymnastic* as supplementary to the word *technic*. In this way we shall say: gymnastic school, and technic school; gymnastic college, and technic college; gymnastic university, and technic university; and these terms will correspond to the continental titles still in use—gymnasium and polytechnicum.

Our first duty will be to consider what is, or ought to be, the exact nature of a gymnastic school, college, or university, as contrasted with a technic school, college, and university.

Our second question will be, how far our existing schools, colleges, and universities, are in their nature gymnastic or technic.

Our third question will be, whether our existing schools, colleges, and universities, can be rendered, at the same time, both completely gymnastic and completely technic; or whether, for the future, the gymnastic shall form one entirely separate class of institutions, and a new class, entirely technic, shall be created.

Our universities eminently gymnastic.

I do not think better illustrations could be cited of institutions purely gymnastic, than our own two universities—Oxford and Cambridge. As we all know, the one has reputation as a school of classics, the other as a school of mathematics; but, equally in both, the thing sought is the gymnastic, and the thing casual and subordinate is the technic. Classics are taught in Oxford, not for the purpose of preparing men during the rest of their lives to talk Latin or to write Greek; not to train Greek poets, or rear Latin tragedians; nor even is the training of pedagogues in those tongues the end and object of university life: the whole course of the training, uses Latin and Greek as instrumental merely. They are to the mind what poles and bars are to the body; poles are climbed, and bars are leapt, for the good the body gets in climbing and leaping; and, when sufficiently leapt and climbed, they are left for ever behind as useless matter. Hexameters and pentameters are the bars and poles of the mind, knotty, high, and hard to clear; to do them is difficult: once well done, they have served their turn, and may be thrown aside.

Between Oxford and Cambridge there is little difference, except that the gymnastic is not made by hexameters and pentameters, but is built up of geometrical lines, and differential and integral calculi. The stone wall is as hard to climb, and the geometrical line as hard to leap, as the hexameter and pentameter of classic verse; they equally strengthen the youthful intellect, and, when well strung, the gymnastic poles are equally flung aside.

Our classical and our mathematical universities are then equally, and to the same extent, pure gymnasia, with apparatus mainly similar in effect, and only different in the nature of the material, and the source from which it is drawn; and, in general, nine-tenths of those who have completed their university studies abandon for ever the classic lore and Greek geometry, which cost them so many years of study and pain. In how many cases such pain has been well wared, and the gymnastic training been worth the sacrifice of years spent in its drill, is a matter which each class of scholar will answer in a different way. To so many noble and great men has our university gymnastic formed the successful training of a brilliant and useful public career, that no one dare say that they have failed in breeding great men for the service of the country. The classics and the mathematics are, therefore, both, perhaps, in equal degree, the material of a noble gymnastic education.

Gymnastic education preliminary to technic.

As non-technical schools, then, our universities are admirable; and for men whose lives are destined to be non-technical, they are, perhaps, adequate and sufficient. But in the modern life of the civilised world, each man's sphere is becoming narrower; his work harder, and more technical. A man must not only be capable of learning how to do hard things, but he must have acquired the skill of actually doing them; and he must be capable of doing many things as well as any man, and also some one thing better than most men. That is the inevitable condition of the educated man in civilised life.

Let us see what those technic occupations are which form the matter and substance of modern working life—that is, the after career of your university man. Is he born to wealth and leisure—then statesmanship is his probable career; and, in England at least, statesmanship has been rendered the least technical of the duties of life; and, even for a minister, it has been reckoned the most important of qualities that he should have the least possible technical knowledge of the duties of the office over which he presides. For a statesman, then, an acquaintance with the Greek republics, the Roman empire, and the history of nations, may be considered adequate technical education. But if our standard of statesmanship were higher, we might, perhaps, require of a foreign minister that he should be familiar with the tongues, races, countries, manners, institutions, and ways of the peoples with whom he is to conduct international negotiation. We might require of the Minister at the Admiralty that he should have a familiar acquaintance with the nature of the vast establishments in which our fleets are constructed, equipped, armed, and sent to sea; and know something of the elements of their construction, the fitness of their equipment, and the nature of their armament; and that the duties of his admirals, superintendents, naval architects, and sailors should be not altogether unknown to him. If, in these and other cases of ministerial responsibility, we required special knowledge as a qualification for special duty, then statesmanship might require, like other duties of life, a special preparation and technical training; and we should have to inquire how far our universities

Modern technical occupations:

The statesman;

provided, even for the statesman, the technical preliminaries required of a fit candidate for office.

As we now stand, however, the university may be considered as adequate training for the youthful statesman of rank and fortune.

The divine, doctor, lawyer;

But, we have to inquire, does it also fit for the duties of common life the men of those other professions which may be supposed to require liberal education and high training? What do our universities provide besides gymnastics in the way of special preparation for the career of the divine, doctor, lawyer, schoolmaster, professor, man of science, military man, naval man, agriculturist, machinist, manufacturer, architect, engineer, naval architect, surveyor or shipowner? Have they set before them in the university models for their imitation of all that is most perfect in their art and duty, just as the statesman has set before him the Greek democracy and the Roman empire, as models to form or beacons to warn? Are stores of methodical knowledge hoarded for them on the shelves of the university library, or spread out before them in the rooms of the university museum? Are the lectures of the university devoted to explaining the methods, how to make the hard things of life easy, the confused clear, and the doubtful certain?—If so, we will admit that the universities are for these professions competent teachers, and have a right to be called technic as well as gymnastic institutions.

Soldier, sailor, architect, engineer, &c.

But let us look nearer at the hard facts. Our universities confer the degree "Master of Arts," as a testimony of the highest proficiency, on the men who have completed their university curriculum. Is such a man really Master of Arts, or master of anything that pertains to the theory and practice of those multifarious arts that form the daily duty of professional life? I fear, the most faithful alumnus of our mother universities will not venture to say for them, that Magister Artium is anything more than a mediæval title, utterly destitute of the practical meaning it was originally meant to bear; and that the finished Master of Arts has scarcely begun to learn the elements of the profession into which he carries the fictitious title of Master. He has done his gymnastic—he has not entered upon his technic.

I have been told—and, in justice to our universities, it should never be forgotten—that they were originally technical schools, and of the most special kind. They were founded originally for the rearing and training of clergy, and then extended to the education of lawyers, and finally to that of medical men. Degrees of theology, law, and medicine, were the dignities they conferred, although now an LL. D. need know as little of practical law as a Master of Arts of any practical art. Neither, I fear, can it be said that the education of a medical man is to be adequately found within the walls of either of our two great universities.

The learned universities, technical for the divine, lawyer, and doctor.

Nevertheless, for the present purpose I will take it for granted that the universities provide an ample theological education for the clergy; an ample medical education for the doctors; and sufficient store of legal knowledge to initiate the youthful lawyer into the mysteries of his craft and profession; and I will confine myself to the further question,—Are our universities in any respect technical universities for training in the other modern professions, exclusive of the three ancient ones, theology, law, and medicine? I think the answer must be that they do not, and that they never were meant to; and for all the other professions I will assume, for the future, that the two great universities are gymnastic, not technic.

CHAPTER X.

OUR MODERN PROFESSIONS, AND THE KINDS OF TECHNICAL EDUCATION THEY WANT.

What shall be our technical education ?—Where to draw the line between technic and gymnastic.—It must vary with each profession.—For the agriculturist ? — For the miner ? — For the metallurgist ? — For the merchant ?—For the manufacturer ?—For the machinist ?—For the civil engineer ?—For the architect ?—For seafaring professions ?—For men of science, professors and teachers ?

What shall be our technical education ?

What sort of Technical Education shall we provide for our Technical men ?—Although, as we have seen, there is much of modern education that is mere gymnastic, and some that is unquestionably technic ; yet it is now, and may probably long remain, impossible to draw a clear line of mathematical precision among studies, and say, "On this side of the line, all shall be called gymnastic; and on that side of the line, all shall be called technic." The subject forbids such abstract division : for here it may be purely gymnastic, and there it may break out into practical flowers and fruit full of valuable technical use ; or the history of the individual may prevent it—for to-day a student with no fixed destiny may do and learn that which is mere gymnastic, and to-morrow, with a fixed destiny, may do and learn the very same thing with an aim and purpose purely technical. The man who learns Latin to-day as mere gymnastic, may find himself to-morrow destined to be a Catholic priest ; and so Latin may become the tongue of his craft.

The student of French to-day, which he learns as a mere accomplishment, may find himself to-morrow named as attaché to an embassy. Studies, therefore, become technic or gymnastic, according to the degree of their practical application, and according to the varying destiny of the men who make them their study.

When we ask, then, what sort of technical education shall we provide, we must endeavour, however difficult, to draw the line between technic and non-technic education, if not quite precise, at least sufficiently clear to show where, when, and how, gymnastic shall be considered to end, and technic education to begin; and we must settle that line, not only for subjects and places, but also for classes and individuals.

Where to draw the line between technic and gymnastic:

What, then, shall the gymnastic education be of those pupils whom we shall agree to admit as candidates for our technic university? To what extent must they already be linguists, grammarians, arithmeticians, geometricians? Shall we exact of them reading, writing, and speaking in some of the foreign tongues? Shall they know history, ancient or modern? Shall they know anything of the elements of political and physical geography?—anything or nothing of political economy?—any logic or ethics, any elementary mathematics, physics, or chemistry? Shall they be able to handle any instruments, or draw truly any plain forms that are set before them?

It is plain that the answer to all this must be, that all these things form an indispensable part of a liberal education, and therefore ought to be a portion of the gymnastic education which every man should have received before being called upon to decide his vocation in life. An educated gentleman from 16 to 18 years old must know, more or less, all of these things, at least in their elementary portions, and therefore it would be unfair to call these elements any part of a technical education, although in their higher grades they might become eminently so. If it be agreed, then, that at the outset of our technic university the mere elements of those subjects shall be demanded as a condition of entrance, we shall be able to make a fair start in our career of elementary education.

It must vary with each profession.

What, then, shall be the Technical Education of our Agriculturist?—Shall he know anything of the nature of soils? Shall he understand anything of the structure of plants?—what is good for their food; when young; when flowering; when bearing seeds? Shall he know anything about trees, fruits, timber? Shall he know anything of manures, of their chemical elements, of their history, and whence they draw their virtue? Shall he know anything about insects, especially those that infest crops and blight them? Should he know anything of the anatomy of a horse—of his physiology, of his diseases, and their modes of cure? Should he study animal physiology, to know how fat comes, how healthy structures are developed, how races improve or decay? Should an agriculturist understand a plan of his farm, drawn out on paper? Should he be able to make or improve the plan on paper, and should he be able to lay out his improvements from the plan on the ground? Ought he to understand any of the principles on which to drain his land, or to irrigate it when necessary? Should he understand the mechanical construction of a gate, its balance on its hinges, its mechanical action on the gate-post? Would it be of use to him, or not, to know something about the crops that are grown, the

For the agriculturist?

animals that are reared, and the processes that are employed in other countries than his own? Should he understand the true mechanical principles on which a good plough is to be made and worked, as distinguished from a bad one?—a good cart or waggon, a good threshing-machine, or a steam plough?

If on all these our conclusion be that an agriculturist has a great many and very hard things to learn, and that he will be the better throughout life for knowing them than for not knowing them, then we may safely draw the conclusion that he had better learn something in the shape of technical knowledge. Assuming, therefore, that the subjects given above are those that he ought to learn, we have next to decide what are the peculiar sciences that ought to be taught in a technic university, in order to give him this great variety of knowledge.

AGRICULTURAL EDUCATION.

Farming Knowledge.	*Technical Teaching.*
Nature of soil	Surface geology.
Structure of plants	Anatomical botany.
Food of plants	Physiological botany.
Manures	Agricultural chemistry.
Structure and constitution of animals	Comparative anatomy.
Rearing of animals	Animal physiology.
Diseases of animals	Veterinary medicine and surgery.
Laying out of farms	Land surveying.
Draining and irrigating . . .	Surveying and levelling.
Gates and fences	Practical mechanics.
Construction of farm buildings .	Agricultural economics, and plan drawing.
Improvement of seeds and breeds	Agricultural geography.
Ploughs, waggons, implements .	Theoretical mechanics.
Steam engines and machinery . .	Elements of mechanism.
Fruit trees and timber . .	Technical botany.

What shall be the Technical Education for the Miner?—While the agriculturist is engaged in cultivating the earth's surface, in order to utilise for man the productive energies of the rays of the sun, the miner is as diligently exploring its hidden and interior resources, to recover those buried stores of antediluvian vegetation which millions of years of the sun's rays had accumulated in former ages, and to bring to the surface many precious metals and gems which the intense heat of our huge central fire had, in the course of time, refined, condensed, separated, and fitted to form the material of mineral manufacture. To us, who live on the surface, it is not easy to imagine the needs and ways of these underground workers; but as it is for our good they are spending their lives in subterranean dungeons, shut out from the light of heaven, it is for us to think of and care for their welfare, and see if we can make their life more cheerful, their occupation more wholesome, and their work lighter; if we can teach them how more wisely to seek and more surely to find the minerals we want; if we can feed them with fresher and more wholesome air; if we can more methodically teach them to draw plans of their underground cities and works; if there be one substitute for the light of heaven fitter for their use, safer for their lives, than another; if there be knowledge that would save them the risk of fearful accident; if there be kinds of mechanism and machinery to lighten their labour; and if, by superior knowledge, there are means of making that life, which has been perilous and debasing, secure and civilised;—then no pains we can bestow should be spared to render the whole technic of mining, from the highest engineering to the humblest coal-gathering, clear, well understood,

For the miner?

methodical, and unwasteful. There can be little doubt that, by the application of higher knowledge and more practical wisdom, the enormous losses of past times in property, human suffering, and human life, might be spared; for it is only too true that the very abundance of our mineral riches has made us wasteful, heedless, and short-sighted.

If, therefore, it be true that far below our agricultural population there is an under layer of population farming out the vegetable and mineral productions of past ages, then it is also true that we ought to aid them in planning their work, draining and making their subterranean ways, and using, in all their work, artifices more refined, if possible, than the highest of those used by the cultivators of the surface. If we decide on this, we shall have to provide for the miner the following course of technic training:—

MINING TECHNIC EDUCATION.

Mining Knowledge.	*Technical Teaching.*
How to distinguish minerals .	Mineralogy.
How to find minerals . . .	Geology.
How to get at minerals . .	Geological surveying.
Ventilation of mines . . .	Mechanical physics.
Illumination of mines . .	Practical chemistry.
Working of mines	Elements of machinery.
Economy of the products of mining	
Survey of mines	Geometry and trigonometry.
Mining health	Physiology and chemistry of life.

For the metallurgist?

What shall be the Technic Education for Metallurgists?—It is the metallurgist who has to receive from the miner his produce, and these he must take as the miner gives them, in a confused heterogeneous condition. It will, therefore, be necessary that he should know what he is getting, not only by eyesight, but by history, origin, and nature. If the miner must know the natural shapes which characterise the minerals he finds, no less must the metallurgist know the characters of what he buys; and the history of the minerals, whence they came, and how they grew, will help further to enlighten him on their properties, nature, and value. To the metallurgist, then, it will be as useful to know mineralogy and geology, as for an agriculturist to know seeds when he sees them, and what plant they come from. But that is not enough: scarcely anything ever comes to him pure; it is as if the farmer received in one cart-load all the seeds of his farm mixed rudely together with the seeds of weeds and all sorts of rubbish. To distinguish, and sort, and part, and analyse, and mix, is the next step in his business; and all that means such a knowledge of analytical and synthetic chemistry, that without it the occupation of a modern metallurgist must degenerate into mechanical routine, or the merest guess-work. And this knowledge is not enough, for he must add to skill power, and wield the forces of nature—heat, pressure, fierce streams of air, intense force of steam—all the powers of the alembic, and the engine, to calcine his refractory ores, to reduce his obstinate metals, to fuse his minerals, and to part the useful from the dross. The physical forces of nature, then, he must master. Machinery, engines, and furnaces, must obey his control; his eye must temper or intensify the red and the white heats, the blue and violet flames, to the precise degrees that suit the qualities and natures of the metals he governs.

The resources of physical science—light, heat, electricity, galvanism, steam-engines, machinery—must all unite their forces under his control, if he is to prove stronger than mother Nature, to separate what she has joined, and join what she has put asunder. To part Nature's combinations, and substitute for them man's—that, on a gigantic scale, is the duty of our modern Vulcan. For the metallurgist, then, nearly all the miner's education is necessary; and more, he is at once miner, chemist, and engineer.

METALLURGIC EDUCATION.

Metallurgic Knowledge.	*Technic Teaching.*
Nature and source of ores	Practical geology.
Characteristics of minerals	Mineralogy.
Tests of minerals	Analytical chemistry.
Separation of ores	Practical chemistry.
Reduction of ores	Science of caloric.
Refining of metals	Sciences of caloric, electricity, and magnetism.
Manufacture of metals	Steam engines, machinery, general physics, and mechanical engineering.

For the merchant?

What shall be the Technic Education for Merchants?—Just as the metallurgist receives from the miner the produce of his laborious diggings under ground, so does the merchant receive from the farmer of every soil on the surface of the earth the produce of his culture and climate, and he makes his contributions to the wealth of nations by the substitution in each country of something more rare and of higher value for some other thing common and cheap. This equal exchange has the charm of making both wealthier; each enriches the other, and thus the enlightened merchant is the benefactor both of buyer and of seller. To do his work well, he must know what is wanted by all classes of the community in his own country, and it is his duty to find out that thing in some other part of the world where its abundance makes it little valued, and whence it can be withdrawn without loss or harm to the producer. This state of things gives rise to what is called the mercantile equation. The work he has to do, is to move this material out of the place where it is abundant and cheap, into the place where it is scarce and dear. The difference between those two constitutes the merchantable margin; the problem of his profit or loss comes out of the question, whether he has the talent, knowledge, and power to move the merchandise quickly, while it is wanted, out of the cheap into the dear place, and at less cost than the difference of price? These are the elements of the mercantile equation. If he has knowledge and ability to do this, he makes a profit, and all are gainers by the transaction; if not, and his margin will not cover his expenses, he either makes a loss, or he resorts to some of the thousand-and-one dishonest artifices which throw the loss of his incompetence on some other person who happens to be ignorant of the false calculation which has been made. It is thus evident that, for our world-wide modern business, enormous knowledge is necessary, or enormous dishonesty takes its place. Original miscalculation by the merchant is too often remedied by combination for the production of artificial scarcity, by substitution of false quantity for true, or in the shape of worthless mixture; and so, where skill fails, dishonesty steps in, and character disappears. Above all things, then, it is necessary that the merchant should have two things —high skill, and high character; he should know not only the past history of trade in his own department, but as the circumstances of the commercial and political world are every day producing sudden change, his knowledge should be far wider than that which seems to be required in the daily duties of a mercantile office. While the staff of a merchant's house are busied in routine transactions, the merchant should forecast the changes which increased consumption or diminished production may be bringing about in any of those countries from which supplies come, or to which exports go; for diminished supply, and increased demand, he must be continually considering what new sources the world can give, or human ingenuity contrive, to supply increasing wants; how transport can be cheapened, time saved, risk diminished, exchange made easy. There is no part of the industrial community, on the largeness of whose views, on the soundness of whose character and practical wisdom, more of the wealth, power, and well-being of the nation depend, than on the class which, in the large sense of the term, enjoys the proud title of British merchant. But, also, there is no class whose name is more abused, or which contains a greater number of persons who usurp the title without contributing a single element to the prosperity of that society, on which they merely live as parasites and birds of prey. To give, therefore, to the future race of British merchants such a large and liberal range of education as shall make them worthy representatives of this long highly-respected class, is one of our most urgent and most responsible duties.

MERCHANTS' TECHNIC EDUCATION.

Mercantile Knowledge.	*Technic Education.*
Knowledge of countries . . .	Political and physical geography.
Knowledge of seas and ports .	Naval charts and nautical geography.
Raw materials, animal and vegetable	Geographical botany and zoology.
Customs, usages, and institutions of nations . . .	Political history, voyages and discoveries.

Population, consumption, and production	Mercantile and political statistics.
Correspondence, weights, measures, and customs of nations.	Foreign languages, literature, laws.
Monetary affairs	Laws of currency, exchange, banking.
Ships' freights, cargo, and insurance	Laws of mercantile marine, international law, and calculations of risks.
Supply and demand and price .	Political economy, and theory of prices.
Profit and loss	Calculation of exchanges, interest and book-keeping.

What shall be the Technic Education for the Manufacturer?—But if it be the merchant who converts the cheap surplus of foreign climes to the use and wealth of our nation, it is very frequently in a subordinate position, rather than directly, that his work becomes a boon to the community. The produce of foreign countries, as he finds and fetches it, is for the most part only the raw material, in a state in which it cannot enter into the supply of our social wants until after it has undergone the multifarious processes of manufacture. The cotton of America, the jute of India, the grass of Spain, the cochineal of Mexico, the wool of Australia, the hemp of Russia, the hides of South America, the silk of Japan, are all of small practical value in the raw condition in which they reach these shores. It is the art of the manufacturer, by his industry and skill to give to them forms, textures, combinations, and colours, which fit them for the uses and purposes of civilised life. In doing this, he doubles or triples their original value, and so pays back to the merchant, by his skill, some of the material which the foresight of that merchant had originally procured for him; but the portion thus paid back is so much enhanced in usefulness, beauty,

For the manufacturer?

and value, that a comparatively small part of it, once more exported to the country from whence it came, both pays for the original cargo of material, for the ship which brought it here, and now brings it out again, and yields the merchant a double profit, after having duly paid the manufacturer for its conversion, and left a large portion of itself behind for home consumption. This is the combination of manufacturing skill with mercantile foresight which has made the dense cities of England centres of an industrious, thriving, and ingenious population.

But this wealth is to be created only so long as skill, knowledge, and power are applied to it in England in a higher degree than elsewhere to give to the raw materials the texture, shape, and colour that enhance their use and value. Should the day come when our manufacturers are less skilled, less informed, less able than our rivals, the flood of these materials to our shores, and the back current of manufactures to replace them, may take another direction and surge on other shores. Let the tasteful manufacturer of Lyons, the frugal workman of Switzerland, the well-educated artificer of Germany, apply greater strength, skill, and taste to the manufacturer's work, and our goods will soon cease to pay either for foresight of importation, conversion into manufactured goods, or freight of transport; and so manufacturer, merchant, and shipowner will fall down into low profits for risk, low remuneration for work, and low freights for ships.

No argument, therefore, is necessary to show that the English manufacturer belongs to one of those classes on whom the means of obtaining the highest intelligence, knowledge, and refinement will be well wared, or, indeed, cannot be left wanting, without foreboding great national calamity.

The tools he uses in his processes are, for the most part, boilers, steam-engines, driving manyfold complicated mechanisms of delicate structure, moving with nearly invisible speed, endowed with the highest refinements the engineer and mechanician is able to devise or execute. We cannot afford that the man who has to work with such tools shall grow up ignorant, awkward, unrefined. The man who does not know the difference between the better and the worse machine will never be allowed to own the better, but will have the worst thrust upon him; and, in some degree, already the work of the mills of the more intelligent mill-owners begins to fetch more money, and to have a preference in the market; and as intelligence and morality increase, the preference will become more and more marked. Every day character, intelligence, and taste enhance more and more the value of the materials they deal with. Let us take care, then, that the rising race of manufacturers grow up better skilled in manufacture, better reputed for quality of materials, and more discerning in matters of taste than those of other lands. It is plain, then, that, like the merchant. he must know the sources, the character, the sorts of the materials that are to pass through his hands. The selection and sorting of these is a first condition of excellence; and as every different sort, from every different source, has some peculiar quality and virtue, the ability to select, by his own judgment, is of great importance to him. To be able to select for each sort of material the fittest process and best kind of machinery for its preparation and conversion is the next step in the manufacturer's trade; and if he be able to invent, design, make, or select the most suitable mechanism for working it up, that will give him high chances of excellence. For the delicate, complicated processes of refined manufactures, the choice of the best situation for his establishment, the design and organisation of the establishment itself, the wise selection of manufacturing power by means of coal, water, or steam, the organisation of his workmen for the purposes of their training, industry, and skill, are subjects that require large economical views, and profound mechanical knowledge. Every element used in his mill—oil, tallow, steam, leather, fuel—is an element of waste, loss, or frugality in use. The best markets to buy and to sell in, the time to accumulate stock, or to reduce it, are also matters of forethought and anticipation; and last, not least, the ability to send out into the world things of beauty in form, colour, arrangement, and design, unsurpassed by other manufacturers, is so great a pleasure to the individual, so important an advantage to the commerce of the country, so improving to the customer, is one of the means of so enormously adding to the value of the raw material, that the nation which possesses the greatest number of such skilled men will be amply repaid for all the pains it may have taken to educate and train them. A manufacturer should combine, then, in his own person, in no inconsiderable degree, the qualities of the merchant, the machinist, and the artist.

MANUFACTURERS' TECHNIC EDUCATION.

Manufacturing Knowledge.	*Technic Education.*
Knowledge of raw materials .	Vegetable and animal physiology.
Sources of raw materials . . .	Economical geography.
Sources of power . . .	Mechanical physics.
Nature of tools	Practical mechanics.

Mills and buildings . . .	Industrial architecture.
Social organisation of workmen .	Political economy.
Drawing plans	Descriptive geometry.
Drawing designs	Decorative geometry.
Coloured patterns . . .	Theory of colour and beauty.
Dyeing and bleaching . . .	Practical chemistry.
Monetary affairs	Laws of commerce and banking.
Profit and loss and insurance . .	Interest, risks, and book-keeping.

For the machinist?

What Technical Education should we give to the Mechanical Engineer or Machinist?—From the days of James Watt and Arkwright until now, comprehending the whole of the present century, the mechanical engineer or machinist has formed one of the most important classes of this country, and has conferred on it immeasurable benefit. It was the mechanical engineer and the manufacturer who, together, during the early part of the present century, while the whole of Europe was overrun by the curse of war, created wealth in this country so rapidly, as to enable her to struggle through a burden of expenditure to which there has been no parallel, and to come out of it prosperous and wealthy.

There are no occupations or trades concerning which there could be so little difference of opinion as to the practical importance of special technical education, as this class of mechanical engineer and machinist. Philosophers have defined man as the tool-using animal; but if the man of this century were defined, the "engine-maker" and "machine-user" would be his leading characteristic: it is the triumph of human nature in our time, that it has achieved the understanding of the forces of nature so completely, that whatever material service we wish to perform, we can always discover some elementary force in nature, willing to lend us its aid to conquer our difficulty, provided we will study its nature sufficiently to direct it into the way in which it can best serve our end. The steam-hammer of Nasmyth, and the steel ingots of Krupp, are symbols of the powerful yet plastic forces man wields, in his gigantic shape-compelling processes of manufacture. We may sum up the duties of a man of this craft by saying, that there is scarcely a process now performed by animal or man, which our engineers or machinists of the next generation may not be called upon to perform better and quicker by machines of their own creation.

Of the engineer and machinist it is therefore very easy to indicate the course of instruction; unluckily, much easier to indicate than to accomplish. He must master all the known powers of material nature: heat and cold; weight and impulse; matter in all conditions—liquid, solid, and gaseous; standing or running, condensed or rare, adamantine or plastic—all must be seen through and comprehended, by the master of modern mechanics. The same laws which govern the machinery of the heavens, he has to apply to the machinery of the earth; and the same exquisite mechanism which the Creator has used in the structure of his animals, the modern mechanician has to apply in the construction of his microcosms. The modern mechanician, who would be equal to his work, must be prepared to shape a tool and frame an engine for the execution of tasks which were never even dreamt of by the older mechanicians.

TECHNIC EDUCATION OF THE MECHANICAL ENGINEER AND MACHINIST.

Mechanical Knowledge.	*Technic Education.*
Shapes and sizes of things . .	Geometry.
Quantities	Algebra.
Numbers	Arithmetic, calculation.

Weights	Laws of gravity.
Forces and motions . . .	Laws of dynamics.
Strengths	Laws of statics.
Mechanical powers	Theoretical mechanics.
Laws of solids	Kinematics.
Laws of liquids	Hydrostatics and hydrodynamics.
Laws of airs and gases . .	Hydrostatics and hydrodynamics.
Generation of motion . .	Heat, light, electricity, attraction, and repulsion.
Sources of power	Chemical physics.
Applications of power. . .	Elements of mechanism.
Mechanical inventions . . .	History of machinery.

What Technic Education should we give the Civil Engineer?—The great public works of a civilised country have always demanded and generally received from its Government, earnest solicitude and forethought. In France, the civil engineers are the *élite* of the nation; the most distinguished pupils in the colleges throughout the country are promoted into the central technic institution of France in Paris; and out of this again, a selection is made of the most talented for the "corps de génie maritime;" for the "corps de génie militaire;" and for the "corps de génie civil," or "ponts et chaussées."

For the civil engineer?

By the great public works of a country so much is gained or lost to the public well-being, that the most liberal measures are justified, if they succeed in providing for its service the profoundest knowledge, the most brilliant talent, and the highest skill. In the time of the Romans, Europe was covered with those wonderful roads which have been perpetuated to the present day, and are marvels of conception and execution. The correction of rivers and supply of waters to great cities, the drainage of marshes and the irrigation of plains, have developed the industry and created the wealth of populous countries; and it has depended almost entirely on the wisdom or folly of modern Governments, in the selection of their engineering systems, whether those great engines of commerce, the modern railways, have been given to a country at small cost, on a wise system of development, with gain at once to the capitalist, to the trader, and the Government. Where Governments have been wise, the railways have been well selected, cheaply made, economically and profitably worked. Where they have been reckless, ignorant, unwise, railways have been made at great cost, extravagantly worked, dear to the public, and unprofitable to the capitalist.

When it is considered that the telegraphs which now work the commerce of the world ; the great lines of steam-ships which unite its most civilised portions ; the railways which everywhere connect the populous centres of empires; the water supply ; roads; ports and harbours ; the direction, training and permanence of our navigable rivers—are all works involving enormous cost, involving the highest national interests, and requiring consummate knowledge and skill, it is plain that we may judge of the wisdom of a nation by the foresight and forethought it bestows upon the rearing, training, and selection of this *corps d'élite* or *corps de génie* ; and it is therefore self-evident that, in a technical university, the pupils of this section must find a prominent place. For England especially, with her wide-spread dominions, it is evident that the youthful engineer should be prepared to find a sphere of usefulness in any quarter of the globe, and to carry with him a mastery of all the resources of modern science and skill.

TECHNIC EDUCATION OF THE CIVIL ENGINEER.

Engineering Knowledge.	*Technic Education.*
Laws of water—standing and running	Hydrostatics and hydraulics.
Laws of dead matter	Strength and resistance of materials.
Laws of fixed and moving bodies	Statics and dynamics.
Building of bridges and ways	Theory of structures in stone, timber, and iron.
Surveying, mapping, selection of routes	Geometry, trigonometry, and surveying.
Erection of buildings	Theory of beauty and ugliness.
Estimates of cost and production of public works	Prices, wages, and economical valuations.
Steam-ships and machinery	Naval architecture and mechanical engineering.

To a great extent, the civil engineer must have also the same education as the mechanical engineer.

What should be the Technic Education of the Architect?—In old times the architect was also the civil engineer of the State. In modern times the engineer must become to a great extent the architect of the State; for whenever a modern building becomes more than a mere dwelling-house, or decorated mansion, it requires so many of the resources of the engineer to give it strength and permanence, that it is nearly impossible to say where engineering ends or architecture begins. Up to the present time we must admit, from the examples we have seen, that nothing can be worse than the engineering of architects, unless it be the architecture of engineers. The huge engineering deformities that disgrace the City of London are almost an excuse for the imbecile puerilities of architects, who have tried to plant on the engineering structures such meretricious masks as should hide their uncouth uglinesses. When engineers shall have received a good education, they will appreciate the For the architect?

refinements of the sister art, and learn from the architects how not to create and expose to public gaze, clumsy, ungainly masses of inorganised material; and when, in like manner, architects shall have received an education in all the arts by which strength may be thrown into any form, and forms of strength developed in any material, they will be able to erect beautiful structures which do not tell lies, and buildings which express at once artistic feeling, refined intelligence, and a mastery of the materials they use, and of the purposes these materials should be made to achieve. In short, the engineer will gain what he now wants in refinement, and the architect what he now wants in directness of purpose and truth of expression.

What the architect wants to know is the qualities, weights, and resistance of materials, quite as much as the engineer; to understand shapes, strengths, and proportions of different sorts of matter, quite as familiarly as the mechanical engineer; and, further, to know how to organise the skill of men and the power of machinery for the creation of his structures, quite as thoroughly as the manufacturer knows how to use them in the creation of his wares. But, besides being an engineer and a manufacturer, the architect has to be an artist; he has to touch the feelings as well as to overcome material difficulties; his works must not be a dissight to his neighbour, nor a distaste to the passer-by, who should be forced to exclaim, "There is a sight does one good to see;" "There is a man who knew his work, and did it;" "There is a pleasure made permanent for generations to come."

But if we will have such works and such men, we must first train the men, and then appreciate their work.

TECHNIC EDUCATION FOR ARCHITECTS.

Architectural Knowledge.	*Technic Training.*
Knowledge of forms	Higher geometry.
Knowledge of ground	Surveying.
Knowledge of strengths and combination of materials	Civil engineering.
Forming, shaping and moving masses	Mechanical engineering.
Knowledge of symmetry, proportion and beauty	Theory of the beautiful.
Employment of materials	Principles of masonry, carpentry, and metal work.
Decoration	Ornamental materials, and art workmanship.
Style	Expression of use, intention, and feeling.
Adaptation to uses and wants of society	Health, cleanliness, comfort, and convenience.
Nobility of plan and elevation of purpose, as distinguished from meanness and triviality	Æsthetics.
Knowledge of styles	History of ancient, mediæval, and modern architecture.
Methods and processes of furnishing, fitting, and finishing	Contemporary decoration in different countries.

What ought to be the Technic Education of the Naval Architect, Naval Engineer, Shipowner, and Sailor?— For the two first of these classes, ample provision has already been made in the Royal School of Naval Architecture at South Kensington, which would naturally form part of such a technic university as I have been describing; and there could be no school devised in which the shipowner could obtain a better knowledge of the qualities his ship ought to possess, or where the sailor could better learn how all the qualities which make a ship good at sea can be bestowed in her original construction, and enhanced or diminished by subsequent bad judgment or ignorance. To such college might be advantageously added a complete

For seafaring professions?

course of theoretical navigation and seamanship, for the use of the officers and captains of the mercantile marine.

TECHNIC EDUCATION OF THE NAVAL ARCHITECT, NAVAL ENGINEER, SHIPOWNER, SAILOR.

Seafaring Knowledge.	*Technic Training.*
Construction of ships . . .	Naval architecture.
Construction of marine engines .	Marine engineering.
Owning of ships	Construction, equipment, and outfit.
Navigating ships	Construction and equipment, seamanship and navigation.

Together with the other elements of the course of education now given in the Royal School of Naval Architecture and Navigation.

For men of science—professors and teachers?

What Technic Education ought Professors, Philosophers, Teachers, Schoolmasters, to receive?—It might be supposed that to excellence in teaching an art or science, no other training would be necessary than to have attained consummate excellence in the art or science to be taught. This is one of those partial truths which is neither true enough to be reliable, nor false enough to be readily refuted, and it is the source of many a grievous practical blunder. I remember to have studied mathematics under a professor who was a profound mathematician and a practical idiot. He pursued his even way with thoughtful painstaking upon the board, following out investigations of which he had neither explained to us the end nor the plan; and, after a few days of futile painstaking in attempts to follow him, we had to give up the hopeless task, and occupy the remainder of the course with reading our own books, making our own drawing, or such other amusements as most pleasantly passed our time, while the Professor continued to apply, in social solitude, his chalk and board. This man knew too much of mathematics, and too little of our minds, to be of the slightest use to us.

But there came another Professor, the famous Dugald Stewart, himself a young man, and a young teacher; he had to teach as much as he knew, but he had the wonderful ability of being able to teach all he knew. He explained the excellence of his teaching, by showing that he possessed the highest conditions of the art—hearty sympathy with his pupils, a thorough knowledge of their condition, and the peculiar difficulties of their subjects: "I teach well, because I am only twenty-four hours in advance of my pupils; what I teach, I have just learnt myself."

Each of these men may be said to have possessed exactly one-half of the requisites of a teacher. To give intrinsic value to the things taught, his own knowledge ought to be so profound as to confer high authority on all he says or shows. The second requisite is that he should know the stepping stones of the mind so thoroughly as to be able to guide his pupils step by step across a difficult stream of thought, without allowing them ever to strain their powers, or get beyond their depth. That is true teaching, to lead them an arduous way—so arduous, that they must fail to find it without a guide. I know the case of a distinguished foreign engineer, who, after having executed for his country works of importance, felt a strong desire to devote his matured powers to the education of the rising race in his profession, whom he knew to be inadequately and feebly taught. With exemplary patriotism he abandoned his more lucrative profession, and accepted the ill-remunerated post of

Professor of Civil Engineering in the technic university. His teaching proved a failure; he knew thoroughly what he wanted to teach, but found himself unable to teach it. Luckily for his university and for himself, he was a man used to overcoming difficulties. He took to the study of Pedagogy, or *Teaching as an art;* he had formerly studied physical science and material nature, he now took to the study of psychical science, or human nature. This new study was as great a success as his former material achievements, and I found that he had become one of the most successful teachers, and one of the most beloved as well as esteemed of masters. He found his pupils, youths green from the inferior schools, and before leaving him he had converted them into youthful associates and practical assistants, employed in the actual construction and design of the details of public works afterwards executed.

The training of an eminent teacher must therefore consist of two parts. The original qualifications and personal standing of the teachers in our high schools cannot be too high. It would be of infinite benefit to the nation, if the men by whom the minds of our children are modelled, and by whom they are fitted to fill their place in life, were the most eminent of our compatriots. Who can doubt the benign influence upon their minds of companionship with and sympathy from a distinguished leading man? Might it not confer a tone upon their whole life, and occupy their minds with noble aims and thoughts?

Let us take it, therefore, as an axiom that we will not accept as the teachers of our youth in their highest professional walks, any but men whose knowledge of their respective subjects is thorough and profound.

In our country we have probably committed a great blunder in not creating for the teachers of our children a higher social position than we have hitherto given to the professor, the tutor, or the schoolmaster. We appoint as schoolmasters of our children, as their associates and guides in their studies, men to whom we neither give the highest seats at our social table, nor place on an equality with our own society. If we were truly wise, we should think no manner of man too distinguished, and no social remuneration unreasonable, which should tempt into the rank of pedagogue the most distinguished men in science, art, and practical life, and so secure the first condition—that the things taught have the advantage of power, weight, and authority.

Next, as to the method of teaching. We must reckon *that* as a special art, for which the knowledge of peculiar principles, acquaintance with special methods, and a specific training, are in general necessary. A man should learn to teach from another who is a master in teaching. This master would show him how he first analyses the special objects and aims of each kind of teaching, and of each branch in that kind; how he next analyses the state of mind and preparation in which each pupil will have to commence that kind of learning, and how he must then parcel out into successive short journeys, with halting places between, the many stages of distance that must intervene between the pupil's aim and its achievement. These three things, applied to all the subjects of pedagogy, make the substance of what is the laborious but valuable art of teaching.

This art will evidently have as many branches as there are things to be taught. In each branch there will be not only the analysis already given of aims, methods, and conditions for each study, but there will also be in each a different set of considerations concerning the apparatus and mechanism by which the pupil may best be aided in each special branch. There is education by lectures, by books, by memory; by analysis, by oral examination, by writing out papers, by practical experiment, by modelling, by drawing, by inventing; by work in little, by work in large; by trial, and error; by method, system, and organisation. All this must be known, and discussed, and settled; and the teacher who is to teach well must see that he has at hand the diagrams, drawings, models, patterns, illustrations, materials—in short, the mechanism and material part of all that he has to teach. The schoolmaster is himself the soul of teaching; but, to teach the work of life well, he must have an ample storehouse of material, a library of books, a museum of models, laboratories, and observatories.

It is plain, then, that one of the most important branches of our new technic university would be that in which each accomplished Professor would explain to an auditory of young Professors, about to go out into the world as teachers, the reasons which had led him to adopt one method rather than some other of initiating his pupils into the more arduous branches of his technic. These pupils must have already learned from him and others the subject-matter of teaching, and it might be thought that they had nothing to do but to begin and teach others as they themselves had been taught; but this is by no means the whole truth, for the younger masters will have in all probability to teach quite another class of pupils, starting in quite other conditions of preparation, with quite other aims and ends of life, and requiring for their practical training quite other methods and processes than those through which the Professor had to pass. It is in this way that each Professor will have in turn to become a teacher of pedagogy in his own branch for the juvenile Professors whom he is about to send out.

CHAPTER XI.

SHALL WE CREATE NEW INSTITUTIONS, OR ROB OLD ONES?

Existing institutions should be enlarged and strengthened, not robbed nor straitened.—Education of skilled men a good investment of national wealth.—The new institutions will give usefulness and development to the old.—Endowed schools a wise expenditure of trade corporation funds.—Two million skilled men require to be educated.—Technical schools no rivals of elementary schools—Nor of secondary schools.—Technical schools supplementary to high schools and grammar schools.—New technical schools should be established in all towns.—Technical colleges wanted in all cities.—Technical universities should be independent and new institutions.

Existing institutions should be enlarged and strengthened, not robbed nor straitened.

It is far easier to rob the rich than to thrive by one's own self-denial and well-doing—and so, a certain class of men, who would show virtue at a cheap rate, have proposed to divert the endowments of old educational institutions to the enrichment of new ones.

In other words—legislators who have not the courage to propose taxation for the common good, are yet willing to exhibit patriotism at the cost of unpopular institutions; and are lavish in their gifts of the goods of our universities and colleges, to new ones of their own devising.

If our own colleges, universities, and schools of learning, were already so wealthy, numerous, and powerful as to make an addition to their number, wealth, and usefulness, superfluous—it might be unwise to attempt the creation of new universities, colleges, and schools, for new uses. But as all our universities, colleges, and schools put together, form a teaching deplorably inadequate to the complete and thorough education of the portion of the nation for which they were destined, wisdom would seem to lie in seeing that they adequately fulfil all their own special duties. Surely, rich England is not so mean, niggardly, and poor, as to rob one part of her community in order to give another part that education which a wealthy nation can so readily afford, by a little parsimony in the expensive luxuries of war—a little economy in the follies of her lavish national waste.

This proposed unprincipled misappropriation of the common wealth of one community to the uses of another, is a good reason for the alarm and opposition with which open and manly demands for better teaching at our common cost, are sometimes met by the alumni and authorities of our endowed universities and schools.

Education of skilled men a good investment of national wealth.

They fear that the promoters of technical education intend to promote it somehow at their expense, or to their hurt. For myself, as one of the early, earnest, and I hope, active and energetic promoters of institutions for supplying that which I think a great national want, and hope to see become a great national benefit, I desire at the outset to disclaim all intention to interfere with, harm, diminish, or rival, existing institutions for education, either in character, independent wealth, or prosperity. I think the endowments of wealthy universities, colleges, and schools, are admirable modes of investing national wealth and capital. I know of no way in which the wealth of rich and grateful citizens can be more wisely spent, than in the endowment of good schools for all posterity; and the rich man who has no heirs, cannot adopt a more promising posterity than the clever children of his fellow citizens.

Instead, therefore, of robbing existing institutions of a fragment of their wealth—instead of rivalling them in a fragment of their honours—instead of diminishing by a farthing the already scanty revenues of many of their teachers—I conceive that the new institutions would avert from them many dangers—would save them from many natural enemies, now hankering after their endowments; and would crown many of their branches of instruction, now fruitless, with the diadem of social, practical usefulness.

The new institutions will give usefulness and development to the old.

First, as to endowments of existing schools and colleges. So far from robbing any of the ancient institutions to feed the new ones, I have the profound conviction that our universities and public schools are not even sufficiently wealthy to accomplish that large and wide duty which is entrusted to them, and which they are continually blamed for not doing. It is given to them to educate the children of all the great wealthy families in our great and wealthy land, in a manner so high and noble, that they shall not only fill and embellish their lofty station, but become shining examples of all that is enlightened, wise, and good. They were endowed to make them patterns of religious training; to model youth on the examples of the heroes and patriots of Greece and Rome, and to send them out into life, filled with chivalrous principles—patterns of refinement in thought and language, and models of all that is wise and beneficent in the leaders of men. To institutions whose duty it has been and still remains to accomplish all this, who would grudge a small portion of that vast hoard of national wealth which their pupils are to administer and enjoy?

What a small tithe on the lands of England are the whole revenues of our public schools and universities!

And as to the endowments of our second-class schools, are there not merchant tailors enough in London sufficiently in need of good education for their children, to employ and usefully exhaust all the funds of their trade association in good Merchant Taylors' Schools? And in like manner, should not each of the other rich guilds be allowed to appropriate some of their vast wealth for the superior education of their children? When every one of those rich guilds of the City of London has poured out its wealth in procuring good schools for their craft, they will find that no one will grudge them the wealth so nobly applied.

Endowed schools a wise expenditure of trade corporation funds.

This applies equally to the citizen schools of other towns, of which it cannot be said that they are too well and too expensively endowed; nor can it be said in general, of the class of teachers in our existing schools, that they are too highly paid, or placed in too high a rank in social position.

In regard, therefore, to the emoluments of existing institutions, not one farthing ought to be abstracted for the special purpose I advocate. If any one thinks that those funds are ill-administered, or that the work is paid for and not done, let him make it his duty to see that the money left, or set aside for that purpose, gives to those classes the complete education for which it was destined; but do not rob them to aid others.

My aim in the establishment of institutions for technical education is quite different; beyond, and even remote from interference with our ancient universities and schools. Whole classes of men have grown into existence in modern times, of whose occupation,

2,000,000 skilled men require to be educated.

name, or existence, the founders of our great schools never dreamt. No less than 2,000,000 of men, most of them heads of families, fill the cities and manufactories of England, for whose very calling the men of the last century had no name. In the present century, more than that number are an absolute addition to the population, and it is for this additional new race of Englishmen that I demand additional schools, colleges, and universities; and it is out of the wealth they earn, and pour into the lap of the public treasury, that I ask for this new and special contribution, in order to enable us to perpetuate and increase the earnings of their knowledge and skill, and so add to the national wealth and well-being. I put this upon the lowest ground—the shopkeeper's ground. If I thought well, I might demand it as a right, that a small portion of the national earnings of these men should procure a national education for their children. I might have asked the nation, as she prides herself on having among her sons men of incomparable skill and knowledge, that she should take care to provide that in the coming race of nations her children should still fill a first place. But even if patriotism and duty fail, I would still ask the British shopkeeper to make a small investment in education and in culture of brains, as a disposal of his capital which would enormously enhance the value of his other property.

When I have thus drawn a marked line between these 2,000,000 of skilled men and the rest of the people of England, and when I thus propose to provide their education by entirely new means, I hope our universities and schools, and all who love and promote their prosperity, will cease to regard as enemies the advocates of technical education. On the contrary, we wish to bring them pupils. An increase in the number of educated and skilled men will increase the number of the lovers of learning of all kinds; not technical learning merely, but high education of every sort, will be more and more in demand. It is of the nature of learning that its scholar craves evermore; and no sound educational institution can ask a better guarantee for its prosperity, than to see all the ground around it, far and near, sown with a fresh crop of learning and knowledge. The love of truth is peculiarly the appetite which grows by feeding. We are therefore, to the existing institutions of learning, friends and helpers, not foes nor competitors.

Having once decided that for our 2,000,000 of skilled workers an entirely new set of institutions of a purely technical character are necessary, the practical question arises—what are the relations in which the new institutions shall be placed to the old, so that they may each obtain from the other the greatest amount of co-operation?

Technical schools no rivals of elementary schools;

I. Of elementary or primary schools. There need be no technical schools of the elementary or primary period. They will depend entirely on the existing schools for the education of their pupils, but their establishment will, nevertheless, tend to improve the education, and promote the interest of primary schools, for the technical schools will require that the pupils who enter them shall already possess good primary education, and they will have to prove that they are competent to begin their technical education before they are permitted to enter. Moreover, it will soon become evident to the parents whose children are to train for technical trades, that even in elementary schools it would be well that the children should begin to acquire the dexterous use of their fingers and eyes by learning to draw accurately on paper the forms which they see around them—first freely by hand, then by rule and measure. It will also become obvious that the less children do their elementary work by rote, and the more they do it by method and reason—even in reading, writing, and counting—the more valuable will be the preparation for after-life. By this means, therefore, the establishment of technical schools will tend to give an increased worth to good teaching in elementary schools.

Nor of secondary schools.

II. If we now pass upwards from the primary school, which gives mere education in the vehicles of knowledge, and to which it appropriates the first three years of the child's school-life, to the secondary school of the small town or larger village, in which the child puts language and number to use, and learns, reads, and records not words and figures merely, but the things they mean—the technical schools will create a demand for their instruction also, and will tend to give additional value to what is there taught: for they will require from their scholars on entrance, not only that they should read, write, and count, but that they should read with purpose; and that they should know, understand, remember, and digest what they read. They will have not merely to write letters in lines, uniformly and clearly, but they will have to write thoughts, methodically, clearly, and grammatically; and thirdly, they will have to do, not mere accounts of addition and multiplication, which cover slates with figures, and fill up time with dreary drudgery, but they will have to apply figures to purpose, and to the measure of things in real human life. Schools, therefore, of the second period, which teach these things well, will be sought and valued as the second class of school, without which no technical scholar can enter upon technical education.

Technical schools supplementary to high schools and grammar schools.

III. Primary and secondary schools being now free from all apprehended interference from technical schools, we come to schools of the third period, which form our town schools, high schools, upper schools, middle-class schools. Here, for the first time, the question does arise—What relation is to exist between these and the technical schools? The first answer to this question is, that there need be no interference, that any change in these schools is entirely a matter of consideration for themselves, and that from the outside no interference should be apprehended. Such schools, probably, give the ordinary elements of upper education; they teach Latin, Greek, English, a little French—possibly a little Euclid. Geography, history, and arithmetic, which have been commenced in the secondary, may be continued in the upper schools; and with such a course—especially if meant for the doctor, lawyer, clergyman, or gentleman of no profession—the technical school would not interfere. One thing it would, however, have to do on its own account; those pupils who were meant for a technical profession would, in this period, require to learn a good deal more of higher arithmetic, elementary algebra, and practical geometry; they might even be asked to learn a little knowledge of plants and trees—of beasts, birds, and fishes—of the existence of stars—even of the laws of reason and common-sense; and they might be asked to know something of the laws of dead matter, and of the elementary substances of which the world is made. By this it need not be meant or understood that they are to learn anything so formidable as what are vulgarly called the 'ologies; and such formidable words as geology, physiology, botany, astrology, and natural philosophy, might all be sedulously excluded; nevertheless, it might be of great value to a boy's future, that by the age of fifteen he should begin to have notions about the sorts of stuff the world was made of—of the sorts of forces by which things were moved or fixed in their places—of the way in which one thing grows out of another—and of the difference between a plant, a tree, a bird, a beast, and a fish. All this could probably be taught as well, and better, by not putting it into big words.

Now, the question which arises here is this—Would the existing schools like the trouble of teaching all this in addition to what they already teach, or not? My own opinion is that they would rather not—even that for their own interests, and the public welfare, they had better not. What they understand and do well they had better continue to teach well to their former class of pupils, and thus we should agree to leave well alone.

New technical schools should be established in all towns.

Without interfering, therefore, with the existing town and high schools, it would be expedient to establish, in all considerable towns and centres of skilled workmen, a new set of special schools for this new special purpose. In these, no Latin or Greek should be taught, so that there should be no interference with the old schools—only all the new technical knowledge wanted should there begin to be taught; and it would also be of great advantage that the pupils should learn to do all their reading, writing, and counting in the modern languages, and in the weights, measures, and coins of the trading countries of Europe; for as our technical successors are to work and trade with all the world, and are to be in continual intercourse with, and rivalry to, other educated nations, he who knows modern tongues, and understands foreign ways, will possess important advantages. These are evidently not schools of ancient learning, but of the modern world—the future world of business and of trade; and so we shall probably agree that they had better be quite apart from, and not at all interfere with, our established schools.

The name given to these schools abroad is an awkward, not very intelligible one; they are called schools of real knowledge—*Real Schulen*—by which they do not mean to depreciate, or attribute unreality to the knowledge given in the old schools, but what they do mean is—that whereas reading, writing, arithmetic, and classical tongues are only ways or vehicles to knowledge, the time must come in a man's life when he should no longer acquire the forms of knowledge, but should get at the reality of knowledge; and that at that time he should begin to study the nature of the real material world we live in—of the living, active people who live in it, and of the nature of things and events in the life into which he is about to plunge; that is what they mean when they call their schools *Real Schulen*.

Such are the new knowledge schools which the technical professions and trades absolutely require for the training of their pupils, though they do not yet give them the name of technical schools. It is a matter, however, quite open to the choice of existing schools whether they will choose and desire to open a new class of knowledge schools in alliance with their old schools, and whether they have rooms, means, and fit men in the same building, and as part of the same establishment. It is an alternative that they might choose, and if it were done willingly, heartily, and on an adequate scale, it might be as good for the public service as if new and independent institutions were created for the special purpose. But it is probable that, in the greater number of cases, there would be such an aversion to deviate from the old routine—such desire to subordinate the new-fangled notions to the old ways—that the attempt would be the realisation of the fable of new wine in old skins, and might entail the double expense of first doing the work as a failure, and then having to do it over again for success.

IV. It is neither my desire nor intention that the technical education of that higher class which is wanted to prepare students for a technic university shall be accomplished at the expense, or to the injury, of existing public schools and colleges which train men for the learned universities and for the learned professions. These have enough to do if they train well the classes for whom they are intended; and so long as their halls are full of diligent students, and their stalls are occupied by efficient teachers, it would be folly to interfere with any successful educational organisation. What we do want is, efficient training schools of quite another sort—where men shall be trained for their struggles with brute matter—where they shall learn the laws by which to govern and organise the materials and forces of nature, and be taught to wield them at will; and for this purpose I think the technical college preparatory to the technical university would be better kept apart from the learned school or college, whose quiet it might disturb, and whose routine it would certainly derange.

Technical colleges wanted in all cities.

I would, therefore, recommend that corresponding to every good public school or good training college now in existence, there should be created an equally large and equally well endowed establishment for the technical part of the youth of England. Should, however, the managers of some wealthy ancient foundation desire to comprehend this new institution within the limits of their old establishment, I should strongly advise that an entirely new building be erected for the purpose, so as to prevent either the fact or the fear of interference with the old. But this extension of an old institution should only take place where a cordial desire to extend the benefits of an old endowment prompts hearty and sincere effort. In all other cases, the foundation of a new technical college in such new site as will best fit the new class of students and studies is far the best measure; and this for another reason, that it may be found convenient that the seats of technical education should lie near those seats of practical industry where the pupils may see carried into practice under their eyes all the processes of which the principles are taught in the college.

Technical universities should be independent and new institutions.

V. The last question which arises is—whether our great national universities should, or should not, attempt to convert themselves into technic universities? I venture to express a strong personal conviction of the inexpediency of their doing so. Between the learned repose of Oxford and Cambridge, and the busy spinning mills of Manchester and Leeds, I find no natural congruity or association. I cannot see why the study of the steam-engine and the spinning-wheel should be more fitly initiated in the academic groves of Alma Mater than amid the forges and steam-hammers of Lancashire or South Wales; and it seems to me that the laws of commerce and merchandise are more naturally associated with Liverpool, Glasgow, or London, than with the streams of the Cam or the Isis.

But there may be quite an opposite view of this subject reasonably taken. The thoughtful and well-educated parent may desire to detain his son as long as possible remote from the clamour of an exchange, the smoke of manufacturing towns, and the din and distraction of crowded cities. He might think it expedient that all the student can gain of fitting knowledge or abstract science should be acquired in the quiet and seclusion of remote university life before he is compelled to plunge into the turmoil of business and the whirl of trade. Should such views be entertained by a large number of parents, and should they find sympathy and cordial support in the governing bodies of our two ancient universities, I see no reason why effect might not be advantageously given to their views. What, in that case, I should like best to see done, would be the creation of a new college within its own extensive grounds, having its own buildings apart, with its own professors, lecturers, museums, laboratories, and observatories secluded within its walls. It seems to me that in this manner no harm could come to the university, and that all the members there, destined for technical pursuits, might be drafted off, and enjoy the privileges of this new technical division of the ancient university.

It will be seen that what I most fear and deprecate for these new institutions, is the meddling and muddling which would most probably result from the attempt to mix them up with old and established institutions. If England were already so overrun with good high schools, colleges, and universities, that no more work remained for them to do, there might be some reason for their disturbing present arrangements, and diverting these establishments from occupations they might have ceased to fulfil; but as the fact is the contrary, and as the population of this country has enormously outrun in numbers our ancient provisions for acquiring science and skill, it appears to me that it is for this new and enormous number of skilled workers that new institutions and new kinds of training are wanted; and I think that the Legislature would be much more wisely occupied in creating new schools, colleges, and universities, for the new millions of its tax-paying people, than in meddling with ancient endowments, which will be much more likely to reform themselves, if they have before their eyes the new and model institutions created for modern uses, which they would have strong inducement to imitate and emulate.

There is one class of institutions on which it is necessary to say a few words. There are schools, colleges, and even universities in England, which are of the nature of mere mercantile enterprise. What was called the University of London and is now University College, was a joint-stock trading company, its trade being teaching. Such institutions have their capital, dividends and debentures like a railway, canal, or hotel company; and have therefore those vested interests to be protected, which we, as a mercantile nation, so profoundly respect. What part are these institutions to take in a systematic provision for the technical education of the people?

In regard to them I would proceed, as nearly as possible, according to the analogy of the existing endowed institutions. If they possess an efficient building, staff, and apparatus, and desire incorporation with the national technical system, it would be easy, wise, and just to incorporate them with it, reckoning them at their intrinsic value, and awarding to them a liberal and fair compensation for their accumulated capital or vested interests. Some of these institutions, like University College, might be enlarged, and rendered much more efficient by such transformation out of a mercantile enterprise into a national institution. It would therefore appear both wise and expedient, that all free and voluntary institutions might be left untrammelled and independent where they chose to retain their isolation; and that powers should be given to incorporate with the general system only such as desired it.

CHAPTER XII.

OUR ENGLISH TECHNICAL UNIVERSITY, ITS SUBSTANCE AND SCOPE.

An educated English nation.—Higher degrees of professional education.—The professions that require it:—Class I. The old professions, partly provided for—Class II. New professions, untaught—Class III. Leaders and teachers.—Twenty-one professions untaught.—Advantages of teaching many professions in one building.—Table.

An educated English nation.

I NOW assume that we have determined to become an educated people, and that we have determined to acquit ourselves of our responsibility by providing special training for all the professions, occupations, and trades practised among the English people; that while we abolish what is vulgarly called "class education," we shall provide equally for working men of every class, head-workers and hand-workers, the means of enabling them to improve themselves, and to cultivate their power of usefulness to others, and to do so thoroughly, in order that no citizen of England shall have the right to say to the community that he has become either useless or burdensome to it, because the community neglected their duty to him at the moment when they should have rendered him the services essential to a life of independent usefulness.

Highest degrees of professional education.

At the head of this system of training for usefulness, we must place our technical university. Here we must give the highest degrees of professional education; it must send forth the professional leaders of the nation; it must produce the future teachers of the people, and those who teach the teachers must be the wisest, profoundest, and most experienced of her eminent men. Subordinate to it, emanating from it, and again leading up to it, must be numerous technical colleges in our centres of manufacturing industry, which are to be reproductions of it in miniature; teaching the same knowledge, developed into fewer branches, and predominating in those special directions which local wants indicate; with teachers who bring down with them from the university above, all the knowledge and methods of teaching which superior wisdom has wrought out, but making a special study of the local peculiarities and practical wants of the district, for the purpose of fitting the citizens for the special duties of their citizenship, and the most forward students for the higher instruction of the national university.

The professions that require it:

In setting about the formidable task of creating this university, we should reconsider in detail the nature of the professions to which this higher culture should extend. The following enumeration of these may serve our purpose:—

The statesman; the soldier and sailor; the theologian; the lawyer; the doctor; the agriculturist; the miner; the metallurgist; the manufacturer; the civil engineer; the mechanical engineer; the machinist; the architect; the naval architect; the marine engineer; the merchant sailor; the merchant; the shipowner; the practical chemist; the surveyor; the astronomer; the professor of pure science; the professor of literature; the professor of fine art; the teacher or schoolmaster; the political economist.

Such is the inventory of the men whom our university has to send out, as the educated and accomplished leaders and teachers of their fellow-countrymen. They will be a *corps d'élite* of the youth of the nation, trained and accomplished in the knowledge and skill best calculated to render their lives of the greatest service to their country and usefulness to their kind.

For the purpose of founding this university it will be useful to separate some of these from the others, as follows:—

CLASS I.

1. The Statesman.	3. The Theologian.
2. The Soldier and Sailor.*	4. The Lawyer.

5. The Doctor.

CLASS II.

6. The Agriculturist.	14. The Naval Architect.
7. The Miner.	15. The Marine Engineer.
8. The Metallurgist.	16. The Merchant Sailor.
9. The Manufacturer.	17. The Merchant.
10. The Civil Engineer.	18. The Ship-owner.
11. The Mechanical Engineer.	19. The Practical Chemist.
12. The Machinist.	20. The Surveyor.
13. The Architect.	21. The Astronomer.

CLASS III.

22. The Professor of Pure Science.	24. The Professor of Fine Art.
23. The Professor of Literature.	25. The Teacher or School-master.

26. The Political Economist.

CLASS I.

The question we have to raise in regard to Class I. is simple and soon settled. Our learned universities were founded chiefly for the education of the divine, the lawyer, and the doctor of medicine. These we may call the *old* professions as distinguished from the *new*. As our new university is intended in no way to interfere with the old, and as the number of divines, lawyers, and doctors, is sufficiently large to occupy the

Class I. The old professions, partly provided for;

* The Army and Navy.

whole forces and funds in the due and adequate training of these learned gentlemen to the all-important duties which their titles imply, of taking the entire charge and responsibility of the souls, the bodies, and the goods of our countrymen on themselves, it will be admitted that they have ample duties on their hands, and that they amply earn the gratitude of the nation, if they fitly discharge such grave responsibility.

In regard to the statesman or legislator and his servants the soldier and sailor, it is less easy to determine whether the universities do amply provide for the training of these three governing classes. But when we consider that the statesman is himself, generally, though not always, an educated man, we may leave it to him to say what is the education he desires for his own class and his executive instruments. As far as the Civil Service is concerned, the Civil Service Commissioners have long ago expressed their opinion of the necessity of some small degree of education for statesmen and public servants of every rank; and after having thus taken the initiative they may be left to choose, find, and make their own way in their own departments.

Class II.

Class II. New professions, untaught;

It is this second class, the new professions, in which modern society feels the deepest interest, and which modern legislature incurs the deepest responsibility for having altogether neglected.

Agriculture, it may be said, is the oldest of professions instead of a new one. But I will venture to remark, that there are agriculturists *and* agriculturists—that is, agriculturists who let their land take pretty much care of itself, and who know and care to know as little as possible how plants grow, how the earth feeds them, or how and why they thrive or die; and agriculturists who know to the very bottom all that is in their soil and all it wants; who know thoroughly a good seed and a better seed—a good breed and a better breed—good food for plants and good food for animals; who know whence fat comes and whence lean; who know whence full ears of corn and whence lean ears; what sort of climate is good for one sort of crop and what climate for another; what plants draw their food from the top of the soil, and what from the bottom; what food produces disease, and what food cures it.

This is the sort of man for whom our university is proposed to be founded, and agriculturists of that sort we may reckon as entitled to the rank of a new profession.

In like manner, the architect may be reckoned one of the new professions, although he is one of the oldest. The architect is a member of a new and untrained profession, because the wants, materials, and machinery of architecture are all new. Modern buildings, modern cities, modern manufactories, modern stores and warehouses, railway stations, locomotive-engine buildings, and dock warehouses, are all new kinds of structures, composed of iron, glass, machine-made bricks, and modern forms and combinations of material, which have to be combined by skilled parsimony into forms useful to the modern owner, without being offensive to the eye-sight of the spectator. Such architecture requires to be the work of a new-made profession, trained in all the refinements of science, engineering skill, and æsthetic principle. Imitation of Greek temples for modern warehouses, is, we trust, at an end;

and we are sure that the school of Pericles would have used quite other forms for cast iron and brick, than those which they built of their admirable stone, and which our uneducated architects merely copy, caricature and mis-apply. Modern architecture is therefore a modern profession.

It is unnecessary to say more of the sixteen modern professions in Class II., except that where the name does not happen to be modern, the nature of the thing and the requisite knowledge are eminently modern; and it is for those sixteen professions mainly, that our modern technical university is essential.

Class III.

Class III. Leaders and teachers.

We have made this a separate class for convenience merely, although in its essence it is one with the preceding class. Class III. consists of the teachers, trainers and leaders of the men who form Class II. The man who would teach technical or applied science, must first know thoroughly the pure science of which he is to teach the application and use; and so the professor of architecture, or any other fine art, must first know its theories and principles, before he can teach the application and practical rules. The man who would give instruction in the principles of exchange, banking, and merchandise, must first know the political laws of demand and supply, value and exchange, of currency and circulating medium; and moreover, if our technical university is to train young men adequately and effectually for their future life, they must be fit to teach them, not only all the technical knowledge now possessed by their rivals and contemporaries in other nations, but also be occupied continually in pointing out to them the probable changes of the coming time, in which they will encounter circumstances entirely different from the past, and have to meet new difficulties, with instruments entirely invented for an unprecedented future. Hence it is, that our university would be defective in the perpetuation of its usefulness, if it did not train the philosopher of pure science, who is to be continually watching the future, and aiming at further progress; and if it did not supply a continual succession of professors, schoolmasters, and teachers, always fitted to give the training to a new generation which will be necessary to fit that new generation to the new conditions in which it is launched into life. That among these teachers of men we have ranked as a profession the men of letters and the men of the press, will not surprise the statesman who has considered how important to the elevation or the degradation of a people, is the personal character, ability and training of these, the schoolmasters of grown-up men; and least of all will they object to include in this enumeration the professors of those higher, less material, less mercantile, more refined arts, which teach and train the feelings and aspirations of humanity, by a language far more elevating, incomparably more expressive than the black ink impressions of geometrical types.

Twenty-one professions untaught.

There are, then, at least twenty-one distinct professions for whom our university has to provide knowledge and training; and the next question which arises is—what shall this knowledge be, and of what sort shall be this training? At first sight, the array of uneducated professions is alarming by their number and diversity.

How can one teach all these men all that variety of professional knowledge? If our two great learned universities are barely enough to teach the three learned professions, what possible institutions could we invent to teach all these other twenty-one?

Advantage of teaching many professions in one building.

The solution of this problem is far easier than it seems. The solution is this—these twenty-one professions do not demand twenty-one separate establishments and courses of instruction entirely different. The great advantage of one central university over a multitude of detached professional schools lies in this very circumstance. For a great many of the modern professions, much of the teaching must be alike, and may be gathered simultaneously in the same room from the same professor at one time by a multitude of the different professions. All those who have to do their work in dead matter may study its properties and learn its laws together. All those professions which have to deal with living matter may study vegetable life in the same lecture-room, in the same museum, in the same garden, in the same field, and in the same forest.

The nautical astronomer, the geographical astronomer, the trigonometrical surveyor, the physical astronomer, and the professional observer, may all use the same observatory, and inhale the wisdom of the same astronomer. And the laws of strength, economy, durability, and mechanical excellence of various material structures, of various substances and forms, may be studied with equal advantage in the same room by the civil engineer, the mechanical engineer, the machinist, architect, and marine engineer.

It becomes, therefore, of primary importance in the establishment of our university to consider first carefully, and in fact to prepare an inventory of all the knowledges which are either essential to every one of these professions, or which form helps and aids towards their mastery. Then we are to see how those knowledges can be grouped together so that they may be adequately taught to every class of student without waste of time, money, men, or room; for it is plain we cannot have an infinite number of professors and teachers. Next we have to see how the teaching of these men whom we select shall be grouped together so as to afford to every class of student, not merely the comprehensive views of science which form the solid foundations of knowledge, but also the detailed and special applications which will constitute its chief usefulness to him in his narrowed sphere of individual duty. These form the subject of the following Chapters.

Classes for whom Systematic Professional Education and Training is necessary. Table.

I.

1. The Statesman.	3. The Theologian.
2. Soldiers and Sailors.	4. The Lawyer.

5. The Doctor.

(The first, third, fourth and fifth of these are provided by the Universities, and the second by the military schools.)

II.

6. The Agriculturist.	14. The Naval Architect.
7. The Miner.	15. The Merchant.
8. The Metallurgist.	16. The Ship-owner.
9. The Manufacturer.	17. The Merchant Sailor.
10. The Civil Engineer.	18. The Practical Chemist.
11. The Mechanical Engineer.	19. The Astronomer.
12. The Machinist.	20. The Marine Engineer.
13. The Architect.	21. The Surveyor.

(Some of these are provided for by Government in the Royal School of Mines and of Naval Architecture, which might form portions of the future systematic course of education.)

III.

22. The Professor of Pure Science.	24. The Professor of Fine Arts.
23. The Professor of Literature.	25. The Teacher or School-master.

26. The Political Economist.

(Some of these are imperfectly provided for in schools and universities.)

CHAPTER XIII.

OUR ENGLISH TECHNICAL UNIVERSITY, ITS TEACHING AND TEACHERS.

Technical education, hitherto traditional, must now become scientific.—Wide field of modern science.—Wide knowledge, sound knowledge.—Narrow knowledge dangerous.—Nature of human knowledge.—Law merely the form of power.—Laws of matter-nature.—Laws of human nature.—The two divisions of knowledge:—Sciences, philosophies.—Object of the sciences.—Object of the philosophies.—Two divisions in our university:—Schools of science, schools of philosophy.—Mathematics.—Physics.—Cosmology.—Biology.—Philosophy of mind.—Speech.—History.—Society.—Selection of studies.—Omission of theology, law and medicine.—Table of two philosophies.—Professors and professorships:—In mathematics—In physics—In astronomy, geography, geology—In natural history—In the philosophies—In special applications of science.—Number and nature of special technical applications of science.

Technical education, hitherto traditional, must now become scientific.

THE problem of educating the highest members of our civilised community in all the branches of knowledge which shall contribute to render them valuable members of society, and worthy leaders of technical men, may seem a problem too ambitious and hopelessly large. It is also difficult in proportion to its novelty; for we may almost assert the practical discovery of the secret that "knowledge is power," and that science is the sole foundation of skill, to have been made by the present century. The maxim had been created and repeated long ago, but was scarcely acted on until now. Tradition, not science, formed the essence of the knowledge of our skilled trades and professions; what was taught was merely that which had been taught to our fathers, who thought us sufficiently taught by the simple transmission of *their* fathers' knowledge. Heat, light, and electricity were scarcely recognised as beings and agents; they were influences mysterious, almost supernatural; their laws were little known, their nature ill understood. The laws of heat, light, and electricity, seem creations of modern science, and yet it would be hard to name powers more omnipotent in their action, more universal in their influence, more perfectly under the control of technical men, than these three mysterious, impalpable powers. Tribes of skilled men have in these days as their chief duty to handle and direct heat, to initiate and direct electrical currents, to manipulate the sun's rays. For all these things the skill of our fathers is of no use, and the master of modern sciences our sole teacher.

Wide field of modern science.

Modern science is now so broad and manifold, that it is hard to bring within one institution a sufficiently large group of profound and able men to cover the whole ground which is necessary for the teaching of all our modern professions. But our teaching will be a failure if it is not both broad and deep. The saying that "a little knowledge is a dangerous thing" is just in one application—namely, that he who knows bits of a science, or bits of sciences, has knowledge of a very dangerous kind. Scarcely any problem of modern technical life can be solved by a single science. The man who manipulates a single substance, cannot manipulate that substance by a single science, or bit of a science. Whatever be the substance he handles, it must have form to deal with; and manipulation of form implies knowledge of geometry. Its manipulation may imply physical force, and the laws of force and motion are parts of physical science. But his matter is either an elementary or a compound substance, and if so, will be liable to change of quality, either in manipulation or use. The usefulness of an exquisite instrument or machine may be altogether ruined by some unheeded chemical defect, of which the manipulator happened to know nothing; and so the professional mechanic has often been ruined from his ignorance of chemistry. Thus, bits of knowledge are dangerous things; and even to the narrowest technical accomplishment the largest survey of scientific truth is the safest. The pioneer of social technical life cannot therefore lay down the plan of his future exertion on too large a scientific map, nor can he know his own defined province too thoroughly and deeply.

Wide knowledge, sound knowledge.

Narrow knowledge dangerous.

The new field of science which must be covered by our teachers must therefore be carefully mapped out before us, in order to settle who, and what sort, are to be our teachers and teaching. Even at the risk of being called theoretical, high-flown, and unpractical, we must take a large view of human knowledge, in order to pick out what is most wanted for human needs. To assist us in this selection, I have prepared the following simple map of teachable human knowledge.

Nature of human knowledge.

Knowledge for technical men may be divided into two sorts:—

1. Knowledge of matter nature; and
2. Knowledge of human nature.

It may also have another division:—

1. Knowledge of the works of God and His nature; and
2. Knowledge of the works of man and his nature.

I use this phraseology in preference to the more common expressions, works and laws of nature, because to technical men, laws being mere empty forms of thoughts or of words, can do nothing. To a technical man who has had to do work of his own, it is impossible to look at the world and its contents without thinking of the Worker who made the world and its contents. The technical man who has to mould matter by his will into the forms which suit his invention, fancy, or use, knows very well that laws won't do work—that work must have a workman, and he knows by his own nature that, in such things as he can understand, the world around him is the work of a skilled workman, infinitely stronger, more clear-sighted, more dexterous and inventive than himself, or the cleverest of his fellow craftsmen. To such a man I need hardly say that to study the works and the way of working of the Great Master-workman, who set agoing the machinery of the heavens, who arrayed the lily of the field in all its glory, and who contrived every grain of dust to be exquisitely symmetrical in its own crystalline atoms, and who made all matter of such a chemical nature as to reject all confused, disorganised, ill-proportioned mixtures, will be infinitely the best introduction to the man who desires to handle the powers of nature on a small scale with the same dexterity, and according to the same ways after which God has handled matter on the large scale of the universe. For all works of man, God has already made beautiful patterns, and provided exquisite materials; and for the human workman there is no such pattern to follow as the Divine workman, His patterns, and His ways of working. His way of thinking we call Philosophy, the knowledge of His

Law is merely the form of power.

Laws of matter nature.

patterns of work we call Science, and the knowledge of His ways of working we may call Technical or Applied Science.

Laws of human nature.

Man's nature and works form the second division, and to those technical men whose business lies with living men and acting society, instead of with dead matter and forces of nature, human nature is as necessary, as difficult, and as complicated a study, as matter nature. But as it is the duty of a large portion of our race to teach others, guide others, and govern others, and as we all have it in the destiny of our lives either to be useful and helpful to the society we live in, or to form hindrances and obstacles in the way of social improvement and social progress, so the study of human nature is quite as practical, technical, and useful as the study of matter nature.

The teacher who has to show others how to think with truth, know with exactness, choose with wisdom, and act with effect, must have studied the laws of thought, fathomed the well of truth, surveyed the range of human choice, and studied the consequences of human action. To him the human mind is the first matter of study, and the next is that human speech which man has created as the instrument of his human thought. How to speak intelligibly, elegantly, wisely, and persuasively, are four of the highest arts in human technical accomplishment, and technical excellence in these arts will go as far to rule the future as eloquence and literature have done to rule the past. But the organisation of man in human society is a still greater work of human art, and the knowledge of the way in which societies have grown up into their present state of organisation is an indispensable preparation to the technical men who, as historians, philosophers, or legislators, have to study the amelioration of the condition of the human race. How families, races, and nations have risen, thriven, decayed, and fallen; how institutions have been reared and destroyed; how religions have served their day and disappeared—are the great lessons of human life of which no teachers of their fellow-men dare be ignorant. And lastly, those men whose technical business it is to guide a State by legislation, and lead the members of organised society upwards to increased refinement, knowledge, and well-being, must add to the knowledge of past organisations of human society a thorough knowledge of all those principles of legislation, and all those organisations of administration, which most immediately conduce to the security, wisdom, wealth, and strength of nations.

The two divisions of knowledge—sciences, philosophies.

These, then, are two entire groups of knowledges which it is impossible to omit from our technical university, without leaving it maimed, deformed, and ineffectual.

No man must be left to act on his own judgment of that of which he knows only a corner or little bit. The man who handles matter must know its whole nature; the man who handles mind must know its hidden working.

Object of the sciences.

It is necessary therefore that we map out this human knowledge in its whole extent before we can say how much of that knowledge is suited to form part of human culture, whether any of it can be omitted, and what are the selections to which we may be forced by want of leisure or special inaptitude. There are first the two philosophies—philosophy of nature, and philosophy of human nature. Under philosophy of nature we may consider the things around us: first, in the aspect they present to us as mere occupants of outside space, as mere empty forms. We may go further, and becoming realists, examine their natures and powers, as embodied forms or substantial realities. We may next study the matter which fills space as it has been moulded, sub-divided, mixed, separated, endowed with symmetry and organisation. We may recognise in universal space fixed stars, moving stars, celestial globes, planetary or lunar worlds, our own globe, its lands and seas, its mountains and valleys, its continents and islands, or we may dive into its crust and study how it has been made, or how it grew. Or last, we may philosophise on that intensely more interesting phase of being than material substance, or organised matter; we may study that living soul with which creation is animated—the living, growing plant; the living, locomotive animal; the creeping things, the flying things, the swimming things, that swarm around us;—the philosophy that comes nearest to ourselves, the philosophy of life.

Object of the philosophies.

After having ransacked the world without, we may next take to the study of the world within. What is the nature of this human soul? What is this eternal inner flow of human thought? How is it that we can know what is passing without us, know what is passing within us, and so, as it were, be where we are not, know the past as well as the present, the distant as well as the near, and even have glimpses of the far future? Next we may study that part of our nature which has to do more than think and know, which has to choose and resolve, and which, choosing, resolving, and acting, becomes a moving cause and origin, and creating power in the phenomena of nature, and in the events of society. Next we may consider the nature of those forms without which the thoughts of one human soul cannot pass into the thoughts of another human soul, without which human society, culture, and progress were impossible. The voice of thought; the manifestation of the mind of man in his handiwork; the creation of language, spoken, written, emblematic, pantomimic, creative; the whole range of the manifestation of human thought, open a wide field for philosophical research, and of practical human knowledge. Next there is the study of the great story of human life; the beginnings of our race; the early families of human beings; their different natures, their varying climates, their structures, cultures, and mental aptitudes; their developments into nations with knowledges, arts, social institutions, religions. All *that*, the great story of human society, forms a great volume of the history of himself, the contents of which no educated man can afford to ignore. Finally comes the study of the great ends of human nature and of human society. What is man, if not a portion of human society? What is human society, if it do not add to, promote, elevate, each human individual? Is not mutual culture, mutual help, as much the duty of human society as mutual protection? What are the means by which we can best secure the progress of the human being in society? How can we best save him from want, ignorance, disease, vice? How can we give him intelligence, refinement, well-being, usefulness, virtue? These are the great problems of human life; they form the subject of the philosophy of human society, the matter of human politics, the life of a nation.

The map of human knowledge therefore consists of:

I.—THE PHILOSOPHY OF NATURE;

II.—THE PHILOSOPHY OF HUMAN NATURE.

Next, the philosophy of nature is divided into the following philosophies:

PHILOSOPHIES OF

FORM; SUBSTANCE; CREATION; LIFE.

And the philosophy of human nature is divided into—

PHILOSOPHIES OF

MIND; SPEECH; HISTORY; POLITICS.

Two divisions in our university: schools of science, schools of philosophy.

Here we have already some data for the organisation of our university. These philosophies are by custom not called philosophies of nature and of human nature, as we have called them; but the philosophy of nature is generally called science, and the *science* of human nature is generally called *philosophy*. Our university will accordingly take those two divisions; the division of science, and the division of philosophy.

THE UNIVERSITY.

I.—*The Sciences.*

1. THE MATHEMATICAL SCIENCES.
2. THE PHYSICAL SCIENCES.
3. THE GEOGRAPHICAL SCIENCES.
4. THE BIOLOGICAL SCIENCES.

II.—*The Philosophies.*

1. THE PHILOSOPHY OF MIND.
2. THE PHILOSOPHY OF LITERATURE.
3. THE PHILOSOPHY OF HISTORY.
4. THE PHILOSOPHY OF SOCIETY.

I.—THE PHILOSOPHY OF NATURE.

But these eight departments of university teaching must be broken up and specialised before they can either be taught effectually to our students, or be by them effectually employed to fill the wants of human life. The philosophy of form must be used as a general groundwork for the construction of the mathematical sciences, and these sciences group themselves into the departments of calculus and geometry, according as their subject is viewed as made up of discrete parts, or of concrete continuity. And each of these again subdivides itself according as its elements consist of measured or unmeasured quantities, and forms that are stable or changing. Thus the philosophy of form becomes the foundation of the mathematical sciences, in their two departments of calculus and geometry, and their four divisions of quantity, number, place, and form.

PHILOSOPHY OF FORM.

MATHEMATICAL SCIENCES. Mathematics.

The Calculus.	*Geometry.*
Calculus of Quantity.	Geometry of Place.
Calculus of Number.	Geometry of Form.

The philosophy of substance becomes the foundation of the physical sciences, which are two: the science of physics proper, or natural philosophy, which concerns itself with the properties and phenomena of matter, and the laws of matter in general; and the chemical sciences, which concern themselves with distinguishing the different kinds of matter, their properties, their combinations, and the phenomena which result from, and the laws which govern, their union and separation.

The one concerned with the properties of matter and the forces which regulate its phenomena; the other with the peculiarities of matter, and the specialities of the phenomena of each: giving rise to the following divisions:—

PHILOSOPHY OF SUBSTANCE.

Physics.

PHYSICAL SCIENCES.

Natural Philosophy.	*Chemistry.*
Properties of Matter.	Chemistry of Elements.
Phenomena of Force.	Chemistry of Compounds.

We next come to what are often called the natural sciences, in which we record the phenomena, and examine the structure and distribution, of the material creation of which we form a minute part. The survey of the heavens; the inventory, places, and paths of the stars; the earth, its form, its matter, its convolutions; the sea, its distribution, its tides and waves, and currents; the matter of the earth, its convolutions, its hidden structures, its buried inhabitants;—all this forms a world-knowledge, or cosmology, to which the name of natural history, or natural science, is not very appropriately given; and which the names astrology, geography, and geology, do not very aptly describe. Under the philosophy of creation we have therefore the following departments:—

PHILOSOPHY OF CREATION.

Cosmology.

COSMOLOGICAL SCIENCES.

Cosmology Proper.	*Geology.*
Astronomy.	Physical Geography.
Geodesy.	Special Geology.

The last stage in our study of the world of matter is that in which it has been so organised as to form the structure of living beings. The habitations of vegetable life are structures of wonderful complexity, ingenuity, and exquisite beauty. Their hidden anatomy displays to us wonderful examples of every kind of invention, contrivance, and ingenious disposition of matter, and furnishes examples of the application of forces to produce motions, and of means and mechanism to apply those motions to the functions of life and usefulness. By means of the study of these, we too may learn how to organise dead matter in conformity with our thoughts; how to contrive mechanism to obey our commands; how to set means on the way to ends, so as to accomplish even our most fantastic wishes. In the study of the structures and phenomena of material life, we separate them into two great kingdoms,—of growing life, and moving life; of rooted beings, and locomotive beings; and in examining the structure of these beings by the knife of the anatomist, and the eye of the microscopist, we separate with ease the structure of the rooted plant from the framework of the moving animal. The vegetable kingdom and the animal kingdom thus separate the world of life into two; and it is hard to say whether the lesson we take from the organisation of growth in vegetables, or the movements in animals, is the more valuable.

The anatomy of plants, and the anatomy of vegetables, is but the beginning of their study. We have next to see how this hidden mechanism which we have revealed does its work of developing, sustaining, and maturing the living thing. How seeds grow into plants; how the stem of the plant throws roots downward into the earth, and out of that great chemical laboratory selects, extracts, and draws up into itself the matter of organisation and nutriment. How the same stem at its upper end throws up branches larger and wider into the region of the air, there to form another chemical laboratory, where also it exchanges all the matters it does not want for those elements in the air which nourish its life; how each bud of each plant contains first a new plant, the exact copy of its parent stem; and how in the extremity of each stem is cradled a new and young plant, at its birth encircled by the fanciful decorations of wreaths of flowers; and how the cradle of the young plant is so formed as to float its youthful charge in the air, or bear it harmless along the surface of the water, or coated with an armour which shall secure the germ of future life against the blows and shocks of storms. All this forms an insight into the laws and workings of creation, quite as instructive, quite as grand, even more removed beyond the sphere of human mastery than the movements of the planets themselves. This forms the physiology of vegetable life, and leads us to study what food plants should eat; what liquids they should drink; how they should be tended, protected, propagated, improved. These lead us up to the physiology of animal life. How the infant grows, strengthens, matures; how its health should be tended, developed; how its weakness should be cured, disease averted, misfortune set right. The whole story of animal life: sleep, food, digestion, sight, hearing, taste, smell,—all those mysteries which make up the human animal, and go to make the body a fit engine for the rational mind, and habitation for the divine soul,—all that is the subject of the physiology of animal life.

The human body, then, is the crowning knowledge of the whole science of the world of matter. A step further, and we trench on the philosophy of mind.

PHILOSOPHY OF LIFE.

BIOLOGICAL SCIENCES.

Biology.

Anatomy.	*Physiology.*
Vegetable Structure.	Vegetable Life.
Animal Structure.	Animal Life.

II.—THE PHILOSOPHY OF HUMAN NATURE.

Following close on the study of matter, of organisation, and of life, come the studies of mankind, of human thought, of human choice, of human action.

To train the human mind to think rightly and know truly; to train the human will to choose wisely and act well, are practical problems of the highest value to the individual and to humanity. But to train the mind to right thinking, one must know the laws of thought; and to train the mind to true knowing, one must know the nature of true knowing and of false knowing—the ways of finding truth and of falling into error. To regulate human action and influence human choice, one must thoroughly know the ends and means among which one has to choose; the powers and instruments through which one has to act. Thus all human life and all human culture in thought, knowledge, choice, and action, has to form the matter of a careful study, certainly not inferior in importance to the study of the matter world. Hence a new department of our university study, the study of the mind world.

PHILOSOPHY OF MIND.

PSYCHOLOGICAL SCIENCES.

Philosophy of mind.

Metaphysics.	*Ethics.*
Thought.	Choice.
Knowledge.	Action.

Hidden thought or hidden knowledge, stored up in one human mind, might go to the grave, lie buried there, and fail to benefit humanity. To word our thought, to communicate our feeling, to tell our meaning, to express our wish, to show our plan and purpose, to link other human beings to ourselves in thinking, knowing, choosing, and acting—that makes all mankind one. Thinking is divine; it requires speech to make it human. Knowing is good; it requires communication of knowledge to make it useful. Choice requires a reason; action a motive. Speech alone can communicate our reason, and earn the approbation of our race. Speech must tell the purpose of our action, explain our way of acting, and earn the co-operation as well as the sympathy of our fellows. The art of converting hidden thought, of transplanting the thoughts of our bosom into the hearts of others, of transferring the knowledge of the past into the present, the knowledge of the present into the far future, the knowledge of the near into the distant; all that vast apparatus which human nature has struggled for and human ingenuity contrived to link one man to another, and distant time and one place to another—that great apparatus of human speech is the subject of another philosophy. But we should be wrong if we confined our notions of human speech to mere vocal articulation, to the characters of common writing, or the typography of modern books. Speech is but one action; writing but another action of human life; and all those human actions which express the meaning of the thinker, the intention of an action, or the purpose of a work, are equally material incarnations of thought, and belong to the large science of expression. Literature is but one of the fine arts. The human countenance, the human eye and hand and form,

Speech;

the human attitude and motion—all the graceful pantomimic art, is another language of thought and feeling. There is a grace of attitude and a poetry of motion, more expressive of internal beauty, and hidden thought and feeling, than types or articulate sounds. Then there is the poetry of sound, the language of music; a language in all tongues common to the human race; a language that moves even the rude mind of the unlettered barbarian, subdues the ferocious beast, and stirs the very stones. How colour becomes the language of thought and a vehicle for the expression or perpetuation of beauty; how the pale marble can image forth the qualities of a divine soul; how perpetual bronze can lend the forms of melted metal to give immortality to beauty; how stone and marble columns and arches, embodying the exquisite harmonies of music, can sing through untold centuries, hymns of Divine praise; how all man's acts form monuments of his thoughts, and records of all his ways; how all matter can manifest all mind, human or Divine—it is the business of the philosopher of human expression to make plain; and the duty of the teacher of science in literature and science in fine art, of science in reasoning and science in persuasion, to lay down the ways, and make plain the plans and means. How thought developes into language, language into act, act into feeling, feeling into poetry, and reason into rhetoric; to know all that, is to know what the poets of Greece—her architects and sculptors, her philosophers and orators have handed down to us of that classic era of human refinement. We have therefore, in this branch of philosophy, pregnant themes of thought, feeling, and action.

PHILOSOPHY OF SPEECH.

Sciences of Literature and Art.

Expression.	*Method.*
Language.	Logic.
Æsthetics.	Rhetoric.

The study of humanity has two methods: the study of mankind as one, and the study of mankind as many. As man is now presented to us in the world, he can scarcely be considered as *one*. The Negro, the Hindoo, the Greek, the Jew, the Saxon, the Celt, and the Anglo-Saxon, can never be called, or studied, or judged as one.

Much that would be true of any one race or family of mankind would be false of another. The ways of the Chinese race, the most numerous family of men, are utterly apart from those of all other kinds of men. Their thinking is different, their morality is different, their language different, their art different. If, then, one would improve a nation or develop a race, one must first study the nature of that race, and the history of other races. One must know the defects of the race and its strong points, and the legislator, patriot, parent, or pedagogue, must with painstaking study strive to make good the wants of the race, physical, intellectual, and moral, by training, food, condition, education, knowledge, and discipline. Races improve, develop, degenerate, die out. They remain pure; they are mixed and crossed; they are cultivated, or are neglected; governed well, ill governed, or governed not at all.

Thus the greatness of a nation may be achieved if for one or two generations it possess and follow great and good men. It may decay and degenerate when virtue and wisdom cease to rule. Where wise men rule, institutions are founded, established, and perpetuated, which form the people to industry, frugality, refinement, patriotism, intelligence, self-denial, order, virtue, and religion. When evil rule, selfish rule, or no rule predominate, people decay, virtue fades, luxury reigns, feebleness follows, religion subsides into form, empires are extinguished, and nations fall into chaos.

The story of the human race then, its original families, its noble nations, its patriotic institutions, and its religions, true and false,—the story of the human race is the most interesting of philosophies. Wisely told, history gives to each man the lesson of human life. Man as an individual, feeble and undeveloped; man in a cultured nation, wise, great, and good. Here then we have a field of knowledge covering all human time, spreading over the surface of the earth and sea, and comprehending all interests—past, present, and future, family, race, and nation—to man most dear.

PHILOSOPHY OF HUMAN STORY.

THE SCIENCE OF HISTORY. History.

Ethnology.	*Politics.*
Race.	Institutions.
Nation.	Religions.

Founded on the story of the past, each man, each nation, each legislator, each ruler, has to think out with wisdom and foresight, his own life, his children's destiny, the progress of his own community, the welfare of his own nation, its progress and its liberty. To have lived a life of virtue and wisdom, each man must have lived a life of usefulness to others, as well as of personal improvement to himself.

How each man can help not himself merely, but be useful to his neighbours, helpful to his community, valuable as a citizen, and how the benefits of his own time and place may be secured to his fellow countrymen in coming times and spreading place; that it is the business of each patriot to think out, of each legislator to contrive the way, and of each government, administration, or governor, to carry into effect.

The organisation of human society is the foundation of the destiny of all the human beings forming that society, now, and in time to come. All government must be a government either of the wise, the ignorant, or the foolish; the able or the incompetent; the honest or the corrupt. A nation of men that knows not how to choose the wise, the fit, the experienced, the patriotic, the pure, from among her citizens, to place them in the front as her patterns and leaders, and to support the heads of the people in the development of the higher and nobler destinies of the nation—such a nation must be content to be treated as it deserves, to be told only that which is agreeable, to be led to do only that which is pleasant, to have its best interests bought and sold as itself buys and sells its own votes, and to have all the great interests of the coming generation and the coming time subjected to the narrowness, the meanness, the party, and the selfishness of political degeneration. The organisation of society therefore, not merely for present security, but for the culture of the coming generation; not merely for the enjoyment of present wealth, but the maintenance of future strength; is a subject for the study of the highest minds, for the ambition of the highest aims.

PHILOSOPHY OF SOCIETY.

SCIENCE OF POLITICS.

Society.

Legislation.	*Administration.*
Security.	Wealth.
Culture.	Strength.

In thus coming to the conclusion of the list of philosophies which are to be taught in our university, it will be readily admitted that some of these knowledges, if not all, are necessary to every well-educated man of the world. The first philosophy, the philosophy of the material world, is necessary to every man whose life is to be a struggle with matter, whose duty it is to be to transform, shape, and resist or direct its forces.

The second philosophy, the philosophy of human nature, is still more essential to what is called a man of the world; for if it be hard to understand, control, direct, and use dead matter, it is much harder to train, cultivate, mature, ennoble, and guide the matter of society. Nevertheless, of all things in the matter world, formal, physical, or living, none are so important, so interesting, so material to human life, as the study of mankind, past, actual, possible, and future.

Selection of studies.

Which of all these philosophies is to be individually taught to each individual student, as the most important matter for him, is a subject for future consideration; suffice to say here, that there are few of those matters of which any wise man can afford to be utterly ignorant; and every wise man will readily admit that to be profoundly master of any, he must be content to master but very few. The wisdom then to be shown in the education of a man according to this programme, will consist in the judicious selection from among the many things of which he should know something, and the few of which he should know everything. This too we will examine further on.

Omission of theology, law, and medicine.

But it is necessary to notice the grave omissions of a multitude of important knowledges which are not included in our philosophy. An enemy to our philosophy will notice that we have omitted the knowledge of God, and that ours is therefore a Godless university. He will further notice that all the mysteries of the medical profession, and the important subject of human health, find no place in our school, and therefore he will be able to call us a university of misanthropists. Thirdly, he will say that we are anarchists, for the whole philosophy of that industrious body, the members of whose active profession fill every corner of English society, find no training in our university, and that, therefore, lawyers are excluded from its privileges. To all this there is a simple answer. We have not the slightest objection to educate lawyers in the laws of honesty and truth; to teach medical men the laws of human health; and to teach theologians the nature and laws of God. But we abstain from presuming to do so, because these are the ancient professions for which our ancient universities have been provided. We desire not to trespass upon the slightest portion of their ancient ground. It has long been their privilege to create doctors in divinity, in medicine, and in law. We mean to undertake none of these, not because we undervalue them, but because we so highly value them, and because we think that two great universities will have their rich endowments well bestowed if they send out into England and her colonies successive generations of profound theologians, intimately acquainted with the nature and ways of God; lawyers filled with the spirit of honesty, desiring only the peace, agreement, and well-being of their neighbours; and doctors of medicine, who will achieve that highest of all medical triumphs—of so training the rising generations to the knowledge and practice of the laws of human health, as that the business of doctor of medicine shall become a well-paid sinecure. The training of these three learned professions in such knowledge is a noble duty, a field for noble triumphs, but not ours. Our philosophy therefore consists merely of the subjects contained in the following Table.

Table of two philosophies.

HUMAN KNOWLEDGE.

KNOWLEDGE OF MATERIAL NATURE.

THE SCIENCES.

1. The Mathematical Sciences.
2. The Physical Sciences.
3. The Geographical Sciences.
4. The Biological Sciences.

KNOWLEDGE OF HUMAN NATURE.

THE PHILOSOPHIES.

1. The Philosophy of Mind.
2. The Philosophy of Literature.
3. The Philosophy of History.
4. The Philosophy of Society.

SPECIAL KNOWLEDGES.

Philosophy of	Sciences.	Departments.	Divisions.	Philosophy of	Sciences.	Departments.	Divisions.
Form . .	Mathematics.	Calculus . .	Quantity. Number.	Mind . . .	Psychology .	Metaphysics.	Thought. Knowledge.
		Geometry .	Form. Place.			Ethics . .	Choice. Action.
Substance .	Physics . .	Mechanics .	Matter. Force.	Speech . .	Literature and Art . . .	Expression .	Language. Taste.
		Chemics . .	Elements. Compounds.			Method . .	Logic. Rhetoric.
Creation .	Cosmology .	Geodesy . .	The Heavens. The Sea.	Story . . .	Histories . .	Ethnology .	Races. Nations.
		Geology . .	The Earth. Under the Earth.			Politics . .	Religions. Institutions.
Life . . .	Biology . .	Anatomy .	Vegetable structure. Animal structure.	Society . .	Politics . .	Legislation .	Security. Culture.
		Physiology .	Vegetable life. Animal life.			Administration . . .	Wealth. Strength.

Teachers.

Professors and professorships:

Our next business is with the teachers of our philosophy. Whom shall we have? Where shall we seek them? What duties shall we give to each?

In mathematics;

1. In the department of the philosophy of form it is quite plain that we must have one professor of the mathematical sciences; and if our university were an elementary school, a single professorship of mathematics might be deemed enough for all that could be taught or learned; but every student of higher mathematics knows that there are two great organs of mathematical investigation—geometrical analysis, and algebraical analysis,—and that their nature, laws, and methods, are essentially distinct. The calculus ignores as much as possible the specialities of the quantities with which it deals, and regards as nearly as possible their abstract relations.

Geometrical calculus, on the other hand, finds all its elements in a very few species of quantity, comprehending at the most but three dimensions, and extending merely its own laws by analogy into the phenomena of other quantity. Subordinate then to our professorship of mathematics are at least two professors or teachers, the one of geometry, the other of calculus.

But even this subdivision of mathematics by two is not enough for our high university. Discrete quantities are of a familiar sort that mix themselves up with all the measurable questions of matter and common life, and therefore the philosophy of number covers one large kingdom of thought, embracing all the phenomena of matter, and all the relations of human life which we are able to render exact by establishing precise measures of space, time, bulk, direction, weight, force, or commercial value.

A professor, then, of the philosophy of number must find a chair in our university; and beside him we must seat another—the professor who treats quantities not as the vulgar units of common arithmetic, but who represents all quantities, all their relations in all possible permutations, combinations, and fluctuations, by means of abstract quantities, signs, and symbols; who undertakes to forethink and predict all the possible and impossible combinations of all conceivable quantities in all conceivable relations. That is quite enough for any human being, and entitles its master to fill a separate chair.

The geometrical professor also, though limiting the objects of his study to conceivable form and place, and their actual and conceivable changes, has a simpler task. The discrimination, the naming, the definition, the construction and the representation of all the possible forms of things under heaven, in the earth, and in human thought, is surely a large enough occupation for a single human mind, especially if, in addition to grasping all this himself, he has to find the means of making all these thoughts enter clearly into the minds of others, and in that alone is duty enough for a single chair. But when we go further, and follow the geometer into all the laws of transformation of shape, size, and place, and pass with him through all the fluctuations which every conceivable relation of space, place, direction, distance, and size can give to growing, dwining, or transforming shapes, then we have a field open to us of higher or transcendental geometry, sufficiently arduous, and entirely boundless, so that its value, usefulness, and grasp are entirely measured by the greatness of the mind of the professor whom we call upon to assume the chair of the higher geometry. Search we then the wide world round, here are four chairs capable of occupying the minds of a Newton, a Descartes, a Leibnitz, and a Gauss, if we can find them.

Four professorships are, therefore, the smallest number we can found in our university for the mathematical sciences. Two in the divisions of the calculus, and two in the divisions of geometry. If we are more liberal, we should found also two superior professorships—one of the calculus, and one of geometry, not limiting either to one of its divisions, but grasping the mutual relations of both. And if we were still more wise and foreseeing, we should place one other highest philosopher at the head of this whole philosophy to develop the laws and expound the principles which group together all the elements of mathematical knowledge into one high philosophy—a philosophy of exact thinking, and of boundless discovery; to teach men, if possible, the thoughts of God, the great geometer.

In physics; 2. In the department of the philosophy of physics, or the philosophy of the substance, stuff, or matter which fills the visible forms with which we are surrounded, and gives to them force, power, quality, and energetic being, is probably the most immediately important and fundamental of earthly knowledge. The properties of the dead or living matter, of the still or moving matter with which man has to deal, and of which the world, ourselves, and all things in it are made, *that* may be thought the true matter knowledge, and indeed it is perhaps in a higher degree modern science than any other human knowledge. Quantity, number, form, and place were known to the ancients; the heavens, the earth, and the sea were studied by them, and some of the natures of vegetable and animal structures, and some of the laws of vegetable and animal life, were familiar to them. But the laws of the familiar phenomena of matter and force were unknown to them, so that they could neither handle a tool, fire a shot, nor create a machine with a true knowledge of what that tool would do, where the fired shot would arrive, or what the created engine would achieve.

What we, therefore, call the physics of common life, and its philosophy the common laws of matter, were comparatively little known to the ancients; and the philosophy of substance, of force, of matter power, and matter nature, is of the essence of modern material philosophy. A high professorship of the philosophy of matter force and substance may well be founded in our university, and a chair of general physics will find ample occupation for pupils and teachers.

But modern matter discovery has overleapt the bounds of those sciences which treat all matter substance and force as one. That all matter obeys one law, and that all physical force is of one nature, is an old doctrine, and the alchemist who sought to transform earth or iron into gold only expressed his conviction of the physical unity of matter. Modern chemistry has dissolved ancient physics and alchemy, and may be said, by its analysis, to have created a new world—a new world of matter and a new world of thought; and so modern matter philosophy consists of two quite distinct and equal regions of subjects and of thought—the physical phenomena of matter, and the chemical phenomena of matter. For our university, therefore, are necessary, a school of physics, and a school of chemics; one professor or more of physical science; one professor or more of chemical science. But even that physics which is concerned with matter in general must be broken down into branches of study. First must be examined and taught the properties which belong to all matter, and the phenomena which matter and its laws exhibit to us; and in order that we may govern matter, we must ourselves master the nature of all those forces which it can exert or will obey; and so the laws of force found for us a chair of dynamics, and the phenomena of matter provide for us the object of another chair, to master and teach all the phenomena which matter exhibits to us, and to follow certain laws through all the transformations of matter, as the same substance becomes, first a solid, next a liquid, or is finally dissolved into an air impalpable but real. The laws of force are, then, the subject of one chair, and the phenomena of matter the subject of another, both comprehensive divisions of the physical departments of the philosophy of substance.

After the phenomena and forces growing out of matter or governing it, we must consider the properties and forces which belong to or grow out of one kind of matter, and with which some other kind of matter has nothing to do. It is the modern chemist who has discovered that there are kinds of matter which have nothing in common with properties which essentially distinguish one kind of matter, and render it impossible to apply one to the purpose of the other. A hammer, as a mechanical tool, would be equally good for most uses, whether made of brass, iron, steel, copper, or any other sort of matter; but a chemical tool made of any one of these substances might be totally unfit for any other purpose to which it might be applied.

It is these differences in the natures of kinds of matter, which form the special subject of that chemical science which show us that in our earth alone are forty or fifty kinds of matter essentially different, and that out of these forty or fifty are made hundreds of other kinds of matter, simply by combining these elements with each other in certain definite proportions.

From this short statement it will easily be seen that chemistry is one of those sciences to the teaching of which it is not easy to set definite bounds. To say that one teacher or ten teachers of chemistry would be sufficient for our university is extremely difficult; it is certain that ten teachers of chemistry would find ample work in teaching and guiding 100 energetic students, determined to master in three years the chemistry of our material world. But the least number we could assign would be professorships for the two great divisions of chemical analysis and chemical synthesis; or we might assign two—one to organic, and one to inorganic chemistry. For the present we will content ourselves with three—one for inorganic chemistry, one for quantitative analysis, and one for organic chemistry, leaving them to add as many assistants as the convenient subdivisions of their subject require. The science of general physics is therefore a subject for one chair, in which possibly might be also introduced chemical physics, containing principles and matters common to both. Next, two professorships; one of the department of mechanics, or natural philosophy, as it is sometimes called, and another for general or inorganic chemistry. And next for the divisions of properties of matter and laws of force, professors of special physics and dynamics, and in chemistry professors of analytical chemistry and organic chemistry; in all, seven chairs.

In astronomy, geography, geology;

3. The science of cosmology has so wide a scope, that it is hard to limit the number of its professors. World-knowledge implies, first, knowledge of worlds in general; second, knowledge of our own world in particular. How worlds in general grew or were made; how stars group into systems; how suns carry their planets through space; how our own world grew out of a burning mass into a crusted earth, and what sort of revolutions brought it into fitness for vegetable, animal, and human life, there is a story demanding almost superhuman power, knowledge, and skill, to conceive and to make plain to us. It would require the author of a "Cosmos" to teach us how cosmical systems were made, and the philosophy of the creation of stars and of worlds is enough to occupy that one mind. But in coming down from the heights of science to the common work of life, the subject divides itself very regularly into the duties of the man who studies all the stars, and the duties of him who only studies the conformation of our own particular world; and a chair of astronomy, and a chair of geodesy, are two divisions which the nature of the subject clearly dictates.

The astronomer who studies the heavens, and the geodesist who studies the world in its larger relations as one of the planets, have both a geometry of the highest order to wield; and in addition to the geometry of the heavens, they have the physical astronomy of the heavens, and the whole field of celestial mechanics or star machinery to master and teach. To the geographer and the geologist, the more limited task is assigned of studying the world in its divisions of earth and sea, and of bringing to light the hidden treasures of both. The one has to discover to us all lands, peoples, and countries; to show the way across all seas, to fathom all depths of the ocean, to predict winds, tides, and seasons; and that is enough for one professor. To another may be safely left the discovery of all the treasures accumulated under the earth, with infinite foresight, for the use of all-consuming mankind; and to show in what folds and layers and pits each kind of matter has been deposited and stored and kept ready for our use, so that we may know how to seek and where to find it whenever we want it, *that* is quite enough for one professor of geology.

We have, therefore, in this division a professorship of cosmology, a professorship of astronomy and geodesy; and then we have four professorships of divisions—first, of mathematical and physical astronomy; second, of geodesy or mathematical and physical geography; third, of geography proper, or the surface of the earth in its continents, islands, rivers, and seas; and fourth, the constitution of the earth within, as a great storehouse of classified material. We have thus here seven professorships with ample scope and work.

4. The philosophy of life is a subject of still larger range. The laws which determine life and the mode of development of living beings, and their relations to each other and to surrounding creation, is a subject sufficiently deep and large to form the duty of a single chair for the profoundest of our thinkers. The study of structure merely as an organisation of matter for the purposes of life is a subject so complicated, that the structure of vegetable and of animal life each require the devotion of a separate lifetime, and must form the duty of a separate professor; and in like manner, In natural history;

the forces which stir vegetable life, and the laws which govern its phenomena, are ample work for one or more professors, leaving to others as a separate division the study of the higher life of animals. We have thus a professor of the anatomy of vegetables, and another of the physiology of vegetable life; and we have a professor of the anatomy, and another of the physiology of animal life. We may, therefore, have in this department the following chairs:—a chair of biology, one of comparative anatomy, and one of comparative physiology; a chair of vegetable anatomy, another of animal anatomy, a third of vegetable physiology, and a fourth of animal physiology.

We have now, therefore, in the division of the philosophy of matter nature, the following chairs:—

I. In the School of Mathematics:—Seven professorships.
II. In the School of Physics:—Seven professorships.
III. In the School of Cosmology:—Seven professorships.
IV. In the School of Biology:—Seven professorships.

In the philosophies;

In the school of humanity, or the philosophy of human nature, there is ample scope for an equal number of professorships; but whether the state of education and of opinion in England would warrant or sustain the appointment of so large a number of professors in philosophies so immaterial and unmercantile as some of these, may be matter of serious doubt. It is not improbable that in some of the schools of humanity a much smaller number would represent the importance assigned to these studies in England. The following serves as a suggestion of the smaller numbers by which this department might be initiated, leaving, it is hoped, the future prospect, with extending knowledge and refinement, of an increased number of teachers, giving equal importance to education in the laws of mind and education in the laws of matter.

The following may be regarded as a provisional arrangement:—

V. In the School of Psychology:—Two professorships.
VI. In the School of Literature and Art:—Seven professorships.
VII. In the School of History:—Two professorships.
VIII. In the School of Politics:—Two professorships.

Thus, in the whole university we should have forty-one philosophical and scientific professorships provisionally, and ultimately fifty-six.

III.—Special Technical Professorships.

In special applications of science.

It is an axiom of education that knowledge or science is the first condition of power in art; but it is equally axiomatic that skill to apply that art will not come of itself, and requires a course of initiation—which course of initiation is called technical education. How much of this technical education shall be given in the workshop, and how much in the school, will always be a matter for serious judgment, and will depend on the nature of each subject, and the circumstances and capacities of each pupil. But it will still remain unquestionable that one part of the initiation of a man into the duties of his life will be better performed in the school, and another in the workshop, or actual business of life.

In addition, therefore, to these professorships of the science necessary to deal with the material world, there must be professorships of the best ways of dealing with matter, under the particular conditions of the destiny in life of each pupil; and it becomes a question for serious consideration, what are the professorships of application, or purely technical chairs, which shall be provided in our university? Looking at this subject *à priori* merely, one might solve the question by saying that to every professorship there might be attached a subdivision of application, to be taught either by the same professor who teaches the theory, or by a colleague appointed for the purpose. Such an arrangement would be inadequate, for this reason: that the number and importance of the applications of a subject to the business of life vary extremely, so that some of these professors would be overwhelmed while others were idle.

Number and nature of special technical applications of science.

The number and nature of special technical chairs must, however, be carefully studied, both in relation to the professions of the students, and to the methods in which the non-technical professors conduct their teaching. In our technical university, the whole of the teaching of the pure science will naturally be conducted with a technical aim, and to that extent, therefore, all the chairs will be technical chairs; but supplementary to these, and having as their aim—not the principles of knowledge, but the practical methods of application, will be what I call strictly professional chairs.

I. The School of Mechanics:—Five professorships.
II. The School of Civil Construction:—Seven professorships.
III. The School of Naval Architecture:—Five professorships.
IV. The School of Mines:—Five professorships.
V. The School of Commerce:—Five professorships.
VI. The School of Agriculture:—Five professorships.
VII. The School of Astronomy, Navigation, and Surveying:—Five professorships.
VIII. The School of Literature and Languages:—Five (?) professorships.
IX. The School of Fine Arts:—Five professorships.
X. The School of Political Economy:—Five (?) professorships.
XI. The School of Metaphysics and Ethics:—Five (?) professorships.
XII. The School of Pedagogy:—Three professorships.

In regard to Nos. VIII., X., and XI., it is to be remarked that these professorships might possibly be all identified with corresponding professorships of pure philosophy or science—a point which would be determined mainly by personal qualification in the professor, and by practical convenience in the courses. There remain, however, of purely technical professorships, forty-five; so that, in all, our university will require a teaching staff of 101 professors.

CHAPTER XIV.

OUR ENGLISH TECHNICAL UNIVERSITY—ITS STUDENTS, THEIR PROFESSIONS IN LIFE, AND CURRICULUM OF STUDY.

Education of twenty-two modern professions.

When we have provided in our university fifty-six courses of study, covering the wide fields of education in matter and mind, it is quite obvious that we have merely embarrassed the youthful student by the number and variety of the subjects from which he has to select; and if we leave him free liberty of choice, it is evident that he will run the risk of much waste of energy and time. In order that our university may be of the greatest practical service to our student, we must aid him in his choice by presenting him with that selection of subjects which will most directly lead up to his aim in life, and most easily conduct him through the difficulties of learning to technical knowledge and technical skill. As we have in the former Chapter classed our professors according to the nature of the science they have to teach, so now we must class our students and their studies according to the nature of the aims in life which they have in view. This will group both teachers and taught into entirely new subdivisions.

It has already been agreed that we shall provide technical education for twenty-one or twenty-two professions, embracing all the modern professions, and excluding the three ancient ones,—theology, law, and medicine. And our first question is, whether for all these we must provide twenty-two separate and independent courses of study.

If these professional men were all to be educated in different schools—in buildings apart from one another,—we might have to provide twenty-two courses of education; but as they are all meant to be taught in a single building, we shall be able to simplify the matter by means of systematic combination. Resuming here the list of professions for whom we are to provide education, we should have to form the following groups of studies, corresponding to the technical occupations of the students:—

THE SCHOOL OF MECHANICS.

Pure Science.	*Practical Applications.*
Higher Geometry.	Descriptive Geometry.
" Algebra.	Constructive Geometry.
" Arithmetic.	Geometric Movements.
" Statics.	Sources of Materials.
" Dynamics.	Properties of Materials.
" Energetics.	Strength of Materials.
" Chemistry.	Elements of Mechanics.
" Metallurgy.	Structural Mechanics.
	Machinery and Tools.
	Engines and Prime Movers.
	Economics of Work.
	Endurance of Machinery.
	Machine Shops and Buildings.
	Mechanical Manufactures.
	Political Economy.
	Workshop Economy.
	Principles of Design.

Work.

In the Drawing Office.
In the Collection of Machines.
In the Collection of Machine Materials.
In the Collection of Raw Materials of Manufactures.
In the Collection of Engines, &c.
In Mechanical Experiment.
In the Factory.
Round the Tour of Home Manufactories.
In Foreign Travel.

THE SCHOOL OF CIVIL CONSTRUCTION.

The Architectural.

Pure Science.	*Practical Applications.*
Highest Geometry.	Descriptive Geometry.
Laws of Number and Proportion.	Geometry of Vision.
Statics.	Constructive Geometry.
Psychology.	Graphic Geometry and Surveying.
Æsthetics.	History of Building Materials.
Physics.	Strengths of Materials.
Chemistry.	Chemistry of Building Materials.
Animal Physiology.	Geology of Stones and Cements.
Botanic Organography.	Mineralogy.
Geology.	Stability of Foundations.
Art History.	Stability of Structures.
	Theory of Arches and Roofs.
	Forms of Beauty.
	Forms of Strength.
	Proportions of Mass.
	Linear Decoration.
	Surface Decoration.
	Solid Decoration.
	Building Processes, Tools and Machinery.
	Building Economy.
	Building Endurance.
	Domestic Health.
	Domestic Economy.
	Domestic Comfort.
	Laws of Sound and Hearing in Building.
	Laws of Ingress, Egress, and Seeing.
	Laws of Climate and Weather.
	On Use, Purpose, and Fitness.
	Principles of Design.
	Laws of Property and Buildings.
	Landscape Design.

Work.

In the Drawing Office.
In School of Design.
In Modelling School.
In Mechanical Experiment.
In the Museum of Ancient Models.
In the Museum of Modern Architecture.
In the Collection of Building Materials.
In the Collection of Decorations and Art Workmanship.
In an Office of Works.
On the Works.
On Travel at Home.
On Foreign Travel.

THE SCHOOL OF CIVIL CONSTRUCTION—*continued.*

ENGINEERING.

Pure Science.	*Practical Applications.*
Higher Geometry.	Engines and Prime Movers.
" Algebra.	Theory of Vehicles and Locomotive Machines.
" Arithmetic.	Theory of Ships and Steamboats.
" Statics.	Chemistry of Building Materials.
" Dynamics.	Geology of Stones and Cements.
" Energetics.	Mineralogy and Metallurgy.
" Hydrology.	Stability of Foundations.
" Chemistry.	Building Combinations of Materials.
" Geology.	Sources of Materials of Construction.
" Crystallogy.	Theory of Bridges, Roofs, and Tunnels.
	Constructive Geometry.
	Graphic Geometry and Surveying.
	Descriptive Geometry.
	Perspective Geometry.
	Geometric Movements.
	Strengths of Materials.
	Elements of Mechanics.
	Machines and Tools.
	Theory of Rivers.
	Theory of Tides and Waves.
	Theory of Roads, Railroads, and Canals.
	Principles of Architectural Design.
	Principles of Metallurgy.
	Economics of Construction.
	Endurance of Structures, Engines, Machines, and Implements.

Work.

In the Drawing Office.
In the Collection of Engineering Models.
In the Collection of Building Materials.
In the Collection of Machines.
In the Laboratory of Strength of Materials.
In the Chemical Laboratory.
In Engineering Experiment.
In the Factory.
On the Works.
In Foreign Travel.

THE SCHOOL OF MINES.

Pure Science.	*Practical Applications.*
Mathematics.	Descriptive Geometry.
Physics.	Trigonometrical Surveying.
Chemistry.	Mineralogical Drawing.
Geology.	Distribution of Minerals.
Political Economy.	Practical Mechanics.
	Elements of Machinery.
	Steam Engines and Boilers.
	Ventilation.
	Drawing.
	Physiology and Chemistry of Life.

Work.

In the Chemical Laboratory.
In the Physical Laboratory.
In the Drawing Office.
In the Museum of Geology.
In the Mine.
In Foreign Mines.

THE METALLURGIST.

Pure Science.	*Practical Applications.*
Mathematics.	Smelting and Refining.
Physics.	Practical Mechanics.
Chemistry.	Strength of Materials.
Geology.	Descriptive Geometry.
	Mineralogical Drawing.
	Combustion and Ventilation.
	Elements of Machinery.
	Steam Engines and Boilers.
	Statics of Buildings.
	Nature of Machine Tools.
	Hydraulic Machinery.
	Electro-Magnetic Metallurgy.

Work.

In the Chemical Laboratory.
In the Physical Laboratory.
In the Drawing Office.
In the Museum of Geology.
In the Metal Manufactory.
In Foreign Travel.

THE SCHOOL OF AGRICULTURE.

Pure Science.	*Applications of Science.*
Mathematics.	Anatomy of Plants.
Physics.	Physiology of Plants.
Chemistry.	Anatomy of Animals.
Natural History.	Physiology of Animals.
Geology.	Geology of Soils.
	Chemistry of Soils.
	Chemistry of Manures.
	Chemistry of Food.
	Veterinary Medicine and Surgery.
	Surveying, Levelling, Plan-drawing, and Draining.
	Practical Mechanics.
	Principles of Steam Engines.
	Agricultural Machinery and Implements.
	Nature and Influence of Climates.
	Buildings, Roads, Gates, and Fences.
	Training Fruit Trees, and Timber.

Practical Work.

In the Mechanical Workshop.
In the Hospital for Animals.
In the Farm.
In Foreign Travel.
In the Chemical Laboratory.
In the Physical Laboratory.
In the Drawing Office.
In the Museum of Natural History.
In the Museum of Geology.

The Gardener and Forester

Have an education of similar nature to the Agriculturist, with a specialty in each case. Both have, in addition, to study the principles of beauty in their applications to Landscape Decoration, and in their combinations with Architecture; both require a large course of instruction in the Theory of Climate, and in Physical Geography and Botanical Geography—both, therefore, must study Decorative Architecture. For the rest, the study of the same courses as the Agriculturist is necessary.

THE SCHOOL OF COMMERCE.

The Merchant.

Pure Science.	*Practical Applications.*
Geography.	Construction and Outfit of Ships.
Natural History.	Docks and Warehouses.
Ethnology.	Physical Geography.
Political Economy.	Political Geography.
Doctrine of Probabilities.	Geography of Plants.
History.	Geography of Animals.
Languages.	Geography of Minerals.
Ethics.	Weights and Measures of Nations.
Law.	Moneys of Nations.
	Statistics and Wealth of Nations.
	Laws of Value.
	Laws of Insurance.
	Laws of Navigation.
	Principles of Exchange.
	Theories of Price.
	Interest and Banking.
	Laws of Commerce and Shipping.

Work.

In Natural History Collections.
In Collection of Raw Materials.
In Counting-house and Warehouse.
In Foreign Travel.

The Manufacturer.

Pure Science.	*Practical Applications.*
Mathematics.	Geometrical Drawing.
Physics.	Decorative Drawing.
Chemistry.	Light and Shade.
Natural History.	Light and Colour.
Political Economy.	Principles of Beauty.
	Principles of Design.
	Chemistry of Colour.
	Animal Substances.
	Vegetable Substances.
	Mineral Substances.
	Geography of Raw Materials.
	Mechanics of Raw Materials.
	Architecture of Manufactories.
	Architecture of Warehouses.
	Manufacturing Machinery.
	Commerce and Banking.

THE SCHOOL OF COMMERCE—*continued.*

Work.

In Natural History Collections.
In Collection of Raw Materials.
In Collection of Machine Models.
In Collection of Patterns of Manufactured Goods.
In the Laboratory.
In the Factory.
In Foreign Travel.

THE SHIP-OWNER.

Pure Science.	*Practical Applications.*
Elementary Geometry.	Descriptive Geometry.
„ Arithmetic.	Strength and Values of Materials.
„ Mechanics.	Sources of Materials.
„ Hydrostatics.	Physical Geography.
„ Hydrodynamics.	Weights and Measures of Nations.
„ Pneumatics.	Laws of Nations (and Customs).
„ Chemistry.	Moneys of Nations.
„ Geography.	Laws of Commerce.
„ Natural History.	Insurance (Principles of).
„ Ethnology.	Principles of Exchange.
„ Political Economy.	Docks, and Harbours, and Warehouses.
„ Languages.	Navigation.
„ Ethics.	Seamanship.
„ Law.	Ship Building.
	Marine Engine Building.
	Sail Making.
	Masting and Rigging.
	Equipment and Outfit.
	Lading and Storing.
	Manning and Clearing Out.
	Laws of Commerce and Shipping.
	Laws of Freight and Insurance.
	Laws of Measurement and Tonnage.
	Ship's Husbandry.
	Health, Food, and Safety.
	Wages and Disbursements.
	Merchandise and Exchange.
	Banking and Interest.
	Navigation Laws.
	Book-keeping.
	Stowage.

THE SCHOOL OF COMMERCE—*continued.*

Work.

In the Drawing Office.
In the Ship Model Room.
In the Engine Model Room.
In the Building Yard.
In the Engine Factory.
In the Harbour.
In the Ship's Store Rooms.
In the Warehouses.
In the Docks.
In the Repairing Yard.
In Sail-maker's, Mast-maker's, Rigger's Yard.

THE SCHOOL OF ASTRONOMY, NAVIGATION, AND SURVEYING.

The Sailor.

Pure Science.	*Practical Applications.*
Elementary Geometry.	Drawing.
„ Algebra.	Strength of Materials.
„ Arithmetic.	Physical Geography.
„ Geography.	Commercial Geography.
„ Astronomy.	Nautical Astronomy.
„ Mechanics.	Chart-making.
„ Languages.	Marine Surveying.
„ Pneumatics.	Submarine Surveying.
„ Hydraulics.	Ship Building.
	Equipment of Ships and Outfit.
	Stowage and Tonnage.
	Masting and Rigging.
	Laws of Tonnage.
	Customs and Clearance.
	Laws of Nations.
	Navigation Laws.
	Laws of Storms.
	Laws of Commerce.
	Laws of Freight and Insurance.
	Ship's Husbandry.
	Health, Food, and Safety.
	Book-keeping.
	Navigation.
	Seamanship.
	Harbours, Docks, and Slips.
	Weights, Measures, and Moneys.
	Steam-engines and Boilers.
	Artillery.
	Naval Tactics.

THE SCHOOL OF ASTRONOMY, ETC.—*continued.*

Work.

In the Drawing Office.
In the Chart Room.
In the Calculating Room.
In the Ship Model Room.
In the Engine Model Room.
In the Building Yard.
In the Engine Factory.
In the Repairing Yard.
In the Training Ship.
In Ships at Sea.
In Harbours.
In Surveying Ships.
In Ships of War.

THE SCHOOL OF NAVAL ARCHITECTURE.

THE NAVAL ARCHITECT.

Pure Science.	*Practical Applications.*
Higher Geometry.	Descriptive Geometry.
„ Algebra.	Constructive Geometry.
„ Arithmetic.	Sources of Materials.
„ Statics.	Properties of Materials.
„ Hydrostatics.	Strength of Materials.
„ Dynamics.	Elements of Mechanics.
„ Hydrodynamics.	Structural Mechanics.
„ Chemistry.	Engines and Boilers.
„ Metallurgy.	Propellers and Mechanism.
„ Pneumatics.	Artillery and Protection.
	Metallurgy.
	Economics of Work.
	Laws of Commerce and Shipping.
	Freight and Insurance.
	Navigation.
	Seamanship.
	Lading and Ship's Husbandry.
	Naval Tactics and War.
	Health, Food, and Climate.
	Ship's Wages and Economics.
	Harbours and Docks.
	Equipment, Rigging, and Outfit.
	Storing and Lading.
	Measurement and Tonnage.

THE SCHOOL OF NAVAL ARCHITECTURE—*continued.*

Work.

In the Drawing Office.
In the Model Loft.
On the Moulding Floor.
In the Collection of Marine Engines.
In the Collection of Materials.
In the Collection of Ship Models.
In the Experiments of Materials.
In the Building Yard.
At Sea.
In the Engine Factory.

THE MARINE ENGINEER.

This is a mixture of the Ship-builder and the Mechanical Engineer's courses of education, with experience superadded of building Marine Engines, erecting them on board ship, and managing them at sea.

Education of twenty-two modern professions.

We have now to consider how we shall group the students of these schools, that they may avail themselves simultaneously of such courses of education as are common to each group.

It is plain at first sight, that the civil engineer and the architect are allied professions; that the mechanical engineer and the machinist belong in one group; that the merchant and the ship-owner go together; that the manufacturer and the practical chemist have need of the same knowledge; that the miner and the metallurgist may be grouped together, as also the astronomer, the surveyor, and sailor; that the statesman, the political economist, and the man of literature, have many studies in common: and we shall thus be able to simplify much the courses of study each pupil may have to seek out and appropriate to himself.

I.—THE SCHOOL OF MECHANICS.

1. The Mechanical Engineer. | 2. The Machinist.
3. The Marine Engineer.

II.—The School of Civil Construction.

1. The Civil Engineer. | 2. The Architect.
3. The Naval Architect.

III.—The School of Naval Architecture.

1. The Naval Architect. | 3. The Marine Engineer.
2. The Shipowner. | 4. The Sailor.

IV.—The School of Chemistry.

1. The Professor. | 4. The Mineralogist.
2. The Practical Chemist. | 5. The Analyst.
3. The Dyer. | 6. The Chemical Manufacturer.

V.—The School of Mines.

1. The Miner. | 2. The Metallurgist.
3. The Practical Chemist.

VI.—The School of Commerce.

1. The Merchant. | 3. The Political Economist.
2. The Manufacturer. | 4. The Shipowner.

VII.—The School of Agriculture.

1. The Agriculturist. | 2. The Gardener.
3. The Forester.

VIII.—The School of Astronomy, Navigation, and Surveying.

1. The Astronomer. | 2. The Surveyor.
3. The Sailor.

IX.—The School of Literature and Language.

1. The Statesman. | 3. The Teacher.
2. The Political Economist. | 4. The Professor.

X.—The School of Fine Arts.

1. The Architect. | 3. The Painter.
2. The Sculptor. | 4. The Decorator.
5. The Designer.

XI.—The School of Political Economy.

1. The Statesman. | 3. The Merchant.
2. The Economist. | 4. The Manufacturer.
5. The Professor.

XII.—The School of Metaphysics and Ethics.

1. The Statesman. | 2. The Professor.
3. The Moral Philosopher.

XIII.—The School of Pedagogy.

1. The Professor. | 2. The Teacher.
3. The Schoolmaster.

XIV.—The Preparatory and Supplementary School.

A provisional arrangement for bringing up students who are insufficiently prepared for the University.

XV.—The School of Mathematics.

1. The Calculator.	4. The Surveyor.
2. The Actuary.	5. The Astronomer.
3. The Statistician.	6. The Professor.

XVI.—The School of Science and Philosophy.

This is a school for the training of philosophers, men of science, and men of leisure, who may not propose to become members of professions, but who desire to cultivate the sciences and the philosophies for purposes of personal improvement, and hope to apply their knowledge to the advancement of human society. The subjects taught are those in the Table on page 257.

CHAPTER XV.

OUR ENGLISH TECHNICAL UNIVERSITY—ITS METHODS AND MECHANISM OF INSTRUCTION.

Methods of teaching.—Sink or swim.—Want of competent technical teachers.—Total want of provision for high technical teaching or teachers.—High science.—The gift of teaching.—Practical skill.—Technical teaching aims always at use.—Technical men for technical teaching.—The best men in the nation to be taken for teachers.—Method of teaching in our university.—Illustration from technic geometry.—Arts giving form to matter.—Material mechanism for teaching.—Museum of geometry.—Halls of illustration.—Museums of each science.—Hall of geometry.—Hall of mechanics.—Hall of physical science.—Hall of chemistry.—Hall of astronomy and geology.—Hall of nature.—Botanical garden.—Astronomical, electric, and meteorological observatory.—Hall of zoology.—Chemical and mechanical laboratories.—Drawing schools and workshops.—Experimental school.—School for original research.—Apparatus for illustrations of teaching.—Good teaching will employ many methods and various instruments.

Methods of teaching. It is an argument often used against the establishment of our technical teaching, that technical knowledge does not admit of teaching; that technical men, to be successful, must have it in them by nature; and that those who have the natural gift will pick up the necessary knowledge merely by living in the world where it is wanted.

Sink or swim. This is the argument of those whose whole art of teaching to swim consists in throwing the child into the water. It is the doctrine of sink or swim; and it is the reason why a great many members destined for useful professions once thrown in, never rise. The exceptions survive and are therefore distinguished. It is our object, not thus to waste, but to economise and direct the mental force of our youth, so as to give the nation a large predominance of skilled and apt men over unskilled and ignorant. Nature will still continue to make her men of genius;—we shall be well satisfied if we provide for genius apt and fitting tools, instruments, and helpers.

But those who argue more closely still, say that the teachers from whom the youths of skilled professions learn their science, find such teaching and science as they get of little help to them in practical life; and that they will learn far more in the practical workshop or merchant's office than they can be taught either by the professor or in the university. These and many other criticisms are true, and not true; and it is in the distinction between that part of knowledge which is best taught in the university, and that which is best learned in the workshop, that we shall find a criterion of what we should teach in our university, how we should teach it, and what we should omit.

Want of competent technical teachers.

I am continually hearing the complaint made against the professors of technical teaching, that they teach nothing the pupils want to know; and I find the reason of this to lie in the absolute want in our country of any provision for the teaching of a high class of teachers. Our teachers are themselves untaught; and we select them with so little judgment, and assign them their duties with so little skill, that we most likely take a clergyman to teach mechanics, a doctor to teach manufacturing chemistry, and a young barrister from Cambridge to teach the building of bridges and viaducts.

Moreover, we hold the office of teacher in so small repute, that the moment a man of ability or practical knowledge can find a way of escaping out of pedagogy into remunerative working life, he is only too glad to take his leave of an unremunerative, ill-appreciated profession. He straightway turns himself back into barrister, doctor, or clergyman, and becomes speedily judge, physician, or bishop. Pedagogy is the worst rewarded of all professions.

Total want of provision for high technical teaching or teachers.

If our technical university is to be successful, its machinery of teaching must be of a higher and more powerful kind than any we are yet used to in England. For the teaching of our science we must have the most distinguished men our country affords; we must give them an income as large as that of a bishop or a judge; and as their success or their failure is to measure the success in life or the failure of our own children, we must treat them with the same consideration as we should show to a great relation whom we expected to bequeath them a fortune. There is no training for life half so good, as to give the youth an early association with men of genius and ability.

High science.

Having selected eminent men for these distinguished positions, we must next take care that our eminent men are distinguished by three things:—love for the subject they teach; love for their pupils; and love of teaching. You may have the best men, and the worst teachers; and young men will learn little from any man who cares little about their learning. The gift of teaching must then be the second element in our selection.

The gift of teaching.

A third point is indispensable to technical teaching:—knowledge of the purpose and end in life for which the pupil wants his teaching.

For a mere philosopher and for a practical mechanic, the science of physics must be taught in quite a different way. Certain elementary principles are, no doubt, the same for all men and all circumstances, but that is only the purest and most abstract science. To the man of science, the science itself is the end and aim; to the technical man, science is the mere tool and instrument, and what he wants to know, is not the mere science only, but the means of shaping it to his end, and the best way of using it so as to achieve his purpose.

Practical skill.

To aid the technical student, therefore, his teacher must know two things thoroughly, instead of one:—1. His own science profoundly; 2. He should thoroughly know the nature of that practical profession, for the aims of which his own science is to be made useful to his pupils. In scarcely any of our schools is this last requisite adequately recognised or met.

Technical teaching aims always at use.

The essential feature of the method of teaching in our technical university must be, that it shall throughout bear the impress of its ultimate aim and purpose. The forms in which abstract truth is expressed, must be forms easily translated into the language of practice. When a doctrine is enunciated as the seed of important science, the fruit which its cultivation will bring forth must at least be indicated, so that the pupil may understand from the beginning how the abstractions which he takes pains to master are to form tools to enable him with less pains to master greater difficulties. If to the announcement of an abstract doctrine the professor will merely add: "*This* you will find a key to one part of your profession: *that* you will find a tool to such a part of your business;"—these words will be like a silken string to guide the groping student through many a dark difficulty. All through the course of teaching of every profession, the shaping the means to the end must be the special duty of our technical professor.

Technical men for technical teaching.

But where shall we find these twin giants, these two-fold men?—master of the broad and deep truth, and master of the sharp and narrow application;—masters of science, and masters of skill. There are three ways to conquer this difficulty:—1. We must resolutely search our own and foreign countries to find such men, and at any cost we must bring them into our universities. 2. The men whom we cannot find, we must make—in two ways. We must take a man of eminent science, and prevail on him to humble himself, and go study, in the workshop of their fathers, the trades and professions of the children we wish him to teach. Let him stoop to learn the wants of the business of whose principles he is master;—that is one way to make technical teachers. Another is, to take a man already distinguished as the most eminent member of his profession, and prevail on him to qualify himself as the teacher of such science as leads to distinction in his business. 3. Finally, we must at once set about providing the future supply of fit teachers by an organised system in our own university of training eminent men for technical professors. But that is already one of the special departments we have indicated. Unluckily for the rising generation, we are too late, and must improvise their teachers as best we can.

This method of improvising technical professors is not a theory. I have seen it employed with eminent success elsewhere. I have seen a man of transcendant ability prevailed on by his fellow patriots to descend from the heights of pure science and study in humble guise the technical difficulties of a modest trade, in order that he might be able to train the children of his countrymen to raise their country to eminence and distinction, by the application of his profound science to their modest skill. And so I have seen the trade of a district revolutionised. I have also seen the other side of the picture.

A distinguished technical man, in the midst of a prosperous business, has had to abandon the pursuit of wealth and professional distinction, and to undertake the humble duty of teaching his neighbours' children to become as distinguished as himself. I have seen the duty with noble self-sacrifice cheerfully accepted: I have seen the technical man put himself as a humble pupil to the art of teaching; set himself down to study over again the fundamental science and principles from which his teaching must begin; and I have seen him rewarded by the production of students coveted in all quarters for their remarkable combination of theory and practice; and I have myself been astonished by their fertility of expedient, and their ready practical solution of unforeseen difficulty.

The best men in the nation to be taken for teachers.

I will take for granted that we are in earnest in our wish that the best men of the nation should be selected to teach our children their duties in life; that the highest honours we can bestow, social rank and independence, shall be theirs; and I will now indicate shortly the system of teaching which appears to me most likely to meet the varied wants of our youth, and qualify them to follow us in life. I have already said that the whole course of technical teaching must take a hue of usefulness, and that purpose and application must characterise it from the beginning. How this is to be accomplished, will not seem easy to those who have never done it, or seen it done; but to me it seems not only easy, but the most agreeable and efficient mode of teaching. For to tell a youth that to-day's task will one day be useful to him, is to add value to his day's work; and to show him how a principle is to be applied, will both give it additional hold on his memory, and help him to see through its essence and nature; in short, the use will illustrate the theory.

Method of teaching in our university.

It is impossible to demonstrate in a short space how every one of the fifty-six sciences in our table should be taught to youths destined for technical life; but it will, perhaps, be enough if I take a single example to illustrate the whole. I will take for that purpose geometry,—the science of form. There is no science less practical, or more practical, than geometry, according as it is taught. It can be made the least useful or the most useful of sciences. As commonly taught, geometry, the geometry of Euclid, is one of two things—a Chinese puzzle, or a gymnastic of sophistry. Euclid was a master geometer; his book is full of great truths, and is a masterpiece of logic. His logic is not always sound; his method is not always direct; but no man can master Euclid without being the stronger and the cleverer for the task. Nevertheless, to a man whose destiny is practical work, and not mere logic or pure mathematics, I think it great waste of time to chop logic with Euclid, or run up and down stairs after the thread of his argument. Modern geometry should be more direct, more purpose-like, more versatile, than Euclid's.

Illustration from technic geometry.

For the students of a technical university, I should define geometry as the science of form; and I should include in it the theory of geometry, the application of geometry, and the arts of geometry. In theoretical geometry I should include the following subjects :—

1. Elementary Geometry.	5. Higher Geometry.
2. Analytical Geometry.	6. Descriptive Geometry.
3. Quantitative Geometry.	7. Graphic Geometry.
4. Logical Geometry.	8. Perspective Geometry.

9. Constructive Geometry.

Arts giving form to matter.

All this may, in a certain sense, be called theoretical geometry; but all the laws, processes, phenomena, and properties which are thus developed in theory, have their application in the material world around us. We may have a geometry of matter as well as of form; a geometry of force; atomic geometry, and geometry of combination. We may have a geometry of the heavens, of the globe, of land and sea, of earth and rocks. And going on into organised nature, we may have geometry of vegetable forms, geometry of animal forms, geometry of growth. Finally, we may have constructive geometry, geometry of beauty, and geometry of sculpture, architecture, and painting. And in practical life we have the arts of shaping, or the arts of formative geometry; arts which consist in giving form to shapeless matter, or in altering that form—shaping, casting, moulding, cutting, folding, flattening, twisting, bending, stretching, squeezing, tearing, hewing, turning, planing, sawing, drilling, screwing—all arts of giving shape and form to matter.

I think I have said enough to show what treasures of useful application to the purposes of life lie hid, and too often buried, under the word geometry.

How rarely are men found who teach geometry, giving clear views to their pupils of short and sure ways to these practical duties of life through the methods of geometry. Yet such treasures every practical teacher of geometry ought to have in ready store for the use of his technical pupils; and he ought to be able to serve them out in well discriminated abundance to each pupil, according to an intelligent appreciation of the wants of his future life.

I will also illustrate by this one science of geometry the material, apparatus, and the practical machinery of teaching which I think ought to characterise our university. **Material mechanism of teaching.**

Geometry is generally taught in abstraction; for our purpose it ought to be taught by pregnant material illustration. Its forms are usually wide generalities; for our purpose they ought to be rendered definite, embodied in matter, fully developed in all their variety, and thoroughly brought home to the mind in material shape.

The walls of a geometric hall should be covered with classified progressive illustrations of all the most beautiful, curious, and useful forms which human genius has created, or which the geometer of nature has embodied in the works of nature, or enveloped in its laws. The variety of angular form with which a plain surface may be rendered continuous, various, and beautiful, is infinite.

The curves which show the development of law, and embody the most abstract relations of quantity, and which, therefore, express the working of most complicated causes in the phenomena of nature, are so numerous and various, that the walls of the largest chamber would not more than suffice for their adequate exhibition.

But the material illustrations of geometry should not end here. A plane surface can but show the skin of matter. Matter itself must be developed in solid forms, which cannot lie flat, and must be shown in the round, the projecting, or the three dimensions. The geometric hall must contain a museum of solid forms. **Museum of geometry.**

The globe must be developed as the geographer develops his maps, the naval surveyor his charts, and the astronomer his plans of the heavens. But the globe and the elements out of which it grows, and into which it resolves, must be exhibited in the round; and all that we call spherical trigonometry must be not merely pictured on the flat, but embodied as it is in fact. Models of spherical geometry and their developments would occupy a large portion of such a museum.

Another round body, the cone, and the whole family of rectilinear but curved and twisted surfaces, must be exhibited to the eye in their two or three dimensions, in every possible variety, combination, and complication.

Next, the infinite variety of solid forms, according to the model of which every kind of matter in the earth's substance has been modelled with an exactness, skill, and uniformity, that are startling to the uninitiated who look on the matter of the earth as unorganised rubbish, and who do not know that every grain of sand on the sea-shore is an exquisitely plain and polished gem; nor that every scrap of a granite mountain is an exquisitely moulded casting, sharp and clear as a chiselled bronze of Benvenuto Cellini;—these infinite varieties of exquisite material forms must be systematically embodied, not in mere isolated examples here and there, but systematically grouped and continuously organised, so as to exhibit the gradual but clear steps by which each grows into or parts from the other. And so, alone, will any man be able to grapple with that infinite variety of forms in exquisite precision and clearness, which makes of all nature a school of geometry, a laboratory, and a workshop.

But for the forms of organised nature another, quite another, museum is necessary. The living and growing creation with which the nakedness of a once sterile globe has now been covered, made graceful, fruitful, and fertile, abounds in beautiful forms, so fanciful, complex, and variously organised, that even the genius of Linnæus was scarcely adequate to the distinction, enumeration, and classification of the infinite variety of forms of plant life and beauty.

The leaves of some plants illustrate an infinite variety of angular form; the roots and fruits of plants exhibit a marvellous fertility of invention of every kind of round body, of many-faced angular solids, and of endless curved surfaces of single or double curvature. A museum of such forms is that in which the science of geometry may be said to terminate, and in which the poetry of geometry most fitly begins. For in creation the sculptor, the architect, and all makers of beautiful things, must look for the principles, models, and laws, which alone can guide them surely in those works of imagination which, if they be devoid of reason, method, and order, degenerate into insanity, puerility, and vulgar imitation. Thus our museum of the geometry of nature will become the alphabet of our school of art.

Halls of illustration and museums of each science.

What I have said of the hall of geometry may be taken to illustrate also the material mechanism by means of which every other science ought to be made to grow into daily familiarity with the mind of the pupil, by making him pass his hours of leisure or work amid familiar illustrations, systematically developed and methodically arranged, so as to speak through his senses and grow into his mind as familiar objects of everyday life. Such things are already done in some schools, but they are fitfully, fragmentarily, and feebly done; and just because they are not parts of any continuous whole, they do not take hold of the mind and enchain it, but fail in their great object, the development of systematic thought. What I have said of geometry must be done with mechanics. The hall of mechanics must contain a systematic development of every kind of tool the human mind has been able to invent, or that the human hand is able to wield. Samples of the best work that these tools can achieve must surround them, and by this means the student must not only know how to select the best tools, but must have a high standard before him by which to pass judgment on his own execution.

Hall of geometry.

Hall of mechanics.

The hall of mechanics must next contain those more complicated means of working matter which are in effect tools, but which, by means of a complicated mechanism, perform the multifarious operations which a human being has to devote all his skill to performing, and are yet, by their structure, able to do skilled work without skill. Modern mechanism presents an enormous field for the study of the student, and no collection could be more profitable than one which should unite in the same hall, under the daily notice of the student, all those thousand ingenious devices by which, out of a single moving force, an infinite variety of complicated and intricate movements are simultaneously performed. No branch of multifarious modern invention plays a greater part in civilised society than the dead mechanism which is continually performing the work of millions of human hands.

The hall of engines should contain an even more wonderful and instructive collection than the hall of tools and machines. Engines do not merely perform the work of human hands; they create living power out of dead matter, and relieve men from the degrading task of being the mere drivers of dead mechanism. Engines may be said to create living things. An engine of 100 horses' power is an engine able to do the work of 400 living horses, and able to do it not for eight hours a day only, but for twenty-four, and all the year round. The future of the world, and of the human race, depends far more upon the steam-engines and water-engines, the fire-engines and air-engines, the magnetic engines and the electric engines yet to be invented and made, than upon the labour of all the horses and oxen in the world. All mere bodily drudgery of human beings, all mere work by the sweat of his brow, will no longer fill up the duties and form the labour of the lifetime of a human being when all men have been educated to the construction, use, and tending of these helpful children of man's brain; for all hard work, each man will have his helpful engine attending on his steps, following his directions, and working his will. Such a life may be deemed a life of thoughtful leisure—thoughtful, for minding his engines will be no sinecure, for this one will be committing blunders, that will be falling and hurting itself, and his little flock of workers will be always in trouble, in which only their master can help them. Such men will be no more animals, even in the drudgery of common life. They will form the providence of little engines, the work of their own hands, and their functions will be forethought, construction, and inventive leisure. If, then, this be the good time coming, how necessary it is that, in his youth, the student whose life is to be a polytechnichism should be surrounded in his study with modern engines of every sort which human calculation may design, or human invention contrive to render the elements of nature the servants of human will.

Hall of physical science.

The hall of physical science should be a record of every great discovery—an illustration of every great law of matter nature. How solids grow liquids, how liquids grow airs, how airs return to liquid and liquids again resume the solid form, should be shown not only in the ordinary solids, liquids, gases, of the actual world, but also all those solids, liquids, and gases which nature never made in these forms, but which man only has, by the powers of science, created and developed, should be made familiar to the eye of the student. How many men in the world have seen all the liquified gases? How many have seen all the metals?—and has anyone seen the infinite variety of strange matters which the combinations of liquified gases one with another are able to produce? Such collections have existed, have been seen, but by how few!—and what pregnant seeds of future discovery would be the thoughts sown broadcast in the youthful mind by such sights made familiar. So, also, all the sights which in the finite depths of the ocean are continually going on, of matter transformed by enormous submarine pressure out of ordinary semblance into scarce conceivable transformations, might be exhibited to the eye of the student under those intense pressures which human ingenuity and modern mechanism could substitute in this hall of science for the enormous powers of nature working in the bottom of the sea. So, likewise, the phenomena of the air, all that happens in the highest regions of the atmosphere, the life of air in its undulations, the soul of nature in the vibrations of sound, the whole language and poetry of thought, is a field, the illustrations of which would of themselves form a course of familiar philosophy more elevating to human thought, and more helpful to human character, than the lessons of lawyers or the discourses of dogmatists. The hall of physical science might thus become a school of divine culture.

Hall of chemistry.

But of the material means of cultivation for fitting man's mind for his future work, none should be on a larger scale, for none can be more useful, than the hall of the modern magician, the all-powerful alchemist. The halls of chemistry should be as large and various as are the functions of chemical research; and the functions of chemistry are little other than the making of everything out of everything else, to convert a metal into an earth, an earth into a water, a water into a gas, and each gas into several other gases—to make half-a-dozen substances into one, and one substance into half-a-dozen substances; to turn a colourless liquid into a bright-coloured air, and a colourless air into a bright-coloured metal. Such are the marvels of modern chemistry; and if the chemist have not yet turned anything into gold, it is because he knows how to make everything else, by some transformation or other, into something more valuable than gold. Out of every gross, vulgar, filthy mass of shapeless matter, your chemist can extract some pure ethereal valuable essence. His wand is a divining rod, and the chemists' hall may be called—what, in our school, it ought really to become—one grand transformation scene. No school of our university would be more fascinating, or could be more instructive, than the hall which exhibited the successive transformation of every known substance in its passage through the chemist's hand, and an exhibition of the uses to which every portion of transformed matter has been, is now, or will be put. And in the adjacent hall would be the school of the young magicians actually employed in acting these transformations; and on the other side another hall, where the elder magicians were busy inventing the transformations of the future.

Hall of astronomy and geology.

Perhaps the grandest hall of all should be the hall whose transformation scene is the chemistry and mechanics of the Great Chemist and Mechanic of the Universe. How He made planets, how He slowly matured them, how He fitted this our planet for life, intelligence, and humanity. How He stored up in the slow progress of ages crop after crop of forest timber, generation after generation of microscopic shells, millions on millions of polished crystals, all kinds of metal and oil, and fuel, and even food. How He engraved in the bowels of the earth on stone tables the story of His work for our reading. How He set glaciers to hollow out valleys and gather together] the slow-grown soil into fertile heaps in the bottom of our valleys and along the sides of our streams. How He set the waters and the lakes to fetch down soil and deposit vegetable matter on the surface of vast areas of water-worn gravel; and how, when they had done, the streams were set to saw out sluices and gates for emptying these lakes and bringing to light those fields covered with alluvial deposit; and how upon all this, in the end, were laid for the human habitation the rich velvet carpet of green sward, the decorative embroidery of plants and flowers, and the tasselled fringe of orchards and forests; and how all this became food, furniture, and fire for human beings endowed with power to understand the past, to govern the present, and to foresee the future—how all this was set about and done is a story to be told in the enblazoned halls of the geologist, and is a tale so long and so eventful, that no hall of learning could be more eloquent, no hall of theology more pregnant, than this same school of God's work in nature.

Coming down to the world of things that are from that of things that have been, the student of the world of nature as it is, must revel in a garden of living plants rather than ruminate in a museum of dead ones. And though much may be learned of the vegetable world in a museum, it is plain that the gardens of Kew are much more nearly the type of our School of Botany than any museum of dry specimens.

Hall of nature.

Botanical gardens.

In choosing the site, therefore, of the university, the possibility of surrounding it with a large, beautiful, and instructive garden, should not be forgotten.

An observatory, not only of the heavens, but of those magnetic and electric phenomena which now form so large a portion of human knowledge, and even play an important part in human life, is necessary, placed in a separate building, and might have a convenient site in the gardens of the university.

Astronomical, electric and meteorological observatory.

A zoological and anatomical collection, a museum illustrating the technical history of mankind, an historical museum of works of art, would also find their place in the university.

Hall of zoology.

It has been a serious question whether actual workshops and manufactories of any kind should be attached to technical schools. That is not a matter for dogmatism either way. In a manufacturing country, surrounded by technical establishments in which students might do actual useful work, workshops for the mimicry of work would be absurd. The method which I myself prefer for teaching technical students' work is to place them, for alternate periods of six months,

Chemical and mechanical laboratories, drawing schools and workshops.

Experimental school.

in the university and in the workshop, where each enhances the value of studying the other. And if the Government which establishes the university should happen also to possess establishments in which work is well done, nothing could be wiser than that the students of the university should learn their work in establishments which should be made models of perfect design and execution.

But if good establishments and well-organised workshops are not accessible to the students, then common wisdom dictates that such workshops would be of special value, and might with advantage be created in the university itself.

Independent, however, of what may be called workshops and manufactories, in the commercial sense of the term, there can be no doubt that a certain number of workshops, well supplied with tools, materials, and models, should be at the disposal of the students for mechanical work in leisure hours. Moreover, there are a great number of mathematical and physical researches which are studied with much greater advantage in actual work than by abstract illustration. Of the value of a practical chemical laboratory on a large scale there is no longer any doubt; but it is equally certain that sound ideas of physical, mechanical, and constructive properties of matter can nohow be obtained so well as by the actual construction and destruction of material forms of different kinds of substance.

Strength, toughness, elasticity and endurance, adhesion, attraction, friction, and sliding, are all properties of matter, practical familiarity with which is only to be obtained by familiar handling. And the phenomena of tearing and wrenching can only be known to those who have painfully wrestled with matter and been able to force its obedience or endure its successful resistance. A practical school of mechanical dealing with matter is, therefore, one of the most important establishments that can be attached to a practical school of mechanics, and one that has as yet nowhere received the full development which it merits.

School for original research.

There is one last institution which our technical university might do well to distinguish itself by establishing. It has already been indicated elsewhere, but has nowhere received adequate development. A student who has just completed his curriculum at the university may probably desire to extend his studies beyond its limits; he may be a man of leisure or of genius, possessed with the desire of original and ulterior scientific or philosophical investigations. It should be a privilege granted to the students of our university that they have privileged access to the workshops, laboratories, halls, museums, and library of our technical university, for the purposes of continued education, original study, and investigation. And the university might even possess pecuniary funds which it might have the privilege of placing at the disposal of young investigators of distinguished talent and knowledge, to aid them in such original investigations. They might thus assist young men of genius in the beginning of a brilliant and useful career.

Apparatus for illustration of teaching.

In conclusion, among the establishments of the university it has been thought unnecessary to do more than merely name the existence of an extensive library of technical books, and an extensive collection of technical drawings on a large scale, fit for the lucid illustration of the courses of lectures; as well as of a large cabinet of special illustration or experiment for each particular branch of study.

Good teaching will employ many methods and various instruments.

On the whole subject of methods of teaching, and of material illustration, I desire to emphasise strongly the value of education by the eye, and of education by practical experiment, as the basis of sound scientific education. Nor need I be accused in so doing of undervaluing abstract teaching, and pure ideal reasoning and calculation. I trust I may be permitted to insist on the value of all the ways of teaching, by all the avenues of thought, without being accused of undervaluing any. What I blame in most of the institutions I have seen, is the weakness of one-sidedness. One university is famous for its pure mathematics, another is famous for its experimental chemical research. What I want is, that our university should be famous equally for abstract reasoning and experimental research; equally for teaching the head, the hands, and the senses; equally for persuading by reason and by experience. And in regard to the order of the teaching, I think that the best method is—first, to teach students what they are to expect; next, to show them what actually happens in fact, under their own observation, and by their own experiment; thirdly, to teach them the reasons of that which they have already found to be the fact; and lastly, to teach them the methods of predicting that which has not yet come to pass. It is this union of education in fact, with education in thought, which gives to the human mind the empire of matter.

CHAPTER XVI.

OUR ENGLISH TECHNICAL UNIVERSITY—ITS GOVERNMENT, WORKING, AND FINANCE.

Knowledge goes from above downwards in society, not upwards.—High education above must raise education below.—Money value of education for a nation.—Past war costs twenty-five millions per annum.—Coming wars cost twenty-five millions per annum.—What should the culture of all England cost? five millions?—A grant for technical universities of two hundred and fifty thousand pounds.—Government of the technical university.—Table of finance.

Knowledge goes from above downwards in society, not upwards.

THERE is no truth concerning knowledge less understood in England than that knowledge must begin in the higher regions of society, and descend. Yet, if we listen to the commonplaces of political economists, and parliamentary conversations, one might think that knowledge begins at the bottom of society, and taking root among the mass, sends its branches upwards into the regions of high life. "The man who would have knowledge must first seek it; the parent must see to the education of his own child." "The poor man must spare his beer if he would have schooling for his children." "Those who will not have learning must take the consequences of going without." Such are the platitudes which men in legislative assemblies dignify with the name of common sense.

Nothing can be more common or more devoid of sense. It is saying: The ignorant must be wise; those who know nothing of knowledge must set the highest value on it. The most ignorant must be most ready to make the greatest sacrifices for knowledge and virtue. The foolish must show an example to the wise.

That knowledge must proceed from those who know, civilisation from the civilised, refinement from the refined, truth from philosophers, technical skill from the most highly skilled, and learning from the learned, one would have thought axiomatic; although those who speak falsely, in the name of common sense, say otherwise.

In these matters it almost seems as if the generation before us were wiser than ourselves. Men whom we call barbarous and unlearned founded free schools, free colleges, and free universities, empowered by the sanction of the State, ennobled by privileges, and endowed with vast wealth, in order that the most learned and the wise of all England, and the most distinguished teachers from beyond the seas, might be planted in England to civilise, educate, and refine the common English people.

Our forefathers thought that the rich and the wise were able to take care of themselves; that they knew what learning to choose, and had free choice where to seek it; that what they could not find at home, they could send their children to foreign universities and courts to learn. But they thought it the duty of those who governed and guided the people to erect free fountains of truth, knowledge, religion, and refinement, in, among, and throughout the masses of poor English folk, and to bring knowledge home to every poor man's door. That was the practice of poor old England; it is the contrary of the practice and the preaching of rich modern England. It is the direct consequence of such wrong doctrine, that England has fallen behind other countries in the condition of its industry-loving, hard-working people.

High education above must raise education below.

Perhaps I am too sanguine when I express the hope that there may soon arise in England legislators sufficiently raised above mere demagogy on the one hand, and mere condescending aristocracy on the other hand,—legislators taking wider views than the narrow interests of political party, giving themselves concern and assuming responsibility for the purpose of elevating and lastingly benefiting the English people;—legislators who will esteem mankind more than matter; who will value cultivated human beings more highly than cultivated horses, cultivated dogs, or cultivated vegetables;—men who will consider human souls of greater weight than cotton bags, or grey shirtings. I hope such men may soon arise in England, and that they will not think it beneath the duty of governors to see that the rising race of English people do not suffer from their governors the same neglect of culture which the passing generation of skilled men have had to endure; and that they will not think it beneath their dignity to see that the youth of England shall enjoy at least equally valuable privileges, assisting them to fulfil their duties in life, as the most favoured nations abroad. Should this happily be the case, we might hope to see our technical university founded on a scale worthy of the dignity and wealth of the nation.

Money value of education for our nation.

The first question, then, which an English legislator would ask, would be,—How much money ought to be voted for the education of the English people, in order to put England on the same footing as the best educated nations abroad? To this my answer is easy. I have before me the national expenditure of Switzerland. On the same scale the annual vote of England for education should be more than 5,000,000*l.* per annum.

Past war costs twenty-five millions per annum.

When will England be wise enough to save this five millions out of the pauperism and crime which the want of it costs her? The contrast between England and Switzerland is this: that England spends more than five times as much on pauperism and crime as she does on education; and that Switzerland spends seven times as much on education as on pauperism and crime.

Coming wars cost twenty-five millions per annum.

Whenever I have asked a public minister connected with education in England, why he would not do more for the education of the next generation, I have always been answered that the House of Commons would not vote the money. That the House of Commons which willingly votes twenty-five millions for past wars, twenty-five millions for coming wars, and seventy millions in all for what it calls the government of the country, grudges the one million it already pays for education, and thereby entails on the people a further cost of seven or eight millions for pauperism and crime. What a strange and inconceivably inconsistent people we must be, or how strangely and inadequately we must be represented in the House of Commons, if the education of the whole people for all the duties of life seems only worth a million a year, and preparing them for war alone seems worth twenty-five millions a year, and for prisons and poorhouses worth seven millions a year.

What should the culture of all England cost?—five millions?

I have said that five millions a year, if wisely expended, would be about the same proportion of its public expenditure in England which the Swiss Government expends on education, and applying the same measure, 250,000*l.* a year would be the sum which the English Government ought to expend on its technical university. But in this sum I include Ireland and Scotland, and if we say 50,000*l.* for a Scottish University, 50,000*l.* for an Irish Technical University, there remains 150,000*l.* a year for the Metropolitan Technical University. Following out our Swiss analogy, one-third of the latter sum should be expended in providing the teachers of the university, and the remainder on all the material apparatus for teaching which has been the subject of the last Chapter.

A grant for technical universities of two hundred and fifty thousand pounds.

But I shall be told that the revenues of our university ought to be in great part drawn from the pupils. To this my reply is, certainly not. The pupils are no longer children, but men who might, if they chose to abandon study, be earning their own bread. They make sacrifice enough, they and their parents, in abstaining from work that they may attain to that superior knowledge which shall enable them to maintain England in the front rank of working nations. The nation should be only too happy to do the rest, as other nations do.

The students will no doubt contribute something towards the current expenses of the institution, but that sum should be comparatively small, and should be, as in other countries, in addition to the sum contributed by Government. In Switzerland it is only one-fifth of the total sum.

On this scale, the students' contribution to our technical university might be 30,000*l.*; or 10*l.* a year each from 3000 students.

In regard to the expenses of founding this university, that would have to be done from quite other resources. But in these resources, England is already sufficiently rich. A useless unoccupied palace with its park could with little pains and cost be converted to the uses of our university. Greenwich Hospital, Hampton Court Palace, Kensington Palace, are each capable of easy conversion to this use. In my opinion, Greenwich Hospital presents the greatest number of advantages for this purpose. There is a large park at hand for playground and gardens; there is an observatory for astronomy and meteorology quite close; there is ample space for healthy lodging on Blackheath Common; and all round are works and manufactories of the best character for practical illustration and students' work. It is also at a convenient and easy distance for professors who might choose to reside in London; and it is now pretty well understood that no greater kindness could be conferred on its present poor inmates than to release them from a palatial prison, and send them to their homes and family firesides. By the adoption of this measure great present outlay might be spared, immediate accommodation given, and a change rapidly effected most beneficial to the community.

Of the expenditure on the Irish and Scotch technical universities I need say little, for the Universities of Dublin and of Edinburgh and Glasgow have already shown willingness to create within themselves technical divisions of their own universities. They already possess distinguished technical professors, and are already renowned for high technical teaching, in a way which shows their perfect ability to add to their existing curriculum a complete technical organisation, provided only the Government is wise enough to give them their annual grant, and to take measures for the material organisation of buildings, collections, museums, and other teaching materials.

Government of the technical university.

Having provided university buildings, gardens, establishments, and the material organisation of teaching, the next duty would be to provide for the personal organisation of the university. The selection of a proper ruling body and a corps of eminent teachers for the university, is too important to be delegated. The Government must take the direct responsibility of naming every professor, and choosing every member of the governing body. There should be a governing council of the university, but every member of it should be named by the Government; and the Minister of Education himself, or his chief secretary, should be a constant member of this governing council. The members of this council should all receive salaries and do work. It is desirable that the president should be a man of great administrative ability, rather than a man of science or a professor. He is to represent the wants and interests of the country rather than of any branch of science. He has to communicate with the Government, and is virtually its representative at the council. He advises the Government on the selection of the professors, on grants of money, and on laws for the government of the college. He should have a peculiar talent for discovering good teachers, should be popular with the students, and should possess the rare tact of dealing with professors and men of science —a class with whom dealing is in general peculiarly difficult. Such a man, when found, deserves a salary of 2500*l.* a year. He may also name his vice-president from among the council of the university. A council of seven is sufficiently large; and one of them should represent the mechanical professions, another the fine arts, another the manufacturing, another the mercantile, the political, the literary, and the philosophical. This council must not name, but propose professors for the selection of Government; and it must determine the special duties of each professor, the amount of his salary, and the conditions of his promotion or retirement. It must regulate the expenditure of the sums placed in its hand by Government, and in short, rule the university.

The Government must take no steps in the affairs of the university without having first taken the advice of this council. No subordinate in the department of the Minister of Education shall have anything to do with this school; but it is the president of the governing council of this university who must be practically its manager. The direct superintendence of the whole course of teaching, the organisation of courses of study—fixing the hours for the different subjects, organising the curriculum, examinations, diplomas, and discipline of students, all must be under the president; and to him every professor is directly responsible for the performance of his duty. For this purpose the president must reside on the spot, and devote his whole time and attention to his duty.

While finance organisation and police are to be the special duty of the council, it will be equally necessary that they abstain from all interference with the teaching body or professors in the discharge of their special duties. The teachers must necessarily have an organisation which will enable them to arrange their special spheres of duty with due reference to each other. There must therefore be ordinary meetings of professors, to settle the details of courses of study, hours of lectures, and subjects of examination.

They must prepare outlines of courses, and arrange that what is taught by one professor is not to be taught by the next, and see that the courses, taken as a whole, are complete and symmetric. It shall be their duty to present each year an organised programme of studies for the approbation of the president and council.

This body of the professors should also select from among themselves a principal, who should sit at the governing council to represent their views and feelings. The same principal should preside at their meetings, and should be elected bi-annually. The professors should also be divided according to the subjects they teach. There might be divisions of the professors into physical sciences, natural sciences, literature, philosophy, fine arts; and to each of these there should be a separate vice-principal elected by themselves. It would be their duty to distribute properly amongst each other the duties of each special division, and their principal should be charged with the superintendence and administration of the teaching and material organisation, establishments and museums, examinations and examination papers, belonging to that division.

All the duties not provided for in any of these arrangements should remain as the special duties of the president of council; and nothing should be concluded in any of these divisions without communication to, and approbation of, the president, who should be *ex officio* a member of every subdivision of the university, and attend all their meetings.

The admission of the students, their discipline, the adjudication of prizes, granting of diplomas and personal distinctions, should be the immediate duty of a council composed of the principals of divisions and the president of the council. These appear to me to be the principal conditions which experience has shown to be necessary for the successful government of such an institution; and it appears to me that by a fit selection of the individuals, all the interests of the country may be represented and brought into harmonious working. I think it important that all these governing duties should have salaries attached to them adequate to confer upon the duty high personal responsibility.

TABLE OF FINANCE.

INCOME.

Annual grant from the State	£150,000
Annual vote from the city	15,000
Students' fees	25,000
Endowment?	5,000
	£195,000

OUTLAY.

Government and staff of the university	£ 15,000
Salaries of professors and teachers	100,000
Collections, illustrations, materials	45,000
Laboratories, workshops, observatories	20,000
Grants to original investigations	15,000
	£195,000

CHAPTER XVII.

THE CONNECTION BETWEEN SYSTEMATIC EDUCATION AND THE TRANSITION PERIOD OF CIVILISED COUNTRIES.

Changing material conditions.—Changing relations of men and nations—Require changes in our own culture.—Knowledge which was supplied for the past worthless for the future.—Training required for the future.—Foreign tongues wanted for wide world commerce.—Requisites of the rapid revolutions of modern trade.—The universal adoption of machinery for works of mere routine and brute-force.—Revolution in sea-faring life.—A revolution in commerce.—Principals and middlemen.—Loss of value to the public.—Loss of character to the producer.—Necessity of higher training for the merchant and manufacturer.—A moral revolution in commerce and trade.—A revolution in mechanical engineering trade and public works.—Revolution in chemical trades.—Higher morality of an educated and skilled community.

Changing material conditions.

THAT "the present" forms a transition period in European life, who can doubt? We have had revolutions in science, in politics, in means of intercourse of nations by sea, in transport of goods and persons by land, and in the transmission of thought from place to place with such an annihilation of time as to give the human being almost the advantage of omnipresence. Each morning we hear everything that has happened everywhere yesterday; and we shall soon be able on every to-morrow to make our wishes and commands known at any centre of action to which an iron wire can be carried, all round the globe.

Changing relations of men and nations;

How all these changes have altered the relations of men, communities, nations, to one another, most of us have had ample opportunity to know; and those who have travelled most know best that every one of these material revolutions has brought about moral, social, and political changes. Who that knew Germany before railways, and since, can fail to have noticed that it was the railway which first effectually made the Germans known to one another, and that the German military system and the needle-gun only completed that unity which railways had begun.

Require changes in our own culture.

These revolutions have been brought about mainly by discoveries in science of the laws and forces of material nature, and by inventions for rendering these forces the servants of man. By science, the sphere of knowledge has been indefinitely increased; by invention, human power has been indefinitely extended. But along with this increased power comes the necessity for increased human capacity, wisdom, virtue, forethought, and foresight—otherwise, the consequences of ignorance and folly will become magnified in as high a proportion as the increase of power or of means. We of the present day, standing on the brink of this period of transition, and seeing before us a world of the future, of which we know at least this—that it will not resemble the past, have need of all our sagacity to single out from the future the aims which are good or bad—the ways which are wise or foolish, the methods of conducting our affairs which will benefit our family, our community, our nation; and the great question comes home to every one of us—how shall we train the children who are to succeed us in this world, changed by science and invention, for the wide field of responsibility and action which lies before them?

Knowledge which was supplied

The obvious answer is, that we must use some quite other method of training than that which we ourselves have received. In our youth it sufficed to train a boy to his father's business, that he should inherit his connection in trade or his skill in craft; that he should grow up in his counting-house, workshop, farm, or ship. For the new generation that training not only is inadequate, but even worse than the want of it. The aims and methods of the future and of the past are altogether distinct, and the education of the future has to be created, not changed.

for the past worthless for the future.

The first condition in the training of a man who is to fight his way in the future, is that he shall be able to understand and make himself understood in any of the civilised countries of the world. No young Englishman of the present day knows among whom his lot may not one day be cast. Is he an agriculturist?—he may have to find his farm in Upper Canada, and may have to use French as the language of his daily life. Is he an engineer?—he may have to make railways in Italy, Turkey, or Japan. Is he a merchant?—the nature of his merchandise will at once indicate three or four languages, the knowledge of which may prove the means of his earning or losing a fortune. It is indispensable to the man of the future that he should know well, familiarly, conversationally, one or two languages besides his own; and this is true not of the upper classes only, but of the skilled craftsman; for the well-trained workman who knows one foreign language will have an additional market for his labour. It is this early gift of foreign tongues which enables the German craftsman to earn his living here, when he finds himself badly fed or clothed at home, and the Swiss peasant to find comfortable quarters in many lands. The Englishman who would qualify himself for the future, must con-

Training required for the future.

sider one or two languages as part of the implements of his tool-chest.

To our insular notions such an idea is probably Utopian, but my answer is, that the English boy is surely not less competent for this task than the Swiss or German boy, where every child in his "real" school learns to speak, read, and write three tongues; and I would entreat the working community to consider how this acquirement would help them in case of difficulty regarding wages or employment at home: the solution is simply to shift himself and his tool-box abroad, and get employment there until the return of better times at home. At present, his ignorance of any tongue but his own renders the experiment nearly impossible, and the educated foreigner displaces him at home without risk of reprisal.

Foreign tongues wanted for world-wide commerce.

To be able thus to shift the place of our occupation, and find fresh markets for our industry, is not the only preliminary to a successful life in the future. We must be so educated as to be able without great suffering to change at any moment the whole nature of our trade, craft, or profession. Are you to-day a chemical manufacturer, skilled in the production of a valuable article of commerce? To-morrow a chemical discovery may annihilate your trade, transfer it into a new class of substance, or a new locality; and if you are either obstinate or unprepared—if your knowledge be scanty, and your views narrow, your business will pass into abler hands. Are you a manufacturer?—a new loom, a new material, a new process, a new mechanical power, may at once deprive your present stock-in-trade of its value, and you will have to begin life again: it is probable that twenty-five years hence neither the implements, processes, nor materials of any trade will bear a close resemblance to the present.

Requisites of the rapid revolutions of modern trade.

One of the most prosperous mercantile and manufacturing firms known is one which has practised the doctrine I here preach. Placed in a continental port, which has a world-wide commerce, the heads of the firm are mainly occupied with the consideration of the future, while the subordinates are engaged in carrying out the business through principles already matured, and with connections already formed. They are preparing to withdraw from any branch of business in which they see other people beginning to overtrade, or in which competition seems likely to become excessive; their time is mainly occupied in searching out the probable future wants which the increase of commerce and population, and the spread of civilisation, are likely to create; and I have known them in the last twenty-five years enter upon five successive businesses, having no relation to each other, and in all they have succeeded, and have realised considerable wealth. Their method has been not to touch a business until they had thoroughly mastered its theory, and never blindly to entrust business to their *employés* without first mastering it themselves.

The universal adoption of machinery for works of mere routine and brute-force.

Following their example, let us study the great changes which are about to come over the mercantile and manufacturing interests of this country, in consequence of the science, discoveries, inventions, and rapid communication which are going on. No one of these changes is more marked than the employment of machinery instead of manual labour. What will be the effect of this when it is more fully carried out? Will human labour be increased in use and remuneration, or diminished? Experience and judgment both say that each invention for superseding labour will change its nature rather than its quantity. When every man has his machine to do his work, instead of his horse, his donkey, or his spade, his machine will do more work than either, but will still want his mind to think for it, tend it, and see before it; his machine and he will do more work than before, and earn more money, but he will want knowledge and skill of quite a new sort—for he will require to understand the machine as well as its work, and the consequence of his neglect will be much more expensive than before. From the greater quantity of work done, somebody will reap more profit; whether that increased revenue fill the pocket of the tender of the machine, its owner, maker, or inventor, is a matter of uncertain adjustment—but that among them the fund of joint earning is increased, comes of the nature of the improvement. More money has been earned by railways than by all the horses and coaches of the world put together. Sewing-machines form an admirable proof that modern invention creates the necessity for higher education. Women earn more money by sewing-machines than by their fingers; but their success is proportioned to their intelligence. And a superior sort of intelligence is requisite; for the worker must understand her mechanism, must keep it in order, must see that it does not injure itself nor its work, and must be able to remedy slight derangements in both; and in proportion as the machine itself becomes more developed, it will require more thought and higher instruction.

Revolution in sea-faring life.

A similar revolution, on a great scale, is coming over the business of the sailor. Every year steam ships displace sailing vessels more and more; old sailors complain that nautical skill is less and less required; instead of practical navigation, three kinds of skill will alone be necessary—the skill of the engineer, for the marine steam-engine; the skill of the astronomical calculator, for the ship's place and way; and the skill of the meteorologist, for tide, wind, and weather. In all these departments higher skill is required with every improvement and invention, and in that, as many other branches of mercantile improvement, the only thing still wanting in order to render practicable far higher improvements than have as yet been achieved is, that all the people connected with owning ships and using them should receive a higher intellectual and moral training than they now possess. Higher speed and higher economy are far easier to achieve by invention than they are to maintain and conduct with security, owing to the deficiency of high-class men to work them. Character and skill prescribe much narrower limits to improvement than powers of invention or laws of nature.

A revolution in commerce.

But the improvements in communication between distant persons and countries are about to give rise to indirect and remote consequences far more revolutionary in their nature than their immediate and direct consequences. It is not many years since the prompt conveyance of messages was the monopoly of a few large mercantile firms. The state of the markets of Europe was conveyed in critical times to those houses only which could afford to maintain adequate establishments of carrier pigeons, and therefore these houses had a monopoly of profitable exchanges. In those days also communications with important parts of China and the East was the monopoly of those who could organise their own conveyance, and thus vast fortunes were accumulated in the hands of a few large firms. We can all remember also when the newspapers and the great bankers kept special steamers on the English Channel, by which to anticipate and turn to profit every change of mercantile value. All this has gone by. The whole multitude of mercantile dealers in every market of the world has now earlier intelligence than was possessed by the wealthiest monopolist of old; and the smallest order flies with the same speed as that for millions. This is on every side a subject for complaint or congratulation—complaint from those who used to make large fortunes with small merit and scant knowledge; congratulation from those who possess skill without large capital. The young, skilled, educated houses are now able to make moderate fortunes and retire from business with a youth still unexpended.

Principals and middle-men.

But while this tends to increase the number of well-to-do firms, and to diminish the magnitude of fortunes acquired, another change is at work, which will have a contrary effect, and will throw out of employment a large class of persons hitherto reckoned among the mercantile class. The existence of large monopolists of information and capital had given birth to a large number of secondary or dependent occupations, having for their object the distribution or collection of these large transactions. Between the great merchant abroad and the great manufacturer at home, as also between the producer and the consumer, had grown up a multitude of middle-men, not capable of adding anything to the value of the article produced, or of enhancing the value of that consumed. These men served, and still serve, an important purpose. The man who has too much to do to attend to his business, they enable to do it by proxy, and by various contrivances they make it easier and pleasanter for him to employ them than to do it himself. By judicious contrivance also they make it very unpleasant for the man who has once employed them to dispense with their services; for, like other trade combinations, they organise themselves, and have their black sheep and their white. Layer upon layer these middle-men are to be found in every mercantile community, interposing a series of obstacles to a mutual understanding or community of interest between producer and consumer. In proportion as these combinations become powerful and numerous, they encroach more and more upon the profits of the producer, for by their extensive ramifications they contrive to command the market of buyers, so that the man who will not sell to them finds it difficult to sell at all; and, in like manner, the consumer who wants to buy has immeasurable difficulties placed between him and the man who creates the article he wants; so that each hand through which it has to pass diminishes, by a perceptible quantity, the article which the consumer is to receive for his money; and thus it has happened that these middle-men, whose sole art, business, and craft it was to keep producer and consumer asunder, had gradually absorbed a greater part of the profits of both, and when in bad times both were losers, the middle-men still gained.

Loss of value to the public.

So profitable had this business at last become, that in times not altogether gone by many of the old and great names that had formerly belonged to our merchant princes, who had prided themselves on owning their fleets of ships, equipped magnificently, commanded by captains of skill, navigated by the best sailors, rarely shipwrecked, and rarely insured—the buyers of foreign produce in every market of the world, and the sellers of British manufactures with a name and character that carried them unquestioned everywhere—these men at length yielded to the temptation of ceasing to own their own ships, buy their own manufactures, select their own produce; and, giving that all up to middle-men, ceased to be anything but drawers of bills and acceptors of acceptances. Instead of owning their own ships, they found middle-men to seem to own them, the real owners degenerating into mere mortgagees of their value. The middle-men, to earn their money at once, took a second-rate captain, a third-rate crew, and a fourth-rate outfit, and being obliged by their contract to insure to the full value of the ship in favour of the mortgagee, the mercantile navy speedily descended through the middle-men to its present lowered morality, and unsatisfactory remuneration. Shipwrecks became common, fraudulent insurances ordinary, and so our merchant princes ceased to reign; they merely drew bills and endorsed acceptances.

Loss of character to the producer.

And here the mischief has not ended, for the shrewder and younger among those who had been merchants were not slow to see that what they had given over to the middle-men had, in fact, become the profitable part of the business; they determined to add the respectability of their names to the inferior business of middle-men, and so firms that had begun as princely merchants ended as mere firms of huxtering middle-men.

Now, with the progress of personal education, of individual skill, of technical knowledge, with the extension of the use of foreign languages, and with thoroughness in business knowledge of all our youth, there seems a probability that this whole class of unskilled but voracious middle-men will disappear. Already we begin to find buyers in the distant markets of the world making great efforts to discover and get into closer connection with the trustworthy and skilful man, who is the true producer of the goods they wish to buy; and, in like manner, the buyer at home is beginning to find it his interest to enter into more close relationship with the foreign merchant from whom his goods must come; and in every department the sense is becoming stronger that the producer and the consumer would both greatly benefit by taking direct advantage of the organised methods of speedy communication, and that the man who knows how to produce an article, and he who knows how to put it to use, are the only two persons who have a right to share the advantage of their exchange.

Necessity of higher training for merchants and manufacturers.

When this conviction becomes general, it will produce a revolution in all trades; it will require every man to be a skilled producer or a skilled consumer. Society is full of indications that this revolution is nearer than we apprehend; those who look for it will see indications of it everywhere around them. Almost while I write this I have been travelling with a young mercantile man from the City, who volunteered to say to me that recent keen competition, and the consequent bad times, have made him look about him in the hope of bettering himself, and that he finds out that for years the profits of his trade have gone to persons who never did anything to earn these profits; that some middle-man, who happened to have an intimate friend

A moral revolution in commerce and trade.

—a bank director, some bill discounter, who had set up a dependent of his own in trade, some packer of goods, or shipping agent, or broker—had come between him and his principal in all his transactions; that as a consequence he had been rubbing up his scanty French; he had just made a journey to meet face to face some foreign correspondents, and that they had mutually agreed for the future to deal directly with each other, and emancipate themselves from middle-men; that on his return home he had found out that great impediments would be put in his way in every direction by middle-men and their backers, but that he had determined to persevere, and that several of his friends were now following his example. Everywhere around me I find this under-current, but its expression is seldom made openly, for fear of present inconvenience. Having watched the progress of what I consider the false system of commerce prevalent in England for so long a period, but during the last ten years pregnant with so much misery and calamity, I am satisfied that, for the benefit of society and morality, it should have a speedy end.

A revolution in mechanical engineering trade and public works.

The evil under which society has laboured has been this—that the transactions of mercantile life have passed out of the hands of educated, skilled, and accomplished men, into those of vulgar, uneducated, and therefore unscrupulous agents—the tools of men behind the scenes, who grasp the profits others have earned. As this system has now tumbled to pieces, and shown us the national ruin to which it conducts inevitably, there seems to me a hope that a unanimous effort will be made to reconstitute every kind of technical business on a new footing. The basis of this new footing will have to be extended systems of education, corresponding to the extended spheres of action of modern times. The man of skill who creates or discovers that which is valuable to another, will take pains to put himself in communication with that other only who has knowledge and skill to make a good and wise application of it; each will assist the other to gain the enhanced reputation due to character, responsibility, and skill, and we may return to that high state of commercial reputation in which the name of the English maker and the name of the English merchant were a guarantee all the world over. There will be war between skill, knowledge, meritorious production, and judicious selection, against speculation, finance, irresponsible merchandise, and intermeddling middlemen.

In machinery and engineering a similar revolution is at hand. For want of skill in the user, from want of judgment in the buyer, from ignorance of the true aims and objects of machinery and of public works, they, too, have become objects of mere financial manipulation. A railway has ceased to be an achievement of mechanical skill, in which a path was to be found for a country, or for adjacent countries, through arduous difficulties; to be overcome by talent, with economy of means, and high durability, efficiency, and security. A national railway has descended into a mere manufacture of financial paper—paper to be sold in the Bourses or betting markets, with value scarcely ever real, but from the beginning fictitious; having a capital which is not the true capital of the undertaking, but a fictitious capital created for quite another purpose; having an engineer who is not an engineer in the sense of knowledge or skill, but a calculator having capacity of figures and pliability sufficient to adapt his technical estimates to the fictitious capital of the undertaking; a railway to be made by a man who is not a practical constructor, skilled in the economy of means and labour—knowing how to find, fetch, and place the materials in the best, most effectual, and permanent way, but a nominal contractor knowing how to manipulate, not the materials of construction, but the fictitious paper of financiers; a man knowing in the ways by which materials that are cheap shall play the part of materials that are dear; a man, in short, who knows how to make a railway that will sell, but not wear. These are the sort of public works and the kind of enterprises in which the uneducated and unscrupulous have engaged the capital and the character of the British merchant, engineer, contractor. For them, also, let us hope that a new era now opens. In that era we may look forward to the time when a public work will only be undertaken when it is manifestly for the public good; that it will be considered with strict reference to the greatest economy of capital; and that the wealth of the nation shall be hoarded and employed with the same scrupulous parsimony which distinguishes a man in his private affairs. That the design of the national work will be confided to the most competent and skilled engineer, and not to the most pliable and accommodating calculator, and its execution to the most skilled and thorough workman instead of the cheapest and most reckless undertaker.

Revolution in chemical trades.

In the world of chemistry, also, we must prepare for new times, processes, and trades. Whoever watches the progress of chemistry sees that nearly everything is going to be made out of everything else, and that the manufacturer who is bred to know nothing beyond that branch of a chemical trade to which his father has trained him will be nowhere in the race of life. I find everywhere the educated nations of Europe establishing outposts far forward in the field of chemical discovery; large sums are lavished on chemical observatories, where, from the highest summits of modern discovery, philosophers are placed on the watch for symptoms of future discovery, and whence they give to the workers below early warning of coming change in the atmospheres of electricity, magnetism, galvanism, light, or heat, which may cause a revolution in some department under their charge, in manufactures, industry, or science. Thus forewarned, these nations are forearmed.

Higher morality of an educated and skilled community.

In concluding this review of the prospects of technical knowledge and skill through the life of the coming generation of Englishmen, we have noticed merely some of the most prominent and inevitable social changes which indicate the necessity for better preparation in our youth to meet the times to come. In our opinion, the philosophers are far before the people in foreseeing the times that are coming, and the people don't take warning, because they are not educated. Agriculture is in revolution, for agriculture is becoming chemistry, and husbandry is becoming machinery; yet our agriculturists have not become chemists, nor our husbandmen mechanics. In common trades a revolution is coming; for all that is done without skill is going to be done by dead machinery, not by intelligent men; and it is well that it should be so, for mere routine processes, requiring brute-strength, without refinement or intelligence, can all be better done, more evenly, regularly, and unvaryingly, by dead matter than by living force; and it is, moreover, better for the intelligent and moral being that he should not be degraded to the level of the brute elements, or lowered to the rank of an unsentient machine. Why should a human being be doomed to spend his days in mounting and descending a ladder with twenty-seven burnt bricks on his shoulder, while, at one-tenth of the cost, a machine, made of iron, and fed with coal, will do the work, if he will only undertake the more intelligent task of tending, feeding, oiling, and repairing it. This last demands education, intelligence, conscientious care—all the qualities that go to make a man a superior, thoughtful being. Who, then, can regret the time coming when every occupation which requires no skill, and only brute force, shall cease to be the daily work of a human being, and when that being shall be raised to be a maker, worker, or director of machines?

To that time the working man is rapidly approaching, and for it he must be fitted; but above and over him will arise the class who, in their turn, are to instruct, guide, and think for him. However skilled to work his machine, he will still depend on a superior to invent or make it; on a man who shall go before him to lay out his work and prepare it; on a man who shall come after him to complete it. These are the higher departments which form the higher ranks of crafts; in short, above the skilled doers, we must have the skilled thinkers.

In this view of an intelligent, skilled nation, it is plain that we shall be able to do without the unskilled, the unintelligent, and the uneducated. We shall not merely be able to do without him, but we shall think it better to be without him. The law of society will become this—that he who cannot create his food shall not eat it, for assuredly in the time that is coming he will not find in civilised Europe a place for him; the man of the future must have one of two qualifications—skill to do, education to know—or both.

CHAPTER XVIII.

WAYS, MEANS, AND ORGANISATION FOR THE SYSTEMATIC TECHNICAL EDUCATION OF THE ENGLISH PEOPLE.

Organisation of education the business of Government.—Who will undertake it?—The educated workmen earn double wages.—Increased national revenue from skilled industry.—Difference in value between highly manufactured goods and rough raw material.—Wanted, a fit minister of public education—A competent council of education—Skilled teachers of technical science.—Duty of Government.—Duty of local authorities.—Special education for local trades and works.—Central university.—Local technical colleges.—Country trade schools.—Cost of these institutions for England.—Table.

Organisation of education the business of Government.

THE first question to be settled by the nation is this:—Whether it thinks the technical education of the English people a matter sufficiently important to the whole community to entitle it to be a subject of imperial interest and Government care; or, whether it considers the technical education of each man to be a mere mercantile consideration, personal to himself only, and technical knowledge a commodity which he may be left to buy at any shop which best suits his individual convenience or means? If we choose the latter alternative—and to this moment it is the one we have chosen perseveringly—then we must also be prepared to accept the conclusion that sound technical national education will *not* be offered as a commodity to the English people, nor will the few and exceptional shops that have been opened for its sale find customers.

It would not be worth while to discuss the subject of technical education, if we had not reason to suppose that a systematic technical education for the people is now a want generally felt, if not yet fully recognised; that, in national phrase, it has become everybody's business, and that, in phraseology equally characteristic, that which is everybody's business is felt to be nobody's business.

Perhaps it is also true, though in England too little recognised, that whatever has become a matter of vital interest to the present and future well-being of the whole nation and of all its parts, and which, for that very reason, requires the co-operation of the whole nation for its success, ought to be matter of imperial legislation and execution, in order that we may enjoy the benefit of that large organisation which alone can reconcile the interest of the many with the desire of the few—to reap personal advantage at national cost. How well the system of national organisation has succeeded, even in England, may be seen in our post-office system. How ill the want of system has succeeded, which abandons the organisation of services common to the good of the whole community to the disorganisation which leaves private individuals to further their own interests under pretence of supplying the common wants, may be seen in the present chaos which the railway enterprises of England now present to the civilised world—of national interests destroyed, national reputation lowered, and national wealth squandered. Who will be found to deny that a little of the same forethought, the same systematic balancing of national and local interests, the same wise parsimony, which have procured for other countries railway systems adequate to their wants at one-half or one-third of the cost, and with none of the shame or humiliation which attends the disclosures of our mismanagement, could also have procured for us the supply of a perfect system of railway communication, as well organised and economically administered as our post office;—shall we allow it to be said that we have a national preference for private adventure and individual gain at the expense of the community, to self-denying organisation, and prudent forethought for the public welfare?

I find myself betrayed into these painful remarks by the fact, that the nation is now placed in the critical position, at the critical moment, when she has to decide upon the adoption of *system*, or *no system*, for the education of the coming generation of new citizens. Every one admits that this must now be looked to and re-constituted, and there is no question but this:—Shall it be done as railways were, by individuals, at the cost of the nation? or shall we as a nation see to it, organise it, and do it?

Who will undertake it?

I will proceed on the assumption that we are agreed that the education of the nation is the business of the nation, and that we desire that our executive Government shall organise and do it; and if we shall be so fortunate as to find a minister of State who is willing and able to undertake the organisation of this education as a department of State business, then the first point he will put to us will be—"What value do you put upon technical education, and what will you be willing to pay for it?"

I will here venture to state that the answer I have received from some of those men into whose hands the administration of part of this education would be likely to fall if it were carried into effect, is, that the people are neither ready nor willing to pay for good education. I have ventured to say directly the contrary; and I think I am right when I say that the tax-payer would rejoice to find that our Government had the courage to ask an adequate grant for technical education, and ask for it on the express condition that the education to be provided for rearing the skilled workmen of England was to be as thorough, as universal, and as extensively distributed, as the technical education given to the working artisans and skilled men of the best educated country in Europe. But I am equally satisfied that if the Government was to try any miserable, tentative, stingy, inadequate expedients, such as those paltry gratuities it has hitherto been sparing from the public purse, as little better than a paltry pretence for doing nothing—such half measures would prove in the future the condign and utter failures they have proved in the past, and excite only the contempt and indignation of the people whose highest interests they have so long trifled with or neglected.

If, therefore, the statement were made boldly to the nation which now grants to the Government more than sixty millions a year, and which pays, over and beyond this, for ignorance, improvidence, and crime, seven millions of rates, whether it would grant a million per annum for the purpose of giving increased skill, knowledge, and culture, to training the children of the industrious, skilled, and inventive classes, whose united labours produce the whole industrial and commercial wealth of England;—I say to train them to greater skill, ingenuity, and capacity for giving to her increased wealth;—I will venture this assertion, that the great majority of Englishmen would reply cheerfully—Ay, the gain is well worth the outlay.

The educated workman earns double wages.

What is then the mercantile or monied value of a well-trained, skilful Englishman, as compared to a strong able-bodied man who understands no craft, handiwork, or art? The shop value of the two men is at once told by the labour market. The one man can earn for the community 25*l.* a year, the other man has an average 60*l.*, and with superior skill 100*l.*, a year. Or if we take the three grades of unskilled, moderately skilled, and highly skilled men, we may represent their mean values by 25*l.*, 50*l.*, and 75*l.*; in other words, the highly skilled man is worth three times the value of the unskilled man.

Increased national revenue from skilled industry.

At the present time there are about a million of skilled workmen, but there is a million of very poorly skilled, and two millions of utterly unskilled men. Supposing that by education we can raise the million of lower skilled into highly skilled men, and replace them by one million of unskilled men, raised by some little education to their rank, we have by that single act earned for the country 50,000,000*l.* a year.

We can now put the question in a new and very precise form. Is the addition of 50,000,000*l.* per annum to the nation's wealth through increased training, knowledge, and skill, worth the annual outlay of 1,000,000*l.* from the nation's budget?

It will be objected that this result, even if we resolve upon the expenditure, is distant; that we cannot train the nation in a day; and that a large present expense is incurred for a remote benefit. The answer is, that the expenditure is also progressive. We cannot conjure up training schools and technical colleges in a day. We cannot find masters at hand. We have to endure the penalty of past negligence, and work up slowly, painfully, and expensively, that which we ought to have done in time long gone by. We cannot easily, and at small cost, have the education we have neglected. The mere willingness to buy, and find the money, will not suddenly give us all the advantages of foresight, forethought, and methodical prevision.

There is, however, an important practical question to be asked. Skill, capacity, and ability, are not in themselves wealth, and it may not be clear and obvious how this additional 50,000,000*l.* is to be earned without the addition of a single man to the population. The manner in which skill creates wealth is not difficult to understand. Take one million tons of the iron which we export from this country in little better than the brute form in which Nature has providently stored it up for us immediately below the skin of our soil, and for which we now receive barely 3,000,000*l.*; let us suppose that we expend upon that iron a little of the skill which Mr. Bessemer, the great technical schoolmaster in steel, can so readily teach us, and let us convert it into, say, half a million of Bessemer steel rails, and it will at once have risen to the value of 6,000,000*l.*—the other half million of tons have gone to supply the waste and pay the other costs of the process. In this case skill has earned 3,000,000*l.* sterling, in a highly marketable commodity. But we need not stop here; the steel in these rails may be converted by still higher skill into boilers, wheels, axles, and parts of locomotive engines; and if the skilled workmen of our country are more skilled than those elsewhere, one hundred thousand tons of that steel may be worked up into two thousand locomotive engines and tenders, which will alone be worth

Difference in value between highly manufactured goods and rough raw material.

4,000,000*l.*, and thus the value of this portion of the steel is quadrupled.

It is easy to imagine what may be done with the remaining 400,000 tons of steel; part of it might be converted into agricultural steam-engines and steam ploughs to till every man's fields; and in that shape the value of each ton might be taken at 50*l.* a ton, so that 100,000 tons would become worth 5,000,000*l.* Another portion might form the steel of still smaller tools and implements, which, in proportion to their smallness and the higher ratio of skill and artifice, would easily become of double the value, or 10,000,000*l.* There can hence be no difficulty in seeing how the higher skill of the additional million of skilled men, whom we have raised by education, could be able to earn their twenty-five additional millions of higher wages. And, moreover, there can be no difficulty in seeing how the less skilled million below them could earn their additional wages as helpers to these, or as users and employers of the improved tools and machinery which the others had created.

Nevertheless, it is inevitable that the hard condition on which alone this stream of gold will flow into the national wealth, is that we now begin the painstaking task of making our labourer the most skilled and intelligent of craftsmen; otherwise, these things will be done, not by us, but by the children of some other soil, whose rulers have been more provident than ours.

Perhaps this calculation, which is a very small sample of many that might be adduced from every branch of skilled industry, may solve any remaining doubt of exchanging 1,000,000*l.* of national expenditure for 50,000,000*l.* of return; but the finding of the money is only the beginning of the work: the greatest difficulty will be to find the organisers of the work, the teachers, and the fit organisation to enable the teachers to do their work effectually. We must therefore continue our inquiry under these heads:—

Wanted, a fit minister of public education.

1st. *How to organise a system of National Technical Education.*—Our first great want is a minister of public education, and the fear is that even when we yield to a great public necessity, and appoint him, we may merely be finding a place for a man, instead of the man for the place. The right man in the right place can be nowhere more important than here; and, unhappily, it is a part of our political system that fitness for the special duties of the place is reckoned a minor qualification. The most practical of all people as we think ourselves, we are continually putting a minister at the head of that department of government of which he knows least. We send a man well up in naval affairs to manage the army; an excellent chancellor of the exchequer we make minister for India; the man best versed in commerce or trade we put in the Home Office; and an admirable agriculturist and country gentleman we send to the Board of Trade. At the head of the education department we usually put the useful servant of the party, for whom we are compelled to find some place, and we therefore stow him in a department where it is supposed he can do no harm; but even then we are scarcely safe, for he passes some most inexpedient and unpopular measure such as "payment by results"—a shopkeeping principle utterly inapplicable to the very nature and essence of education, which is a process of moral and intellectual culture, and of a nature utterly foreign to the barter and sale of commodities.

If, therefore, we are in earnest about sound education, our first step is to find a man who, himself possessing high education, has patriotically devoted time, thought, and deliberation to the subject; who would do the duties with sincerity and zeal; and who, instead of being a violent party man, should be one whom opposite sects could trust, and with whom the various ranks of society could freely communicate.

A competent council of education.

The first duty of this minister would be to select as the members of his council, not political agents, not official place-men, not men who have nothing better to do; but to choose from every branch of technical science and technical profession, the men most distinguished for the combination of high scientific knowledge with extensive practical skill and experience. His difficulty would be that the men whom he should most desire to occupy with the discharge of so patriotic a duty might, and would be in all probability, men fully engaged in the discharge of responsible duty; and he would have to determine whether the education of the nation is a cause worthy of obtaining the services of the best men, or whether second or third-rate men would answer the purpose. A nation which regarded with deep solicitude the interests of its children, would naturally desire that the men who trained them to their future life and citizenship should be men whose high example should fire the youthful mind to emulate their worth, and whose wisdom should be able to lead them to the most noble aims by the surest path. Wherever, therefore, that nation could find its Socrates or its Aristotle, it would make them teachers of its youth, and would empower the minister to honour and remunerate them worthily.

Having selected a fit council of directors, it would be necessary that they in their turn should exercise discrimination in selecting to the posts in the technical universities, colleges, and schools, no mere pedagogues in book learning, no mere crammers of facts and figures, no mere repeaters of words and word-knowledge, but men thorough, sound, and deep-skilled in science they had themselves helped to discover, in art they had themselves helped to create, and industries through which they had themselves worked successfully. In short, men to teach equally by precept and example.

Skilled teachers of technical science.

But though the teacher should be no mere word pedagogue, it would far from suffice to make him a teacher that he should have mastered his subject: that is a first qualification. The second is that he should be by nature and affection a teacher. If he love the profession of instructing, and think it the duty of his life so to rear youth as to make their generation of citizens illustrious, he will be sure to teach successfully; but the best and most successful way would be to place him under one who understands the philosophy of teaching—a philosophy which requires little less than the study of the human mind, and the whole nature of human thought—so as to show him how the world of nature and the world of mind fit one another. He will thus learn that there are ways of putting things to the scholar which make him drink in knowledge as mother's milk, while there are other ways of putting knowledge that give to it the flavour of gall or wormwood—only to be swallowed under fear of birch or cane. It will result from this that a college for teaching the teachers is one of the first and most important branches of our national technical establishments, and that success in the selection of the men, and in the method of teaching, is the first condition in the success of the teaching itself.

Duty of Government.

I have elsewhere considered the different sorts and natures of university colleges and schools which go to make a national organisation for technical education, and it is now only necessary to consider how best to fit these to the English nation. The share which the nation at large should take in the establishment and maintenance of these institutions, the share which each locality should take in their establishment and maintenance, and the way in which the pupils should be selected, assisted or made to contribute to their education, are matters full of elements of success or failure. To me it seems the vocation of the central government to decide on the system of education in each class of institution, to select the teachers and to pay them their annual salary, to name the director in chief, or principal, who would be responsible immediately to them for seeing the system carried out. To call upon the local authorities to do their part, and to enforce it.

Duty of local authorities.

It should be the part of the local authorities to contribute and maintain what we will call the *matériel* of the college or school. They must find land, and on it construct the edifice, all the internal arrangements of which must satisfy the conditions prescribed by the central government; and whether the funds thus procured come from the funds of communities already wealthy, or have to be raised by rates, the Government must have power to force their application to a building which is healthy, convenient, and suitable, and they must maintain that building, with its playground and garden, in good order and condition, comfortably furnished, and well warmed and lighted.

It may be matter of doubt whether the central government or the local authorities should bear the cost of the *matériel* of teaching, of libraries, collections of instruments, and drawings, patterns, models, and scientific collections and museums, chemical and mechanical materials for experiment and research. I am strongly of opinion that it should be the duty of the central government, for by that means alone can a perfect and economical system be devised for their supply. The eccentricities of local management would be intolerable and wasteful.

Special education for local trades and works.

There is, however, one department in which the local authorities should have a due influence. Although they might be no judges of the courses of education and methods of training, they might be considered true representatives of the local wants of the district, and they ought therefore to be represented on the council of management by one of the local authorities having a seat at the board, whose duty it would be to organise, in addition to the general education, such special teaching as was most likely to be technically useful in the district; thus, in an agricultural district, agricultural classes and museums might be more fully developed; and in a mineral or manufacturing district, the class of machinery, mining, or textile fabrics might predominate. Thus, without hindrance to systematic organisation, the teaching might be made pliable to local circumstances.

Central university.

There need be only one exception to this arrangement of expenditure between the central government, the places of the schools. The great central technical university ought to be metropolitan, and all its expenses exclusively national. If Greenwich Hospital be vacated, or the public offices transferred from Somerset House to Whitehall, there are two buildings, each worthy of this great object; but if these cannot be spared, then it will become the duty of the nation to erect with all speed a public building, worthy to be the chief training school of the highest class of men who are to direct the whole energy of that part of the nation which is occupied in the creation of public wealth, and the conversion of the powers of nature to the advancement of civilisation and culture.

Local technical colleges.

Subordinate to this metropolitan university, these local technical colleges would be placed in every centre of local industry. The subjects taught would be nearly the same as in the university, only the theoretical part would not be carried to the same heights of science, and the technical part would be more fully carried out into the technical details of the industries of the neighbourhood. Specially attached also to each of them would be an extensive collection of models, examples, materials belonging to the local industries, and a free technical library, with a comfortable reading room.

Country trade schools.

The lower class of institutions would be those which either form preparatory schools for the technical colleges, or finishing technical schools for those who can go no further; and these should pervade not only the whole country, but the large towns and the metropolis, there being one such institution for every 20,000 inhabitants in town districts, and for every 10,000 in country districts; and either in the same building or in a different one there should be technical schools in the evening, as complete in their course of instruction for the working men, as in the morning for the youth of the district; and to these schools should be attached a library, museum, and reading-room, similar to that of the colleges, only more elementary, and on a smaller scale. It is these local night schools and libraries for the working men that ought to fulfil the duties in which our mechanics' institutions have so wofully failed, and it may in some cases be convenient that the Government should make use of the building and organisation of these mechanics' institutes for these technical evening schools.

Cost of these institutes for England.

The reader who considers that this organisation is the minimum apparatus by which the technical training of our million of skilled men, and our three million of half skilled and unskilled men may be carried parallel with the advancement of the training of educated Europe, will see that we can have little difficulty in disposing advantageously of the 1,000,000*l*. a year we have appropriated. One technical university will cost—say 180,000*l*. a year; fifteen colleges, 300,000*l*. a year; a thousand schools, 500,000*l*. a year; museums, libraries, &c., will dispose of the remainder.

For each large town a suitable building ought to be erected, if it does not already exist, and 100,000*l*. is the least sum that can adequately fulfil the purpose for a populous, industrious, wealthy town. In like manner, for the schools, 5000*l*. is the least sum that can be expended.

WAYS, MEANS AND ORGANISATION FOR THE TECHNICAL EDUCATION OF THE ENGLISH PEOPLE.*

I.—The Metropolitan Technical University.

150,000*l.* per annum.

II.—The Local Technical Colleges.

(Fifteen.)

Each, 20,000*l.* per annum.
Total, 300,000*l.* per annum.

III.—Local Trade Schools.

(One thousand.)

Each, 500*l.* per annum.
Total, 500,000*l.* per annum.

Total Annual Parliamentary Vote, 1,000,000*l.*

* Excluding Scotland and Ireland.

CHAPTER XIX.

THE ORGANISATION OF FIFTEEN LOCAL TECHNICAL COLLEGES IN THE CHIEF CENTRES OF ARTS, MANUFACTURES, AND COMMERCE.

The fifteen local technical colleges—To be organised as preparatory to the university—And also as finishing-schools for local industry, commerce, or agriculture.—Their science teaching—Their technical teaching—Its practical nature suited to the wants of the district.—The teachers must teach the practical work of the district.—Agriculture.—Building trades.—Collection of examples of best designs, materials, and workmanship.—Mechanical trades, laws of matter and work.—Work in metals.—Textile workers and works.—Effect of education on taste, wages, and wealth.—Textile education.—Decorative design.—Coloring.—Courses of study.—Education of merchants in commercial cities.—Education of miners in mining districts.—Education of sailors and ship-builders in sea-port towns.

The fifteen local technical colleges:

THE organisation of colleges which shall rank immediately below the great technical university must be, to some extent, of the same nature as the great central university. It is probable that many of the students of that university would be men selected from these colleges, on account of the distinction they might have attained, or the special aptitude they might have shown in the college for higher courses of study. In so far as these colleges, therefore, are preparatory for the university, the subjects and methods of teaching ought to bear a definite and clear relation to each other—the relation of preparatory to finishing schools.

To be organised as prepara-

In this first capacity these colleges would teach the mathematical, physical, and chemical sciences taught tory to the university; in the university, only in an elementary manner, and to a limited extent. Natural history would occupy a prominent place, and especially the natural history of the raw materials used in the commerce or manufacturing industries of the district. Languages also and literature, both English and foreign, would be so taught as to prepare for the higher university; and the training of the students in the use of their senses, and their limbs, in accuracy of eye, dexterity of hand and quickness and sureness of action, would prepare them for the higher duties of the university and the world.

And also as finishing schools for local industry, commerce, or agriculture.

But there is quite another duty for these local technical colleges, which is equally wanted with the preparation of the highest class of professional and technical men for the central university. These local colleges will form the culminating point of technical education to that far larger number of young men who are destined before they reach their eighteenth year to abandon the education of the school for that of the workshop and the office. These men cannot wait to sow the seed and reap the harvest of university education; they must abandon the field of knowledge for that of work. For this large class the local college is not a preparatory but a finishing school, and in the organisation of these colleges we must mainly consider how we can add to so much pure science as their time can afford, as much science applied to the future of their lives as their limited time can afford. Adequate teaching of technical science for them is even more difficult than for the students for the university, because while they want it no less, they are less prepared to receive it than those who have gone further in pure science. The nature of their technical education, therefore, demands serious consideration.

I will take for granted that during their fifteenth, sixteenth, and seventeenth years in these colleges excellent provision is made for a limited portion of mathematical, physical, and chemical teaching. It is only necessary that their pure science should be honestly taught, and that it should in no degree resemble that catchword kind of science which is adroitly got up by professional cram for competitive examinations; on the contrary, it should present the qualities of truth, depth, and thoroughness, and be neither superficial nor detailed; but, for this very reason, the teachers require profounder knowledge, more skill in teaching, and greater discretion in what they teach than the teachers of further advanced pupils. To these youths of limited education the question what to teach and what not to teach requires the utmost judgment. Their career of education being so close to its end, the main object should be to send them away most completely furnished with that which will best serve their future needs, disembarrassed of all that might prove mere lumber.

Their science teaching;

But it is the technical application of their pure science knowledge that requires from their teachers the highest measure of judgment and ability. They are to be shown how all the abstract science they have learnt leads up to all the work they are about to do; and it is necessary not only that they should be told of how much value their science may be to them, but they must be shown how to fit the one into the other; and they must acquire habits of putting their abstract science into practical shape, and of analysing practical work into its scientific elements. If, for example,

Their technical teaching;

they are to be farmers, they must not only be told that the nature of plants is a branch of natural history, that the feeding of plants is a branch of physiology, and that the culture of the soil is a branch of chemistry, but they must be taught the actual natural history of all the individual kinds of plants they will have to cultivate; they must learn the physiology of all the plants they will have to feed, and the chemistry of all the soils they will have to till, and of the kinds of manure they ought to turn into the ground. Without this technical instruction the young farmer who has been persuaded to study natural history, physiology, and chemistry in the belief that it will help his farming, would find that he had merely been befooled by his teachers; for it is quite easy to spend years of one's life in chemistry, natural history, and physiology without finding a particle of knowledge useful to a farmer's life. Modern science is so wide and universal, that a mere elementary knowledge is for practical use both vague and deceitful; it must either be very wide and profound, and most skilfully applied, or it may be worse than useless; or in such a college the student must be taught with especial care that part which will be of value to his narrow vocation, and he must be carefully warned off that which is speculative and remote from his work. While, therefore, his pure science should be as profound as possible, his technical science should be as precise, exact, and narrowly fitting into his work as the technical knowledge of his master can make it.

Its practical nature suited to wants of the district.

This technical part of local colleges it will be most difficult to organise. To a great extent teachers of pure science are unfamiliar with its technical applications; and mere technical men are incapable of teaching the science they scarcely know, and are wholly unpractised in the difficult art of teaching. How, then, to get masters of pure science who are deeply versed in its technical applications is a great difficulty to be overcome, and which only the national resources, zeal and will, can by perseverance conquer. It is hard to say which is to be the more dreaded—superficial science applied to practical use, or profound science applied with ignorance of the true aims and conditions of its application. This divorce of practice from science has been the great misfortune of our generation, and we must spare no pains to avert it from the next.

The teachers must teach the practical work of the district.

Agriculture.

To every special trade in the locality where these colleges are to be planted there must therefore be separate professors of each technical application. It will not do, for example, to have a professor of agriculture, and expect him to teach all agriculture, for that would be like appointing a professor of all science—a kind of man who must inevitably be an impostor or a quack. One man must teach the chemistry of agriculture, and he must both be a profound chemist and be familiar with the practical farming of the district. There must be another teacher for the natural history and physiology of vegetation—acquainted with the nature of cereals, green crops, fruit-trees, and other products of the vegetable kingdom. In a breeding district there must, in like manner, be a professor thoroughly master of the anatomy, physiology, health, and disease of cattle and all farm animals, and who knows the customs, usages, breeds, soil, climate, and diseases of the district. In like manner, the nature of all agricultural buildings, fences, gates, vehicles, implements, machinery, tools, and mechanical processes employed in agriculture should be taught by a master of practical and theoretical mechanics, who has also mastered all the processes and wants of the agriculturist in his district.

Building trades.

I have taken as an illustration agriculture alone, because, wherever these colleges are founded, that is sure to be one of the important subjects in which technical education is urgently required; but I might have taken in like manner all those branches of industry commonly grouped as building trades; and as everywhere dwellings are required, so in every local technical college, means should be provided for teaching the scientific principles of their art to the master stonemason, master carpenter, master joiner, master plasterer, and master painter. And not to these future masters only, but also to all those young men who are being bred to these trades, in the hope that they may rise in the future through the grades of skilled foremen and overseers to be possible masters. Now all these men, without exception, require: first, to understand thoroughly all the possible shapes of their work, which forms the theory of geometry; second, the art of putting them on paper, called descriptive geometry; and, third, the art of taking them off the paper plan and executing them in the stuff they have to deal with, which I will call constructive geometry. Moreover, all these men require to possess, not merely the power of true comprehension and execution, but a knowledge of the comely, the well-proportioned, and the beautiful; otherwise they never can imbue their works with the spirit and feeling which give pleasure to the spectator of true and graceful work. Therefore the whole class of men connected with the construction and beautifying of our homes, require an education in the principles of symmetry, decoration and beauty ; and they equally require education in the cause and nature of ugliness, in order that the eye may not merely be offended by distortion or disproportion, but gratified by truth and beauty of conception and execution. For the purpose of pleasing an intelligent eye, each workman concerned in it must not only know thoroughly how to do his work, but must show his knowledge in every bit of it.

Collection of examples of best designs, materials, and workmanship.

For this purpose, the men in the building trades should be surrounded in their college by samples of the best pieces of workmanship in every branch of their business: not mere historical examples from Greek temples or Gothic cathedrals, that may never again have to be executed, but of real good work, suited to modern use—the cleverest work of the ablest men of this century, brought from every part of Europe. If in Italy there are better ornamental smiths than in England, then the best samples of Italian smith-work should form a portion of their collection. If the plasterers of Berlin do much higher class work than those of London (as I think they do), the best samples of their work should be placed in this museum, and so on through all the elements of the building trade. And this might be carried out through every detail down to handles of doors, locks, hinges, self-closing mechanism, ventilation, water supply, draining, cooking apparatus, and every part of the furnishing mechanism and economy of a house. I am disposed to think that it would be impossible to train up a single generation of young building tradesmen in this manner, imbued with such principles and surrounded with such examples, without creating a revolution in the appearance of the town in which the college was placed, and in the domestic habits and manners of the inhabitants. I can only say, that I have myself watched sufficiently long the effect of such a school in Berlin, as to have seen a complete and beneficial revolution accomplished in the design, materials, decoration, and comfort of the interior. Twenty years of education have sufficed to produce this result.

Mechanical trades, laws of matter and work.

For all the mechanics engaged in house building, and for all other mechanics not so engaged, these various kinds of geometrical and drawing education are indispensable. But for all mechanics there is another branch of education which is equally important and of the essence of their trade—the principles and laws of mechanics must guide and govern every process which the workman performs on his materials. He cannot work with any sort of matter in a way contrary to the laws of that matter, without paying for it in waste of material or labour. The principles of the construction of mechanical instruments and the laws of their use are as well known and clearly defined as any branch of technical science; and the youth who does not know the laws of mechanics, can never become an adroit and expeditious workman. These laws are a branch of mathematical physical science, and every man who has to shape matter or move weights skilfully, should be a master of theoretical mechanics.

Work in metals.

Perhaps this is more especially true of all the trades engaged in the manufacture of metals; in all those connected with the manufacture of machinery; and particularly for all who manufacture the tools, implements, and machines by means of which other tools and implements are made.

For these classes of artificers more strictly called mechanical, it seems almost an axiom, that in the local colleges which are to train their leading men for the highest degrees of skill, there should be provided an extensive collection of all the best machines, tools, and examples of work in the world. British mechanics once were, and ought in future to be ahead in knowledge and skill of all others, for they had the good fortune to be quietly occupied in learning their trades while the nations of Europe were engaged in war, and this gave them a start of all competitors; and they have ever since enjoyed a profusion of good material, furnished by nature with an abundance and cheapness beyond any other country; and therefore, if they had had the wisdom and self-denial, and if their governors had had the forethought and providence to do as much for their education in technical science and technical art as nature had done in the supply of materials, they ought at this moment to have been placed above fear from competition. Let them now be surrounded with the best examples of work done everywhere, and let them be instructed in the highest principles of art and science, applied in the most direct manner to the knowledge of their various trades; and there is no reason why the British workman should not hold his first rank where he has it, and regain it where lost.

Textile workers and works.

There is a large branch of trade and skill in what are called the textile manufactures. A large proportion of our imports and exports consists of raw materials imported to form, when manufactured, the corresponding exports. The profit the nation gains neither consists in the quantity of the import nor of the export; it consists of a part of the increased value given to the raw material in the interval between its importation and exportation in the shape of goods. A pound of raw cotton, which costs a shilling, exported as a pound of cotton goods may cost one shilling and sixpence. To earn this sixpence, we first clean the raw material, sort it, and therefore send a quantity to waste; we then make it into yarn, and weave it into fabric; and in doing so, we expend the capital in our buildings—the coal, oil, and waste in our machinery—the lives and energies and food of our working people; and the question which remains is, whether all these can be said to have been employed profitably to the community at large at the sixpence which forms the whole difference between what we pay the foreigner for the cotton and what he has to give us back again for manufactured goods. There is some reason to suspect that if the working people were adequately paid for their daily labour, the inventive minds adequately paid for their high skill, it would remain a matter of serious doubt whether the competition and low prices by which the foreigner is supplied leave to the community in England an adequate return, and whether the foreign customer is not luxuriously supplied at the expense of the poverty and penury of the English workman.

Now, for this, establishments for skilled education of all the classes engaged in the great variety of textile manufactures would furnish a radical cure. If, instead of sending out a pound of cotton so rudely spun and coarse as not to fetch more than sixpence beyond the pound of raw material imported, our manufacturers were to develop so much skill as to convert that shilling's worth of cotton into fabrics worth two shillings a pound, and that not by mere brute-labour, but by the two simple elements of skill and taste, then the remuneration of all engaged in the manufacture would at once be doubled.

Effect of education on taste, wages, and wealth.

But the question arises whether our customers would be willing to take and pay for these higher class goods rather than the lower? To this I answer, possibly not these same customers, but most certainly others; it is a well-known fact that other nations have taken away from us, by greater skill and taste, those higher and more remunerative branches of textile industry, and have wisely left to us the more coarse, vulgar, and cheap. Our textile manufactures abroad are now only reputed for cheapness—or, to use a common phrase, because we sell them at a sacrifice. Thus, for coarse and cheap goods, foreign nations send to England; for refined and costly goods, England has to send to other nations. To put this in other words, skill and refinement in the makers of textile goods yield high prices, good remuneration, and prosperity; ignorance and want of taste produce coarse, common, unrefined, and unremunerative manufactures. Therefore, to raise the skill and refine the taste of textile manufacturers by education, is the sure way to raise profits and wages.

The things necessary to be taught to a textile manufacturer are the nature, history, and sources of his raw materials; the principles and construction of all the tools and machines by which they can be manufactured; the organisation, distribution, and economies of the factories in which they are to be manipulated; the social condition of the working people; the principles of beauty and design which are to convert a mere textile fabric into a thing of beauty and a work of art. Textile beauty, decorative pattern, and all the play of form and colour, can only be given by high mechanics—geometrical design, artistic invention, and chemical knowledge of harmony of color, and the mode of producing it. When all these are united in the fabrics of any district, or in the patterns of any country, those fabrics carry by storm the minds of the customers, set the fashion to Europe, and lavishly remunerate those educated, tasteful, and skilled workmen who have been able to command this superiority by technical education and training. Such goods, when exported, should be able to place all who are concerned in their production in a superior condition of affluence and refinement; and the local colleges and schools that should bring about such results could not fail to be recognised as inculcating far higher principles than those of merely buying in the cheapest market and selling in the dearest, the lowest class of goods which the lowest class of the population of uncivilised countries would wear. When the profits of our exports and imports can be reckoned on the high scale to which superior skill and taste might raise them, then—but certainly not now—the largeness of both might be reckoned as an index of national prosperity, civilisation, and wealth.

Textile education.

In the textile districts, therefore, the textile division of the technical college should receive a high development. Professors of natural history should teach the nature of every vegetable and animal product fit for use, the climates fitted for its favourable growth, and the conditions suited to its development; for it is known that a high class of material is necessary to a high class of goods, and that selection of material is a first step in skilled work. But these professors in natural history must be equally skilled in all the processes of manufacture through which these materials have to pass, otherwise they will not be able to indicate the peculiar points in each kind of substance which in its growth and preparation render it more or less fitted for its special use. The technical teacher should show as much skill in selecting what is to be taught, as the practical worker in the selection of the material to be worked, and to this end he must be as completely master of the use it is to be put to as of the nature of the substance to be used. In like manner, the professor who instructs in textile machinery must be not only a scientific mechanic and skilled machinist, but must know the materials to be manufactured, and the fabrics to be produced.

Decorative design.

The professor of art who teaches the principles of decorative design, must not merely wield skill in drawing, and apply refined taste to the selection and creation of beautiful form, but must understand what are those forms and those designs which will be suited to or unsuitable for the geometrical and mechanical structure of the fabrics in which those designs are meant to be incorporated, otherwise the most exquisite designs will fail through impracticability of execution.

Coloring.

In like manner the professor who teaches the principles of design on which colored fabrics are to be manufactured, must first be a master of all the physical principles which produce harmony and discord of color, as well as of all the laws of chemical construction by which one color is educed out of another, and also the processes by which one piece of material is made to yield up its color, and another is made to imbibe and retain it. The technical principles of color, therefore, imply a thorough knowledge of profound branches of physical science, an equal knowledge of the doctrines of organic chemistry, an acquaintance with the whole raw material of manufacture, and familiarity with the chemical processes of dyeing, and the mechanical processes of printing.

Courses of study.

The education, therefore, of the rising generation of our textile manufacturers will give ample occupation to the staff of a large college of highly gifted professors in each centre of textile industry, and will require no ordinary sized building for the accommodation of the many teachers, the large laboratories for practical experiments, and the extensive collection of samples, patterns, and models of raw materials, processes and finished work, among which the student should pass the three years of his technical education.

Education of merchants in commercial cities.

There remains another local distinction in the technical occupations of the people, closely connected with the preceding, yet entirely distinct from it. The centres of commerce are very rarely the centres of the manufactures in which they deal, nevertheless it is certain that much of the knowledge which the manufacturer of goods for exportation must possess, must also be acquired by him whose business it is to deal in those goods. The merchant who does not know a better article from a worse, is quite likely to choose the cheaper and get the dearer. Moreover, the enterprising merchant is a man who occupies himself in any part of the civilised or barbarous world, either in discovering new wants which the home manufacturer can supply, or new substances to supply home manufacture. His knowledge, therefore, of the wants of the one, and of the nature of the other, ought to be extensive and exact. In this way the education of the merchant might advantageously partake of that of the manufacturer. But it is also necessary that the merchant should possess extensive, exclusive knowledge; it is his business to deal with all nations, and therefore an acquaintance with their character, language, laws, customs, climates, productions, weights, measures, and monies, is essential. To a great extent, also, the British merchant has been, and may still continue a shipowner; he ought in this case to be a judge of shipping, and should know the laws, usages, practices, of seafaring folk. The laws of political economy, currency, exchange, banking, and insurance, are mixed up with the merchant's every-day business, and the more thoroughly he is acquainted with them the better he will be able to select the wiser course in the conduct of his world-wide affairs. Even in the humbler walks of mercantile life, there is so much to be learned and studied that can be quicker learnt and studied at school than elsewhere, that no merchant's clerk should leave off school-life till he can conduct mercantile correspondence in two or three languages, not only intelligibly, but with an exact knowledge of the weights, measures, coins, and usages of his foreign customers.

No further argument is necessary to show that where our future technical colleges happen to be placed in the centre of a commercial district, there are certain departments of knowledge peculiarly suited to the mercantile class, the professorships, museums, and practical teaching of which ought to be largely developed in that special direction, and that the professorships of natural history, physical geography, chemistry, and physics, should form the foundation merely of an education which should not cease until it has embraced the whole field of raw material which the vegetable and animal products of all climates yield to the enterprise of the merchant, and until his knowledge of the classes of men he deals with at home and abroad shall have embraced their language, customs, and all that portion of their technical knowledge and interests which touches his own.

The technical college in a mercantile town must give, then, in addition to all that knowledge which is common to the other classes of the community, a large preponderance of the kind which is purely special, and men should be selected as professors for it who are not merely masters of science and principles, but who know also mercantile life in its widest development, and are thus able to judge what are the portions of science to which each class of student should most advantageously devote himself, and how such study should be conducted, so as to be most useful in active business.

Education of miners in mining districts.

In a mining district it is obvious that the departments which should take fuller development in the local technical college, are applications of geology, mineralogy, and machinery, together with the chemistry of the various metallurgic processes.

Education of sailors and ship-builders in seaport towns.

In a seaport town, naval architecture and marine engineering would naturally occupy most attention. The education of sailors, mates, and captains, for the mercantile marine, would require the special development of mathematics, physics, and mechanics, into astronomy, navigation, marine surveying, and seamanship.

It would also be probable, that wherever it was thought worth while to found a technical college, there would be public works, roads, bridges, harbours, docks, railways, sufficient to occupy a certain number of engineers, civil and mechanical, and of public buildings, furnishing employment to architects as well as builders, and these have a sufficient number of grades, from the humbler clerk of the works, surveyor, skilled foreman, and superintendent, to make it desirable that those who may not seek or be able to afford technical distinction in the central university, may find in the local college the highest training they want, or which their opportunities require, at the same time, and along with those who are receiving the preparation for the technic university.

All these local technical colleges, therefore, in so far as they are to be preliminary institutions, must be formed on the type of the technical university, only more elementary in their teaching of pure science. But in so far as they are to be the finishing technical schools for the arts, manufactures, or commerce of their district, they should be carried out into the utmost practical completeness and development of detail, in those technical applications by which each locality is distinguished.

Systematic Organisation of a Local Technical College.

Local Organisation.

It is not always easy to determine what duties in the matter of public education are best performed by local authorities, and what are likely to be better performed by the central national authority. I have already said that in the matter of providing land, buildings, and all the material organisation of our local technical colleges which comprise both professional and trade students, local authorities should be called upon to provide a large park, and a large handsome series of buildings in that park suited in every respect for the work, health, and recreation of the students.

They should be called upon to light, warm, clean, and ventilate the buildings, and maintain the whole material organisation in perfect working order. A wealthy commercial town would not be likely on the representation of the Government to refuse this portion of the contribution. They might possibly come to take pride in the beauty of the buildings, the freshness of their park, and the reputation of their college, but I do not think that they would be the best judges of the organisation of the school-teaching, or of the selection of the teachers; nor could a local body safely be trusted with the continually recurring cost of adequate salaries for a high class of teaching. The central government, on the other hand, or, as we may hope, a minister of education, being at the head of the whole education of the British people, should know infinitely better than the mere local boards of a town or county, what were the best systems of education, what men were the fittest teachers, what were the best ways and means of teaching, and what was the right and wise distribution of work and money among the teachers.

I would therefore give to the central government the duty of calling on the local authorities to appropriate the lands, erect the buildings, furnish and maintain them. But the plans of park and buildings must be approved by the central government. The central government should name a principal, select professors, organise a governing council.

In that governing council, which should be small, the professors should have one representative, the local authorities one. The central government should also have to establish and largely contribute to the museums and collections of the school, having the right to accept or refuse the many local contributions which might be offered. But it has to be observed that these local contributions have generally little teaching value.

The locality itself is likely to furnish the best illustrations of local industry outside the college; and what it is most material to exhibit in the technical collections of the college is, the best examples of the highest designs, skill, and work of other places, other countries, other times and races, which are probably unknown to local people. The Government, therefore, is far more likely to fill the museums and collections wisely than the local authorities.

There is, however, one subject on which a permanent local council, to be called the local trades council, could be wisely appointed.

This local trades council should be selected from representative men in the district, and should have a permanent constitution, to watch over the practical nature of the education received, to be present at the examinations of the students, and to report annually or oftener to the principal of the college their views of the manner in which the school's teaching is, or fails to be, efficient for the advancement of the local industries. The local representative on the council of the college might be the president of this local trades' council, and so the council would have a representative share, but not a preponderant one, in the government of the university.

Professors.

I do not think the number of professors in these colleges ought to be fewer than twenty, and where the local technical trades are extensive and varied, so as to require great variety of technical application, the number should be increased to twenty-five or thirty ; in a town of one hundred thousand inhabitants, situated in a county of perhaps one million of industrious inhabitants, I should think the number of students in a technical college would not be less than three hundred, and each teacher would probably have from twenty-five to one hundred students as his pupils. I deem it of primary importance that each professor should not teach many hours a week, nor ever allow his teaching to degenerate into mere routine, a condition to which all teaching rapidly descends when it is protracted. Of all the teaching I have seen, that is the best which occupies the mind of the student intensely for a short time ; but that is also much the most laborious and exhausting to the teacher, and requires the highest class of man.

Teachers like Faraday, Herschel, Airy, or Tyndall, would do more education, and communicate more value to the mind of the student in an hour, than a slow commonplace teacher in a week. When I talk of teaching, I don't mean mere passing the time or occupying an hour—I mean sending away at the end of the hour each pupil wiser and better than when he came. That wants distinguished men for teachers ; great leisure for preparation ; and such good pay as to leave them no care or thought about their own personal or family affairs. If the English people would have their children well cared for at school, they should themselves so care for the interests and families of their children's teachers, as to obtain the best and wisest men in England for the teachers and patterns of their youth. Parsimony in the education of your children is waste of the worst sort.

In our colleges, therefore, we should require the following professors :—

SCIENCES.

1.	Mathematics	2 professors.
2.	Physics	2 „
3.	Chemistry	2 „
4.	Astronomy and Geography	2 „
5.	Geology and Mineralogy	2 „
6.	Botany	1 professor.
7.	Zoology	1 „

PRACTICAL APPLICATION.

1.	Surveying and Measuring	1 professor.
2.	Geometrical Drawing and Perspective	1 „
3.	Practical Building	1 „
4.	Practical Mechanics	1 „
5.	Practical Chemistry	1 „
6.	Agriculture	1 „
7.	Gardening	1 „
8.	Gymnastics and Military Drill	1 „
9.	Special trade of the district	5 professors.

Thus we have exhausted our number of twenty-five professors, even without including subjects of which every one should know something, such as the doctrines of religion, the laws of intelligence and the laws of morality, foreign languages, education of the taste, and history. Some of these, as religion, may be taught out of school, others may be assigned to the courses of education preliminary or subsequent to the college period of three years.

The college period of three years—from fifteen to eighteen—is the least that ought to be devoted to these subjects when the course is used as preliminary to the university ; when employed as a finishing school a fourth should be added.

Finance.

Of the fifteen great English towns to become sites of our technical colleges, the population varies from nearly five hundred thousand inhabitants to one hundred thousand. The population, moreover, of the districts around each central city should materially affect the extent of the college and the nature of its teaching. Liverpool, Bristol, and Hull, would have a large portion of their teaching devoted to commerce and seafaring knowledge; Birmingham and Sheffield to metallurgy, mineralogy, designs and metal handicrafts. Manchester, Leeds, and Bradford, would naturally cultivate the arts of decorative design, the chemistry of dyeing, the mechanism of spinning, weaving, and printing, textile materials and fabrics, along with general commercial and mercantile knowledge. In other districts, like York or Exeter, the interest of the counties might be supposed to predominate over and modify the character of the town college. Agricultural sciences would form the special courses of the college; —the chemistry of soils, the geology of the district, its drainage, its climate, its natural productions, its breeds of animals, its pastures, its cereals, its timber; the chemistry of manures; the health and disease of animals; the constitution of farm-buildings; country road making and fencing; architecture of villages, cottages, and farm-steadings;—these would form the staple of the technical education of the county.

It is difficult to embrace the peculiar circumstances of each of these institutions in any one technical plan of college. In no point of the constitution of these technical colleges can more judgment be shown than in the perfect adaptation of each to the special wants and capabilities of its surrounding district.

In so far as each is a preparatory school for the higher university, the earlier years' courses of study in the fifteen colleges will be nearly alike; but it is almost to be desired that in the local adaptations and the business and trade courses of the district, no two should be alike.

While, however, the organisation of the colleges may thus differ, it does not follow that they should materially differ in extent of organisation, or in cost. There is practically no difference between the cost of educating a class of twenty students and a class of forty. A course of lectures may with equal ease be delivered to ten students or a hundred, and the illustrations of a course of lectures on geometry or mechanics cost just the same sum, whether twenty or fifty students reside in the district and attend the lectures. I will take, therefore, the following as a type of the expenses of the college :—

Expenditure on Building and Site.

Park	£ 50,000
Building	150,000
Apparatus of teaching, furniture, and museums .	50,000
	£250,000

This sum to be supplied jointly by a tax on the counties and by the government of the town in which the college is placed.

Annual Expenses.

Government grant for the salaries of the professors .	£10,000
Local grant for maintenance, warming, lighting, &c. .	1,500
General management, government, and staff of the institution	1,500
Contributions to the library, museums, and collections	1,900
Prizes	100
Exhibitions to meritorious students	5,000
Total expenses . .	£20,000

These expenses would be provided for according to the different circumstances of each centre. It must be remembered that the county or counties would supply a large number of the students, and therefore reap a large proportion of educational benefit. On the other hand, the shop-keepers of the town and the owners of houses would derive direct emolument from the influx of students to the central town, independently of the superior education which they could give their own children. Town and county are therefore equally called upon to make liberal contributions; and in a short time we might expect to have some such receipts as the following:—

RECEIPTS.

Government grant for salaries	£10,000
Annual grant from the town	2,000
Annual grant from the county	2,000
Fees of the students	1,000
Foundations for exhibitions	5,000
	£20,000

In conclusion, it must not be forgotten that these fifteen colleges, well organised and administered, will exert a powerful influence for good over all the other educational institutions within their circuit.

All the elementary schools, parish schools, trade schools, and workmen's schools of the district will naturally work up towards the great central institution, and emulate each other in the fitness of their students to enter the technical college and distinguish themselves there. Moreover, every young man of talent will see within his reach the means of increasing his knowledge, improving his ability, and rising to superior skill in the practice of his special duties in life. In this way, the nation at large will be enabled to turn to the general benefit of the community a vast power of native talent, which at present lies fallow for the want of adequate means of local culture and development.

CHAPTER XX.

A TECHNICAL COLLEGE ABROAD.

Special nature of a local technical college.—To fit the skilled trades of the district.—Pattern technical college—Special for the building trades.—Classes of workmen—Divisions of their education.—Professors and teachers.—Courses of teaching:—First course.—Second course.—Third course.—Fourth course.—Fifth course.

We have already studied the nature of a technical college in its twofold capacity of finishing the education of one class of students and preparing another for the higher education of the university. In regard to the latter class of students, the concluding classes of the college have only to serve as an introduction to the earlier courses of the university; but the students who have to complete and end their course of study in the college require a different though analogous education.

Special nature of a local technical college.

The classes in educated countries abroad to whom the local technical college forms the completion of their studies, are those technical men who aim at occupying the highest positions in technical trades and occupations in business, which may be said to rank immediately after and under the technical professions which are completed in the university. Immediately after and under the architect, we have in England a class of men called builders and clerks of works. The builder is a man who combines the skilled workman with the man of commerce, who contracts to erect a house for so much money; and the clerk of works is a skilled man set over him by the architect to see that his works satisfy the architect's design. Under the master-builder comes his foreman, who must be able to do the duty of substitute in his absence. The foreman will have under him leading hands, or men of superior skill to the others, who watch over particular departments of work.

Thus there is, in every branch of skilled occupation, a kind of hierarchy of skill, beginning from a humble kind of intelligent labour, and rising up to the highest kind of manual skill in the master-workman, and of intellectual accomplishment in the professional designer of work.

To fit students for the skilled trades of the district.

And it is for this second rank in skilled work that the highest order of technical education has to be provided and completed in these local technical colleges. But the nature of that education and completion of education in the local colleges must be varied with great judgment, and adapted with much skill, for the purpose of assisting and advancing the peculiar local trades in the district which contains the local technical college. If it be a city of large population and growing extent, in which much building is required, it is quite possible that the building trades might predominate among the skilled crafts of the district. In a district rich in mining and in minerals, the skilled metal crafts would predominate, and smiths, copper-smiths, and tin-smiths, founders, pattern-makers, and fitters, would predominate as much in that, as masons, bricklayers, carpenters, and plasterers would do in the other. In other districts, it might happen that brewing and distilling were the chief trades; or it might be a great district for horse-breeding and cattle-feeding. In a great seaport, on the contrary, ship-owning, ship-building, and merchandise, might form the staple occupations of the town or district.

Thus, in each centre of a district possessing a technical college, there must be a special local organisation provided, in addition to and in some degree modifying the higher technical education, which is to prepare the more highly educated students for the technical university. But between those two classes of education given in the same technical college, there need be no inconsistency or interference. Up to a certain point, the theoretical education given in both will be the same. But in the last years of study there would probably be this distinction established, that while the higher class of students go forward in their purely theoretical and scientific studies, the practical class of students will stop short in their theory, and devote their last year of schooling to the more directly practical subjects of their business in life. Thus there will be many classes which all the students will attend together, but there will be others in which they go different ways.

Pattern technical college—special for the building trades.

I have selected as my type of the class of schools which fulfil my idea of finishing training for the highest class of practical working men, a college established for the education of a district where the building trades were sufficiently predominant to make that the leading feature of a technical college. The Building Trades' College at Stuttgardt is, I think, the best working man's school with which I am acquainted. It ranks next under their technical university, but it has been so successful that it has outgrown all the earlier anticipations of its magnitude and importance; and there is now preparing for it a building as large, and an organisation nearly as extensive, as the technical university. I do not believe, therefore, that I can better contribute to the establishment of local practical colleges for high-class master-workmen, than by giving a somewhat detailed account of this model working man's college.

I.—The Students of the Building-trades' School.

The purpose of this school is to give a systematic, organised, practical education to the following classes of technical men in their trades:— Classes of workmen:

1. Future master builders of the trades of builders, stonecutters, carpenters, and joiners.
2. Town-surveyors, inspectors of buildings, officers of health and public security.
3. Engineers of drains and sewers, and millowners.
4. Surveyors and measurers.
5. Workmen in all the following trades who may be desirous to qualify themselves to become masters, foremen, or leading men:—
   Plasterers, slaters, bricklayers, mechanics, millwrights, locksmiths;
   Carpenters, glaziers, turners;
   Painters, ornamental carvers, modellers, and moulders;
   Engravers, gold and silver workers;
   Gardeners and farmers;
   Draughtsmen.

II.—Courses of Education.

Divisions of their education.

1. Building School. 2. Surveying and Measuring School. 3. Water-works and Draining School.

III.—The Professors.

It is to be remarked of this excellent college, that the teaching staff transcends all our English notions in eminence and strength. Professors and teachers.

In this workman's college there are no fewer than twenty professors, and these professors are not men of inferior position and humble social rank, but men of eminence and distinction. Imagine in London, our having the courage to propose, or even to dream of taking our most distinguished architects, engineers, builders and philosophers, and making them professors in a workman's college! Some one will say, perhaps, that in Jermyn Street Museum we do something of the sort.

I have only to say, with the highest respect for Jermyn Street, that as a working man's college no comparison can be instituted that is favourable to Jermyn Street, excepting in the fact, that some of our most distinguished men have lectured there, and that some of the classes are known to be attended by workmen. That Jermyn Street Buildings and Jermyn Street Museum might aptly form the nucleus of a great college for the building trades of London, I am perfectly willing to admit, and it would indeed give me great pleasure to see it become, what the college in Stuttgardt is, a favorite resort of working men, filled day and night with teachers enthusiastic, and students zealous, industrious, and ambitious. I ought not to begin the list of eminent men who teach in Stuttgardt, without saying that Oberbaurath Egel, the first on the list, is the man to whose patriotism and enthusiasm the existence and maintenance of the school are mainly owing. He has done for it what Sir Henry Delabeche did for the school of Jermyn Street. In regard to the other professors, I call particular attention to the fact, that the larger number of them are technical men, and not merely professors and teachers.

Principal.

Chief Architect of State	Von Egel.

Vice-Principal.

Professor	Häberle.

Teachers of Building Trades.

Chief Architect	Von Egel.
Master Builder	Silber.
Master Builder	Stahl.
Architect	Beyer.
Architect	Wagner.
Architect	Riess.
Architect	Walter.
Master Workman	Baumgartner.

Teachers of Surveying and Mathematics.

Chief Surveyor	Wall.
Foreman Surveyor	Remmell.

Teachers in Mathematics and Physics.

Professor	Häberle.
Professor	W. Fischer.
Machine Builder	Teichman.
Professor	Bopp.

Teachers in Drawing and Ornament.

Sculptor	Plock.
Architect	Grauth.

Teachers in other Departments.

Doctor	Büchchele.
Doctor	Frauer.

Assistant Teachers.

Häuel, Dewzel, Andelfinger, Scherer, Fischer, Lochman, and three others.

IV.—Curriculum of Education.

The curriculum consists of five divisions, the two first elementary and the three last practical. Each division is also subdivided into two parallel divisions, and each division may be taken either as a summer or a winter course, so that students whose trades pre- **Courses of teaching:**

dominate in summer or in winter can attend the school at the least sacrifice. The whole payment for a complete course in any one of these divisions is 20*s.*, but there are also many free scholars, and many pupils who have exhibitions, both from the State, from communities, and from private foundations. It need hardly be added, that nearly the entire cost of the maintenance of the school is provided by the public funds.

Course of Instruction in the College for the Building Trades.

First class.

FIRST CLASS.

Two Parallel Divisions.

Destined for such pupils as have only visited the National school, or who, having attended a higher school, are not quite up to the mark of the second class.

LANGUAGE OF THE COUNTRY.

Eight hours a-week.

Dictation ; reading, prose and poetry ; explanations and preparations of the same ; exercises ; lectures.

FRENCH LANGUAGE.

Four hours a-week.

Exercises in reading, and translation for beginners.

HISTORY AND GEOGRAPHY.

Four hours a-week.

The principal events of ancient and modern times ; physical and political geography.

CALIGRAPHY.

Six hours a-week.

Perfection of handwriting ; simple copies.

ARITHMETIC.

Six hours a-week.

Vulgar and decimal fractions ; simple and compound addition ; interest and per centage ; proportion.

ELEMENTARY GEOMETRY.

Six hours a-week.

Plane geometry, up to trigonometry.

FREE-HAND DRAWING.

Six hours a-week.

Simple lines and combinations; simple leaves and ornaments in outline.

GEOMETRICAL DRAWING.

Six hours a-week.

Geometrical constructions; geometrical proportions and geometrical ornaments.

SECOND CLASS.

Second class.

Two Parallel Divisions.

LANGUAGE OF THE COUNTRY.

Six hours a-week.

Continuation of the subjects of the first class, with an increase in the exercises on style.

FRENCH LANGUAGE.

Two hours a-week.

Practice in reading and translation for advanced pupils.

CALIGRAPHY.

Three hours a-week.

Plan.

ALGEBRA.

Eight hours a-week.

Literal calculus, powers, roots, and logarithms; equations of the first and second degrees.

GEOMETRY, AND THE GEOMETRY OF SOLID FORMS.

Eight hours a-week.

Repetition with the pupils of the first class, and completion of the remaining divisions of plane geometry; geometry of space with regard to representative geometry; calculation of cubical contents.

BUILDING PLANS.

Eight hours a-week.

Simple foundations; projections and sections; plane projecting and curved decorations; simple buildings in antique and Gothic styles, after drawings with measurement and descriptions on the black board.

ORNAMENTAL DRAWING.

Six hours a-week.

Simple ornaments in outline from copies and casts.

THIRD CLASS.

Three Parallel Divisions.

Third class.

Physics.

Six hours a-week.

Balance and motion of solid, fluid, and gaseous bodies; the laws of heat; on the phenomena of sound, light, magnetism, electricity, and such parts of chemistry as concern building materials.

Representative Geometry.

Eight hours a-week.

Descriptive geometry of the highest order, with immediate reference to its application to the purpose of architectural design and practical building construction.

Trigonometry.

Two hours a-week.

The trigonometry of right-angle triangles.

Practical Geometry.

Six hours a-week.

On surveying, levelling, and map-making by means of planes, reflecting instruments, and levels.

Plan Drawing.

Six hours a-week.

Complicated architectural details; windows, porticoes. Exercises in the adaptation of the simpler forms of buildings.

Ornamental Drawing.

Six hours a-week.

Principally drawings from casts in outline and shading on white and tinted paper, with pen, pencil, and chalk.

Building Art.

Five hours a-week.

On decorative construction in stone for windows, cornices, doors, &c. Some of the drawings must be full size.

Building Construction.

Five hours a-week.

Constructions in stone; partition walls, windows and roofs.

Fourth class.

FOURTH CLASS.

Two Parallel Divisions.

Mechanics.

Three hours a-week. (One professor.)

Examination in the laws of gravity ; application to beams, rafters, &c. ; on stability ; machinery, with regard to the uses of workmen.

Applied Descriptive Geometry.

Six hours a-week. (Two professors.)

Pure descriptive geometry applied to stone carving, light and shade, and perspective. Drawings from copies.

Architectural Drawing.

Six hours a-week. (Four professors.)

Drawing of entire façades in outline ; large drawings from small copies in strictly Renaissance style, preparatory to designing.

Ornamental Drawing.

Four hours a-week. (Two professors.)

Continuation of the instruction of Class III., with use of the paint-brush.

Architecture.

Two hours a-week. (Two professors.)

Decorative forms of timber and woodwork. Lecture and practice in drawing.

Building Construction.

Five hours a-week. (Two professors.)

Timber supports, struts, and ties, roof frames, &c.

Inspection of Buildings.

Four hours a-week. (Two professors.)

Instruction for overseers and inspectors of buildings ; designs and other preparations for superintending the erection of a building ; rules for the method of working, &c.

On Warming and Ventilation of Buildings.

Six hours a-week. (Two professors.)

Properties and heating power of fuels ; temperature of ignition, and necessary air for heating ; draught of chimneys, calculations of their dimensions and construction ; ranges and fireplaces, baking houses, &c.

On the Various Styles of Architecture.

Four hours a-week. (Four professors.)

Short remarks on the commencement of architecture ; account of the Roman and Greek styles in detail.

This department is specially illustrated by diagrams.

Fifth class.

FIFTH CLASS.—(Division A.)

Ornamental Modelling.

Four hours a-week. (One professor.)

Modelling in plaster and clay, generally after their own drawings; plaster castings from clay models.

Building Construction.

Four hours a-week. (One professor.)

Difficult wooden roofs, suspension roofs, &c.; various roofs, their advantages and disadvantages; scaffoldings, ceilings, and roofs with a partial and entire application of iron; carpenters' and glaziers' work.

Designs for Buildings.

9 hours a-week. (One professor.)

Designs for simple town and country houses; simple buildings on a limited or unlimited space; parsonages, farms, stables, small breweries, schools and town-halls. The designs are to be made in ground plans, sections, and elevations, and the façades shaded either with pen or pencil. There will be a competition during each half-year, when a premium will be offered and the drawings publicly exhibited.

Architecture.

Four hours a-week. (Two professors.)

Early Christian styles; Roman and Greek; Renaissance; lectures and drawings after special diagrams; excursions to see different buildings.

Construction of Roads and Bridges.

Four hours a-week. (One professor.)

On drawing up contracts for materials and labour, and a detailed account of costs.

Agriculture.

Three hours a-week. (One professor.)

Designs and contracts for laying out farms, with their buildings and outhouses and breweries.

Mathematics.

Four hours a-week. (One professor.)

Repetition of elementary mathematics, with fresh exercise.

FIFTH CLASS.—(Division B.)

Designs for Buildings.

Development of designs according to programmes for advanced pupils. Larger schoolhouses and town-halls; hospitals, poor-houses, hotels, breweries, &c.

SCHOOL OF SURVEYING AND MEASURING.

Geometrical Construction.

Two hours a-week. (One professor.)

Solutions of geometrical problems; construction of algebraic expressions.

Application of Algebra to Geometry and Stereometry.

Six hours a-week. (One professor.)

Solution of geometric and stereometric problems by means of calculus.

German Exercises.

Two hours a-week. (One professor.)

SPECIAL CLASSES FOR GEOMETERS.

Descriptive Geometry.

Eight hours a-week. (One professor.)

As in the third class of the Building School.

Physics.

Six hours a-week. (One professor.)

As in the third class of the Building School.

Trigonometry.

Six hours a-week. (One professor.)

Practical trigonometry and polygonometry; transformation of rectangular co-ordinates.

Plan Drawing.

Four hours a-week. (One professor.)

Field and land planning and surveying.

Popular Building Construction and Building Drawing.

Eight hours a-week. (One professor.)

Explanations of ordinary building construction with regard to the measurement of buildings; drawings of simple outlines of buildings.

Practical Geometry.

From 6th Nov. to 15th March, 6 hours a-week. From 16th March to 1st May, 28 hours a-week. (One professor.)

Lectures and practice; theory of instruments; surveying and dividing planes by cross-staff and theodolite; distances and sections; surveying contour lines by the level; graphical trigonometrical and polygonometrical determination of points by measuring table and theodolite; errors and co-ordinate calculations; trigonometrical measurement of heights.

Mathematical Practice.

From 6th Nov. to 15th March, 12 hours a-week. From 16th March to 1st May, 4 hours a-week. (One professor.)

Repetition of algebra, geometry, stereometry, and the solution of various problems by construction and calculus. Drawings with the necessary ground plans, sections, and façades. Lesser competition prizes for the pupils at the beginning and end of each course, and at Christmas. Public distribution of prizes.

Designs for Building Constructions.

Six hours a-week. (One professor.)

Construction of designs from prescribed conditions ; simple and complicated roofs, staircases, ceilings, &c. The drawings are to be on a large scale, and the most difficult portions given in great detail.

Repetition of Mathematics, Physics, and Mechanics.

Six hours a-week. (One professor.)

Essays on Building Designs.

Two hours a-week. (One professor.)

SCHOOL FOR DRAINING AND WATERWORKS ENGINEERS.

This branch is in the course of formation.

Machine Drawing.

Eight hours a-week. (One professor.)

Drawings of wheels and toothed wheels ; drawings of parts and wholes of machines.

In conclusion I may add, that the taste of the students is cultivated, by placing before them models of beautiful objects belonging to their trades—museums, collections, drawing rooms, modelling rooms, workshops, are all contained in a large building recently erected for the purpose. It is palatial in extent and beauty, and is a monument of the care, forethought, and patriotism of a small community of German folk, one-twelfth of the number of our own Anglo-Saxon community.

CHAPTER XXI.

ON ENGLISH CLASS EDUCATION, OR THE EDUCATION OF CASTE.

Marked distinctions of caste in English universities.—Teachers of the poor, and teachers of the rich.—Ought the poor to be ill taught?—Do not the difficulties of poor scholars require able teachers?—The poor scholars' school.—Necessity of refined teaching.—Middle-class teaching should be also the higher class teaching.—Higher class teaching must not be lowered.—Middle and lower class teaching must be raised.—Abolition of class distinctions, its social value.—Are not technical schools class schools inevitably?—Therefore elementary schools should be broad, not narrow.

I HAVE elsewhere shown the humanising, refining, kindly results which grow out of an organised system of public education, embracing indiscriminately the children of all citizens. The schoolroom, the church, and the army, form in some educated countries the common ground on which all citizens meet, and in such countries I find, more than elsewhere, that all citizens are eminently patriots. All classes become educated, humanised, reconciled—I had almost said christianised—by this mingling with common aims in common ways. A school is a brotherhood; and a brotherhood which embraces high and low, rich and poor, in one common work, with one common feeling, is a humanising, christianising nursery for men.

The practical effect soon shows itself in the ways, manners, and bearing of the people. The poorer have become gentle and self-respecting; the rich recognise, respect, and work with the poor. The public spirit of the village, of the county, of the county town, becomes a livelier, more pervading, active impulse, and men deny themselves much and willingly for the common good and to help each other. In short, by this community of superior education every one is raised, no one lowered.

Marked distinctions of caste in English Universities.

After having contemplated the humanising effect of a large uniform systematic education for a whole people, one can scarcely avoid seeing how much in contrast with that is the whole system of English education. Perhaps in no country in the world is class education carried to the extreme it is in England. The gentleman commoner at Oxford wears his gold-laced gown; the peer his distinguishing cap; the poor scholar his bursar livery. There is one college reserved for the scholars of this aristocratic school, and another for that; and if it be true that thereby the bonds of companionship are drawn close, and that the friendships of life have first taken root in the intimate intercourse of the college, it is equally true that the separations of class first marked out at school or college continue through life, and only ripen into stronger sympathy and antipathy by the political, social, and religious distinctions into which they afterwards develop themselves. It is true that in the external observances of society abroad, some distinctions of class are more marked than in England, but nowhere do they enter so deeply into the heart of social intercourse, or keep men so wide apart.

But the class distinction in schools which pervades the highest descends even into the lowest class. The poor school is an establishment essentially different from the rich; first, in the rank and payment of its masters—"anybody is good enough" to be master of a poor school. To teach the poor he is paid less than to teach the rich; the matter he teaches is only of the meanest order; and although the ignorant dame school is nearly abolished, the change of sex has not always improved the character of the teaching.

Teachers of the poor, and teachers of the rich.

Is this difference in the nature of the teaching as against the poor, right or wrong? Is it the ignorant and helpless who should select their teaching, or should we who know select it for them? Ought the poorness of the teaching to be proportioned to the poorness of the taught? With this view let us ask: Is it not a more difficult task to teach the poor and the ignorant, than to teach those prepared pupils, who bring to the school minds that have had preliminary culture? Are not the very natures of the poor and ill-bred harder to deal with? Is not the problem we put to the teachers of the poor, harder and more arduous than the problem of teaching the rich? Ought this class of men then to be inferior, and worse paid?

Ought the poor to be ill taught?

Do not the difficulties of poor scholars require able teachers?

Moreover, in an unpopulous, remote, or poor district, are there not other peculiar difficulties which draw upon the talent, the education, and the moral qualities of the teacher? Is it not hard for him to bear up against the lowering influence of an atmosphere impregnated with ignorance? Is it not desirable that the indirect effects of his presence in the district of his school should be as beneficial to the general, moral, and intellectual tone, as his direct instruction? If this be so, then our class idea, that a poor, ignorant, inferior teacher is good enough for a poor, ignorant, inferior class, must be abandoned, and for the most arduous work we must select as able a man as we can find to fill the place.

The poor scholars' school.

Having selected for the poor district the able teacher, we must now help him by the best machinery. The home of the very poor has an atmosphere too often the reverse of all that we should wish his school to become. The bright, happy home, with cheerful influence, intelligent conversation, elevating surroundings, is reserved for the children of the rich, the fortunate, the educated; crowded cottages, narrow lanes, and a dingy atmosphere, are unfavourable to home study. To the poor scholar, the school is, or ought to be, the bright, clear, pure idea of his life: the interior of the school should represent the interior of a happy home; light and a pure atmosphere should fill it; things of beauty and knowledge should cover the walls; he should listen to gentle sounds and kind accents; a pretty garden, full of native flowers, should surround a tidy schoolroom; and a clean, roomy playground should be deemed even more essential to the school of the poor than to that of the rich, who may find in their own homes all the recreation they may need.

Necessity of refined teaching.

Besides, in the poor child's school he may have to receive all the education he is ever to enjoy. The rich man's child may go from the elementary teacher through higher and higher grades, ending with the university. It is therefore neither right nor wise that a worse teacher or school-house should be provided for one than the other; and for every intermediate class the same principle must hold good—that if the education and the influence of school is to colour the life and determine the character of the pupil, it follows, that the more his condition is surrounded with circumstances adverse to intellectual development, and affected by influences unfavourable to refinement of taste and manners, the more necessary it becomes that his school should furnish the antidote to the peculiar evils, and supply the characteristic defects in the life, manners, and habits of his class.

If, therefore, it is desirable that the middle class of Englishmen should possess greater refinement of taste than now characterises them; if their manners should be softened, their aims elevated, their principles raised, it becomes necessary, that in all their schools the children should be surrounded, influenced and educated by such men as possess the manners, ways, habits, principles, and attainments we desire to bestow upon them, and that they should retain through life. Need we call attention to the lamentable fact, that a great mass of the schools now called middle-class, have an atmosphere the very reverse of that which is desirable?

Middle-class teaching should be also the higher class teaching.

The practical measures to give effect to such views are of extreme simplicity. We do not desire to see a finger laid upon the schools or colleges in which the rich obtain for their children the association, influence, and teaching of the most intelligent, accomplished, and refined scholars and men of science; it is every way for the good of the community, that those among us who are of high birth, connection, and occupation, should be prepared in their youth to show a high example of refinement, knowledge, and worth, to all over whom their wide influence will extend. But it is still more necessary, that those whom birth and fortune have endowed with fewer privileges should be aided to supply by their own exertions those deficiencies and wants which had not been so liberally supplied.

Higher class teaching must not be lowered.

But I shall be asked, whether I mean to carry out the abolition of invidious class distinctions at school to such an extent, as to oblige the children of peasant and peer to sit on the same form in the same village school. I answer at once, that that would be un-English, and

Middle and lower class teaching must be raised.

that in no organisation for the supply of the public wants should I think it necessary to compel him who possesses already his separate fountain of pure water to come to the public well and drink ; and whoever chooses to provide for his child at home or elsewhere, what he thinks a better kind of education, or would associate with his friends to provide a kind of education exclusively for their own children, should have full liberty to do so ; but if the system which I have advocated be carried out, this will be one of its most pregnant results—that the class of men who conduct the public schools, and the course of instruction which is provided for the whole people, will be of so high a character, and so perfectly organised for its purpose, that it will no longer be the interest of any man, in any rank of life, to have to seclude himself from his fellows, in order to acquire for his children the advantages of superior education.

To the privileged classes, therefore, it would be an advantage that they should avail themselves of the advantages provided for the community at large, but no obstacle could lie in the way of their bettering their own children in their own way.

Abolition of class distinctions ; its social value.

Thfs abolition of class distinction in the whole career of school life could not fail to exercise a most humanising influence, and to draw closer the bonds which bind men into fraternities, communities, states, and countries. Not only would all ranks be better known to each other, but the lines of demarcation in after life, instead of being hard, angular, and offensive, would be of that soft and gentle character which, by diffusing courtesy, facilitates intercourse and promotes friendly feeling. Moreover, one of the peculiarities which is reckoned to give its chief value to our public schools, would thus be imparted in a still higher degree to all our national schools. Our public schools are eulogised because they typify to boys the public life of the man, and so fit him for wrestling with the future. In how much higher a degree would not public schools, in which all classes received their training for life together, merit the name of training schools for the world, and how much better might the lessons be there inculcated of what we owe to superiors, equals, inferiors? Our schools then would become pre-eminently schools of the world.

Are not technical schools class schools?—inevitably.

But it may be said that we are now arguing against the very principle of technical schools. Are not technical schools, above everything else, class schools? The nature of society and the purposes for which they are created demand that they should be so. The artificial construction of civilised society demands that each member of the social scale should take on himself some special sphere of public duty, by which he should render his time and ability serviceable to the community of which he is a member; and public well-being demands that he should serve the community in the capacity he is best fitted to fill: to do this, his sphere of action must be narrowed—narrowed to a degree which, as regards the character and development of the individual, is terribly confined. Granting, then, the inevitability and value of a most narrowly special and purely technical education in the period of life which immediately precedes entrance on its practical duty, does it not follow that in exact proportion to this inevitable narrowness comes the necessity, expediency, and high social value of giving in early years a large, broad, common basis, for the social and intellectual life of the human being? In short, as the ultimate end of professional life is made narrow and confined by circumstances, should we not, therefore, make the beginning of life for the children over whom we possess absolute control, as wide, genial, humanising, as possible?

Therefore elementary schools should be broad, not narrow.

The occupations of life are then inevitably distinct, and inevitably tend to keep men asunder. What I contend against is the artificial aggravation, by means of schools for the youth of our country, of those extreme distinctions between rich and poor, refined and vulgar, polite and rude, which unfortunately have grown into wider distinctions, and keep the extremes of society further apart in ours than in more educated countries. If we admit that example is better than precept, why should we insist on herding the ragged together—crowding children into one school, and bringing them all up with the brand of pauper upon them?—herding another crowd, whose parents died in their youth, or were themselves victims of misfortune, and marking out this unhappy crowd in the degrading livery of charity children? And why, upward through life, should there be one building—one school—one seat at college—reserved for the son of the rich and great, and the poor and humble scholar of capacity and promise be removed apart into another? That is the kind of class distinction which we think the wise legislators of an enlightened country ought to efface from the programme of the thoughts, ideas, and habits to be inculcated on Englishmen of the next generation.

CHAPTER XXII.

THE ORGANISATION OF TECHNICAL SCHOOLS, SCIENCE SCHOOLS, AND TRADE SCHOOLS, THROUGHOUT ENGLAND.

Higher technical schools to be placed in centres of twenty thousand inhabitants.—Education of higher scholars in science and skill.—Ages, 12 to 15.—School in two divisions:—I. Preparatory for the Technical college—II. Finishing school for skilled trades—III. Night courses for the extended education of Division II.—List of teachers.—Six teachers for special local teaching.—These will be preparatory schools for technical colleges and universities.

Higher technical schools to be placed in centres of 20,000 inhabitants.

IN every community of Englishmen where 10,000 to 20,000 people live together, there are near 2500 to 5000 men earning the bread of their families by labour, skill, or learning;—these men must be succeeded and replaced by their children. These children will require knowledge and skill in a far higher degree than their parents ever learned in youth, or have since been able to acquire. Modern civilisation moves forward so rapidly that an uneducated generation will in future become degraded or starve. Every community or aggregate of 20,000 will require a superior, higher, or high school, for the education of its children—not in reading, writing, and counting merely, or the alphabet of knowledge; not in mere elementary knowledge of the world we live in, the names of its places, its peoples, its stories, its men, beasts, trees, and vegetables, its mountains, climates, and seas merely; not, in short, in mere elementary knowledge useful and indispensable to everybody;—but a higher school for the education of the children who have gone through the elementary schools—who have learned there all that every one else has to learn and know—to teach them all they will have to know, and to know better than those who went before them, in order to become useful citizens, and keep their place respectably in a world which is daily moving forward in knowledge and skill.

Education of higher scholars in science and skill.

These higher schools, common to all, must be placed conveniently in the midst of those communities; and when I say one in each community of 20,000 persons, it must be understood that when the population is much larger these schools should be multiplied; and I should prefer to commit the excess of placing too many schools in less populous districts, rather than the error of parsimony—for parsimony in education is waste of the worst kind,—it is waste of human beings.

Ages 12 to 15.

In a district of 20,000 inhabitants, there will always be 150 pupils from twelve to fifteen years old who require a superior education, and 150 more who ought to be prepared for skilled trades. It is for them that I should propose to have these science schools. The classes of pupils who should frequent such schools are especially two:—those who pass through it as a school of elementary science and knowledge, preparatory to the technical college, and these are the higher pupils who will devote most of their time to pure science—these will form the first division of the school; the second division of the school will consist of those who are about to start into active life without further education, and to these pupils this will be the finishing school.

School in two divisions: I. Preparatory for the technical college;

The separation between the educational courses of these students is easily conceived. In the beginning both divisions of pupils will have identical studies. The elements of the pure sciences; ability in processes of calculation; knowledge of the nature and qualities of matter; knowledge of mechanics; bookkeeping; some foreign tongue; ability to write and speak well in their own tongue. These studies are common to students of both divisions; but the difference is, that one division will continue these more abstract studies longer and further. The second division will abandon pure science sooner, and will take at once to learning the practical applications of theory to their own business. They will apply their mechanics and their geometry to duties of life. Skill to handle instruments; ability to draw by the eye; to draw by instruments; to measure work, and to plan work; laying out their own work; selecting their own materials; the ways of setting out work before it is begun; of designing; of finding ways and means; of keeping records of work, and of measuring and valuing it when done. All *that* should be thoroughly taught and thoroughly learned at those schools.

II. Finishing school for skilled trades;

Hitherto I have spoken without reference to the specialty which every one of these schools must possess. It must have a special adaptation of its teaching, of its masters, of its organisation to the characteristic trades of the district. This cannot be dictated beforehand. The district may be agricultural, pastoral, marine, commercial, mining—may be distinguished by textile, metallic, chemical, mechanical manufactures. All its predominating occupations and trades should find a special provision made for fitting instruction in these schools.

III. Night courses for extended

Each school will thus be double, as it is a preparatory or a finishing school; but I think that in every education of Division II.

case a third division should be added. I mean a complete series of evening educational lectures and classes should be provided, for carrying on and extending the education of those skilled educated youth who are unable to continue their day schooling.

This third division (the evening school) must not, however, be confounded with evening schools for unlearned, unprepared men. The passing generation may not be too old to learn, but it must be provided for elsewhere, because it would only embarrass and retard the progress of the youth for whose advancement this school is destined, if it pretended to instruct the uneducated and unprepared. It is not a mere school—it is a finishing school. From fifteen to eighteen, in these evening schools, the pupils who had used their time and opportunities well in the morning school from twelve to fifteen, would still be able to make progress for three years more. In these evening courses some would probably show such talent and proficiency as to make their further education in college or university a matter of serious consideration for the authorities of the school and the community.

List of teachers

The following teachers must be provided in all these schools :—

1. Teacher of Geometry.
2. Teacher of Calculation.
3. Teacher of Elegant Writing and Printing.
4. Teacher of Drawing Beautiful Forms.
5. Teacher of Colours and Beautiful Colouring.
6. Teacher of Measuring, Surveying, and Drawing by Instruments.
7. Teacher of Mechanical Principles and Powers and Use of Tools.
8. Teacher of Elements of Chemistry.
9. Teacher of Physical and Political Geography.
10. Teacher of Gymnastics, Principles of Health, Strength, Handiness, Dexterity and Military Drill.
11. Teacher of Reading and Writing well, English, and one more tongue.
12. Teacher of Book-keeping, Accounting, and Valuing.

Six teachers for local special teaching.

If to this list I add six more teachers for the practical application of science to the special trades and occupations of the district, it will appear that for one school eighteen teachers are required. I do not specify the peculiar duties of each of these practical technical teachers, because, as I have said, no two schools ought to be alike. In each county town, and in each manufacturing and commercial town, the special teachers would devote themselves to supplying the practical wants of their district. It will require, in the foundation of each school, grave consideration and wise forethought, in order to obtain the right kind and number of local trade teachers.

Eighteen teachers is a large, perhaps excessive, number. I should only propose going to this extent in centres of population so large as to require and be able to contribute to the support of a very large school. It is plain that many towns might come just under the size of those to which I have allotted technical colleges, and in these large towns the technical schools would really be a substitute for a technical college. In such a case the number of eighteen teachers might not be excessive. In a town of smaller population the expense and scale of the school might be easily reduced without impairing its efficiency by giving to each teacher two of the separate departments, thus constituting a school of nine teachers.

The third class of these schools in smaller districts might be reduced to an establishment of six teachers, by giving to each the teaching of three subjects; but I should not be disposed to carry this class of schools lower. It would be wiser to create lower down a higher class of upper village schools.

If we now take twenty of these highest class schools and allot 5000*l.* a-year as the salaries of its teachers, we shall have a Government grant of 100,000*l.* If we take 100 of the second-class schools and allow 2000*l.* a-year each for the salaries of its teachers, we shall require a Government grant of 200,000*l.* If of the third class, with six teachers, we take 180 schools at 1200*l.* a-year each for the salaries of its teachers, we shall require a Government grant of 200,000*l.* Thus these 300 schools would be maintained by the Government grant of 500,000*l.*

In estimating the value to the community of these science high schools, it is necessary to keep in view their relations to the schools under them, and to those above them. In the national organisation for an educated community, the mere mechanism of learning, or "three R's" as we call it, occupies from the sixth to the ninth year. Elementary knowledge occupies from the ninth to the twelfth year, and science in its elementary form only begins in the period from twelve to fifteen. It is plain that these periods must be strictly kept, and that the education in each must be strictly progressive and continuous with that to which it is contiguous. In this point of view children will leave the elementary school for the science school at the commencement of their thirteenth year, if they are destined to proceed further; but if their destiny be to receive no science education, there would have to be some distinct provision for continuing an elementary education beyond the age of twelve.

These will be preparatory schools for the technical colleges and university.

These higher science schools must next be regarded as preparatory schools leading up to the technical college and the technical university. These courses of study should, therefore, be taught with distinct reference to the higher courses beyond the schools, so that when the pupil who is destined for a higher education leaves these schools he may find himself just fitted to enter the career of the college beyond.

One of the great benefits arising from the wide distribution of these high schools among the mass of the people would be to discover and select young men of special talents to become the pupils of the college and the university. For this purpose it would be desirable that the communities and counties in which these schools are placed, should provide exhibitions by which poor students might be sent forward to the college and the university; and it seems probable that the spirit of English liberality which, in old times, has founded so many charities, would now be ready to come forward with funds for the endowment of exhibitions for the young men most likely to achieve future technical distinction, possessing talent without wealth. In this way these schools would become invaluable feeders to the colleges and the university.

The Government of these schools must in most matters follow the example of the technical colleges. The Government should select and pay the salaries of teachers. The locality should find the buildings and maintain them. The Government and the locality should both contribute to museums, collections and libraries for the school, and a council composed of a nominee of the Government, with the assistance of a representative of the teachers and representatives of the town and county, should govern the school. The fees of the students should go partly to the school funds in payment of teachers, and partly to the increase of the libraries and museums.

In regard to the site of such a school it cannot be too strongly urged on the inhabitants to provide a large and healthy park and grounds; but within the same park there might be included other buildings for other schools of the district; and if the whole schools were in a single group of buildings, two elementary schools might form the wings, and the science school the centre building of the group.

TABLE OF FINANCE.

First Class Schools— 20.	Government grant for salaries of teachers .	£100,000
Second Class Schools—100.	Government grant for salaries of teachers .	200,000
Third Class Schools—180.	Government grant for salaries of teachers .	200,000
	Total	£500,000

CHAPTER XXIII.

THE ORGANISATION OF TECHNICAL SCHOOLS FOR TRAINING SKILLED WORKMEN AND APPRENTICES THROUGHOUT ENGLAND.

Educated craftsmen only can achieve perfect work.—Educated workmen do the commonest work better than the uneducated.—Education teaches quick, easy ways of work.—Ignorant men waste materials, tools, and time.—Improvements of great value to society are lost from want of skilled men to use them.—Value of education even for "unskilled" occupations.—Education the essence of skilled trades.—Geometry.—Laws of motion, force, and mechanics.—Better schools, teachers, and teaching.—New laws of apprenticeship.—Short time and schooling.—Education of apprentices the only way to educate skilled workmen.—National want of organised village and workmen's schools.—1. Elementary village school.—2. Upper village school.—3. Town higher school.—4. Village evening science schools.—Exhibitions for apprentices.—Table.

Educated craftsmen only can achieve perfect work.

It is a grave error to imagine that the details and execution of important or valuable work, even from designs of distinguished masters, can be efficiently done by ignorant, unskilled, mere brute labour. I am continually asked why a man—whose business it is to turn a furrow, dig a ditch, wheel a barrow, move bricks, saw trees, plane boards, quarry stones, get coals, or hammer hot iron—need know anything more than how to handle a spade, use his arms, or manipulate his hammer; and whether more knowledge than that would not spoil their minds, and set them above their work.

Intelligent workmen do the commonest work better

To this I can answer, that taking the matter on the very lowest grounds, I never saw any kind of labour in which the man of greater intelligence could not do than the uneducated.

more work in shorter time, to better purpose, and with less waste, than the mere uneducated savage of civilised society. I have seen at the plough the clod-hopper, little more intelligent than the well-fed brutes in front of him, let his clumsy plough wriggle on with small care how it went, and little thought as to how its work were done; and I have seen the skilled ploughman, with half the number of horses, and with no greater toil to them, cover double space on the same kind of land with clean, straight, even, well-finished work. The one knew all about the draft on his cattle, the strains on his harness, the adjustment and action of his plough, and felt at his fingers' ends (instinct with intelligence) every variation of direction or force, which indicated whether his own slight pressure on the plough-stilt should give it bias one way or another. The one man avoids difficulty, because he sees it beforehand; the other endures it because he is in the middle of it before he knows, and so must go through with it. The intelligent ditcher who lays out wisely his day's work before he puts a spade in the soil, has so forecast and arranged it that every bit of earth is moved out of its old place into its new the shortest way, over the least distance, with the least force.

Education teaches easy, quick ways of work.

The skilled navvy can do double the work in the day of the equally stout but unskilled rustic; and if this be the case in the lowest operations of moving earth, it needs no iteration on my part to show that in every succeeding stage of work, in getting stone, or getting coal—even before we come to shaping, selecting, fitting, fixing, and finishing articles of workmanship—the more intelligent and better trained man will use his mind to apply his strength and wield his tools so as to spare strength, time, and

Ignorant men waste materials, tools, and iime.

material, either for himself or his master. Estimated, therefore, on the lowest scale of social value, education means economy, profit, absence of waste.

But when we come to the higher considerations which ought to influence the conduct of the governors, masters, leaders, teachers of a people; when we reckon up the value of an educated, disciplined, refined human soul above a mere tool-using animal; when we reckon the value of an enlightened citizen over a mere money-earning machine; when we multiply the value of such a citizen by the numerical value which his children, also educated, would add to the worth of the growing community—then, indeed, the calculation of our gain from education infinitely transcends the vulgar mercantile measure which we were at first compelled to take. There still remains the higher religious value of an illuminated soul, when compared with that of a sensual sot, which cannot be told in gold or any terrestrial measure.

Improvements of great value to society are lost from want of skilled men to use them.

But to return to the mere vulgar usefulness of educated human beings, I will venture a remark from personal experience in my profession, which I trust may illustrate the vast importance to us of educating not only governors, or masters, but of extending a high scientific education, and skilled technical training, to the working men of all skilled occupations. It is this: The community at large are deprived of the use of enormous treasures in mechanical invention, and enormous progress in scientific arts, by the fact of the general want of education in those who practise them. It may not be known, but it is yet true, that the mechanical power employed in all our manufactures is infinitely more costly than it need be. It is equally true that some skilled men of such professions know thoroughly how to produce immense economy in the production and use of mechanical power, but that we dare not put the means into the hands of the uneducated classes of people who would have to work them, nor into the hands of the uneducated masters under whose control they would be applied. I am not now speaking of a loss of five, ten, twenty, or thirty per cent.; I say that we know that we are only utilising one-tenth to one-twentieth of the power we employ and waste, and that an economy of 100, 200, 300, and 400 per cent. is quite within our power so soon as a better informed, higher skilled, more perfectly trained class of men and masters shall arise, who are fit to be trusted with the use of instruments and tools at present utterly beyond their comprehension, control, or application to use.

Value of education even for "unskilled" occupations.

Altogether apart, however, from this great and, unhappily, remote gain from the highest possible education of our race, there are more moderate gains within easy reach of better educated, better skilled, better conditioned working men. Ascending from the mere labourer to the skilled artisan, I will cite a single but remarkable example of the great advantage which education of the general intelligence gives even to practice of the narrowest calling. We have long been used to say and think that any ignorant man was good enough to make a soldier. We have been told that the mere mechanical drill of the service was sufficient to make even the best soldier. One might have been justified in saying that the narrow limits of walking straight, and shooting straight, and obeying a word of command, and going through a routine of formula with a weapon, would be readily acquired with the minimum of education, or with none. What does recent experience teach us, but the contrary of all this? It comes on us like a modern discovery, that the most intelligent men make the best soldiers, and General Hay has made an official report, based on the widest experience in the English army, that invariably the progress and perfection of a man's shooting depend on his previous standard of education, and that where this is wanting they have to educate the man's brains first before they can set him to shooting with any chance of success. And we may add to this testimony the example of the Prussian army as an army of educated men. An Englishman who will take the trouble, as I have done, to inquire among the Prussians themselves as to what they think are the secrets of their success as soldiers, will find that their best officers attribute it to nothing so much as to the high degree of intelligence and cultivation of the men of whom they have to make soldiers, and of whom they do successfully make them in incredibly short time.

Education the essence of skilled trades.

I have taken some illustrations of the value of education, even in occupations not heretofore classed as skilled, for the express purpose of proving the converse of statements continually reiterated to me by the opponents of the general and high-class education of working men. When we come to the upper ranks of skill there can be little doubt of the usefulness of some degree of knowledge far above our present standard. Every workman should for the most part be able to conceive clearly and accurately in his own mind the shape of everything he may have to make or work with. This makes it a first condition of skill that he should master shape in his own mind, and that mastery requires him to be a geometer. If that were

Geometry. true, there would be written over every skilled workshop the ancient Greek inscription :—

Οὐδεὶς ἀ γεωμέτρητος εἰσίτο ;

"No man ignorant of geometry enters here."

But it is not enough that the workman thoroughly masters the form which his work shall take, he must also be able to draw what we have called the three plans of his work on paper. This may be considered an unnecessary piece of skill for the man who has only to do the particular work assigned to him, and of which probably a perfect pattern is put before his eyes to guide him. But the mere seeing of his pattern is not adequate to superior execution. Every bit of work which one man does has to fit into some other bit of work of some other man's doing. In work there are degrees,—perfect fit and misfit of all grades. To make his work fit other people's, a man must know, not merely his own, but that of all about him. Each man should therefore understand the plans of the complete work on which he and his fellows are engaged in order to work well to the other's hand. The only way to get this thorough understanding of plans is to have learnt to draw them oneself. Complete plan-drawing applied to his own business is therefore essential to a good workman.

Laws of motion, Force, and mechanics.

Knowledge of the laws of mechanics is so obvious and inevitable a part of a workman's education, that it would seem unnecessary to say a word on its value, but for the fact that so many mechanics practising skilled trades are themselves awkward, clumsy, and unskilled in the use of their tools, and the ways in which they set about moving, setting, fixing, and finishing their work. If mechanical science were properly defined to be that which it is—the science of making tools and using them—the science of moving heavy bodies—of employing and directing force with economy and advantage—of shaping, uniting, and arranging materials so as to be strong and enduring; if mechanics were called the way to do all sorts of hard work with least expenditure of strength, in shortest time, and with greatest economy of materials; and if in schools it were taught so as to be worthy of the name—then no one would doubt that such schools should be created for all working men, and that all workmen should use them.

Unhappily, mechanics, when taught to working men, is generally either taught superficially, unphilosophically, or with little or no reference to the business of their life. Economy of bodily strength, best ways of handling things, best ways of moving things, best ways of helping each other, best ways of carrying, lifting, shifting things,—these are seldom taught. Some foolish algebraical formula, or abstract geometrical diagram, is put before the poor mechanic and called science. As well call it magic: it is as inapplicable and as useless.

Better schools, teachers, and teaching.

In short, the English workman's great want is:—1. Good schools; 2. Good teachers; 3. Practical teachers; 4. Collections of the best examples kept ever before his eyes; 5. Education at convenient times and places. For him far higher education is required than has ever entered into the heads of masters, teachers, or rulers to provide or care for.

New laws of apprenticeship.

The workman's technical education must begin with his apprenticeship to his trade, and continue throughout its whole period in order to do real good. The men of skilled trades who admit or reject trade apprentices would do well to see to the education of their own craft. They make many rules now—some of them useless enough—why should they not make it a "law of apprenticeship" that "Every apprentice shall prove that he has received a far better education than his master before he is admitted as apprentice?" Why should any boy be an apprentice before he is sixteen? Why should he not enter the technical school from thirteen to sixteen, and become a clever draughtsman, a fair geometer, a moderate chemist, a decent drawer of plans, a tolerable hand at colours, a clever handler of tools and implements, a well-developed, adroit, muscular lad? Why should he not be able to put on paper any shape he sees, shade it as he sees it, colour it as he sees it, and afterwards be able to model and cut out all he has drawn? Why should he not know the difference between an ugly shape and a comely shape? Why not know the difference of a clumsy way of doing things and a clever way—a careful way and a wasteful way? All this he can learn in a good school. All this he will not learn in the shop, for who is to teach him?

Short time and schooling.

But it may be said: "This school-work is lost time to his apprenticeship." No! For he will learn his work in the shop twice as fast, and twice as well, after this sort of schooling. Besides, what does a boy learn in the shop in his early years? Little but harm; nothing that he could not learn twice as well later in life after complete schooling.

I think, then, that apprentices to skilled trades should be placed in a technical school to learn science and skill before they enter on their apprenticeship. But I don't think schooling should end with the beginning of apprenticeship. After sixteen years a clever, educated boy has still much to learn that might serve him in after-life. I think, therefore, that all apprentices should work *short hours;* and I think that a portion of their time should be compulsorily spent *in school.*

Education of apprentices the only way to educate skilled workmen.

I dwell on this subject of educated apprentices because I have seen its great practical advantages to the after-life of skilled men. But I also dwell on it because I fear it is the only way to obtain educated working men. I am hopeless in the matter of educating the "working man" who has grown up into manhood without education. For the most part such men are too old to learn. I have never seen, but exceptionally, much good come of trying to drive figures and geometrical problems and mechanical theorems and light and shade into the head of a full-grown workman who had failed to get a good education when young. There have been brilliant exceptions—how brilliant! how few!

What I beg the skilled workman to do is to press on technical education for *his craft,* not for himself—for his own *children,* and his friends' *children.* I entreat him to forget himself, to pardon those parents and those rulers who allowed him to grow up uncultivated and untaught, and to give to those who are to follow him all that culture and all that science and civilisation which is indispensable to the maintenance, among other educated nations, of the character and reputation of the English craftsman.

National want of organised village and workmen's schools.

But I shall be told, and it is true, that "it is not the fault of the English workman that he, his craft, and his children are uneducated. There are no fit schools; there is no Government organisation." The ignorant cannot see to the teaching of the people. Those who are above them, and know and rule and govern—these are the persons chargeable with the education of Englishmen. The pilot of a ship has the guiding of the ship; the sailors only work it and obey their captain. The captain and the pilot are alone to blame if the ship is ashore for want of look-out or from miscalculation of courses or distance. So the pilot of the State should have foreseen the necessity of all this technical education, and provided for it long ago.

All that is so, but now let bygones be bygones. Let the statesman put education within the reach of every apprentice. Let him rule that "all apprentices to skilled crafts shall be technically educated," and then let us see the skilled workmen, as one man, uniting for the superior education of their craft and of their children.

The technical schools required in England for the training of English workmen are the following:—

1. Elementary village school.

1. *The Elementary Village School.*—A village school in an educated country is a very different thing from a village school in ill-educated England. Where we have one poor master or mistress, ill-paid, poorly housed, perhaps also ill-educated, educated Germany will have two or three schoolmasters to a single school, salaried by Government, trained and licensed from Government establishments for the education of schoolmasters—schoolmasters who have been taught not merely the things they have to teach, but also the principles of teaching and the practice of teaching, so that the teaching shall do the pupils most good and stay longest with them. They teach in the true sense of the word.

Now in these village schools with good trained masters, the time of the pupils is not wasted as in ours on mere reading, writing and counting; they are taught besides this all the things that reading, writing, and counting are good for. Reading is useless if the pupil does not learn by it something useful, interesting, and worth reading; writing is useless if the pupil gets no notions into his head worth writing about, and if he has nothing to say worth saying; arithmetic is useless if the pupil is taught nothing to use his figures about, if he has no accurate knowledge given to him worth setting down in exact figures, if he knows nothing of the nature of the things which have to be put into figures. In good village schools, supplied with good schoolmasters, every child will be taught those knowledges that are put into reading, writing, and figures, in addition to the processes themselves of reading, writing, and counting. This, however, requires a reform in village schools, and with that reform a skilled craftsman would begin his useful knowledge training in his village school.

Upper village school.

2. *The Upper Village School.*—In educated countries the upper village school is on a small scale what in a town would be a high school. It is a school for teaching elements of science to those villagers who are destined for skilled trades and occupations requiring intelligence and knowledge. The head teacher of an upper village school is a man of considerable education, and has generally one or two teachers under him. A child who has learned writing, reading, and counting, in the first school, may be transferred to the upper at the age of ten or eleven, if he be qualified; but if not, he should remain longer below.

In the upper school the boy improves his hand by learning ornamental or elegant writing and fancy printing; he learns reading and repeating aloud in sounds that fit the sense and meaning; he fits his figures and reckoning to the facts and uses of life; he learns to draw from observation, to measure things about him—he should measure his schoolroom and draw it on paper—measure his village and draw it on paper; he learns what things weigh—what things cost—how much stuff each thing is made of—how strong or durable it is—what each thing is good for—how it is made—where it is found or grown or made; he learns the geography of his country, its population, its taxes, its government, its laws, its customs, the history of its people, the nature of its soil, its productions, its manufactures; he learns not only the names of all common flowers, plants, and trees, but their natures, their soils, their rearing, their uses; he learns something of his own body, the nature of food, the causes of health and of sickness; he is taught the uses of his own limbs in a fit and adroit instead of an awkward and clumsy way; he is taught to sit, write, read, walk, run, leap, handle tools and instruments and weapons in a comely, useful, and dexterous way, instead of an unhealthy, ungainly, unseemly way. He may also here learn some geometry, some chemistry, some physics, some geography and geology, and a little French or some language other than his own, enough to let him know how differently other folks may choose to express the same meaning. All this a boy may learn in an upper village school, provided only the schoolmaster knows what to teach, has properly prepared pupils, has fit apparatus of teaching, has sufficient help, and has the inevitable quality of loving his pupils and getting love from them.

This upper village school is not a fancy school of my own imagining, it is such a school as I have seen successfully working in no very pretentious villages in foreign lands — where education is provided by wise governors and appreciated by an educated people.

Town higher school.

3. *The Third School*, for scholars from twelve to sixteen, cannot be a village school—it must be a town school. But such higher schools should be placed in towns, so distributed as to form centres, to which clever boys destined for skilled trades may be sent from the neighbouring villages. It is, however, chiefly the inhabitants of these towns themselves whose children will be bred skilled craftsmen, as it is their wont to congregate (perhaps too much) in towns, such as those in which high schools should exist. The technical high school of each town, if well organised, will give the boy destined to a skilled trade or profession all the education that can best fit him for his skilled work. But the village boy who shows talent of a special kind should be sent out of his village to the town school, either at the cost of his parent, of his craft, or at the expense of the village community. Thus the *élite* of our country population would be trained to those occupations which their natural aptness would enable them to follow out with most advantage to the community.

Village evening science schools.

4. What I have said regarding apprenticeships being limited to short hours and supplemented by technical schooling, requires that there should be evening special schools for finishing the education of apprentices. In a village where there is an upper village school with

good teachers, there is no difficulty in arranging that courses of science teaching, of drawing, modelling, sketching, and colouring, and courses of practical experimental lectures on physics and chemistry and mechanics, shall be given; only it is essential that Government appoint the teachers, pay them, and provide ample apparatus of teaching, and collections of examples, models, and books.

Exhibitions for apprentices.

5. In the four preceding ways the young English workman may work his way up in knowledge and skill; but here he might have to stop, but for the aids of which Mr. Whitworth has set the pattern. Exhibitions, by which skilled workmen trained in science can be helped on their way to eminence in their business, and a superior education, will, I trust, soon become common in this country; but for this end the technical colleges I have described, and the great technical university, must be established. When this machinery is in full operation, the poorest man's son, blessed with heaven-given talent, will find a school ready to receive him, to nourish his mind with useful knowledge, and to prepare him for a sphere of higher usefulness at each successive stage of his youthful career;—and no man will be able to say that the learned and the governing classes of his country allowed his youth to pass in the hunger and thirst of uncared-for ignorance and unchristian neglect.

THE COURSE OF EDUCATION FOR SKILLED WORKMEN.

1. The First Village School—7th, 8th, 9th years.
2. The Upper Village School—10th, 11th, 12th years.

* 3. The Upper Village Evening School—13th, 14th, 15th years.

4. The Town Higher School—13th, 14th, 15th years.

* 5. The Town Evening Science School—16th, 17th, 18th years.

† 6. The Technical College—16th, 17th, 18th years.

† 7. The Technical University.

* These are finishing schools for those scholars who cannot proceed further.

† These are only for such scholars of distinguished talent as obtain exhibitions, and are thus enabled to educate themselves for foremen, managers, and masters.

CHAPTER XXIV.

THE TECHNICAL EDUCATION OF THE ENGLISHWOMAN.

The English home.—Woman's work, home administration.—Foundation of home.—Wise spending of husband's earnings.—Value and economy of fuel.—Wise treatment of fuel.—Value of food:—Money value—Health value—Strength value.—Cookery:—Waste—Frugality.—Family clothing:—Choice of materials—Cutting and shaping—Sewing, embroidery, mending.—Knowledge of laws of health and disease.—Prevention, not cure.—Religion.—Family education and training is special woman's work.—Woman's education should consist of that of all her children.—Virtue of mothers' teaching.—Seven years of home education.—Seven years of school helping.—Mothers' help in higher education.—This high education of special use to the poor man's wife.—An educated home.—The lone woman.—Education the special business of woman.

An Englishwoman is the head of an English home. Home is an English word, an English thought, a peculiarly English feeling, an English institution. Home is the place of the family; the fireside and the scene of family life, of family birth, growth, culture. Life in England is not what it is in other lands, the life of the forum, the rostrum, the bourse, the salon, the corso, the café, the spectacle. English life grows and shines hidden, in the bosom of the family. The foreigner who has not seen English life in the English home, knows nothing of England or the English.

When, therefore, I speak of the occupation of a woman, I speak of her occupation in her sphere of "home administration." Man does his work abroad, without, in the world, in the crowd; woman's work is to organise, regulate, animate, illuminate home. There is her sphere, and in it she has work, duty, labour to do; industry, art, skill to exercise; intelligence, knowledge, skill to develop. Education is required, special in its object; training in arduous work, method in execution, technical education.

Woman's technical work is the organisation and fulfilment of the duties of home life; and we must first examine the nature of these duties, before we can talk of the education and training they require.

The foundation of the home is marriage; the husband founds or finds the home; he brings his wife "home." He provides there shelter and comfort; and happiness is what he hopes always to find there. *She* has to make *that.* Henceforth his duties lie out of doors; hers lie indoors. He earns or gains their living abroad. He brings his earnings home weekly, monthly, yearly; that is his business. His wife's is, to spend that money—well, or ill?

Wise spending of husband's earnings.

The programme then of a woman's technical duty is simply this: How shall I spend my husband's earnings in our joint home, so as to make it yield him and us the best fruit? How shall I turn these hard-won earnings to best account?

"How to administer given earnings in the wisest, homely, household way"—that is a technical question, wanting some knowledge, teaching, training, education.

The money of a home has to provide for health, amusement, instruction. It has to provide fire, clothes, food, drink, music, reading, comeliness, knowledge, training, refinement.

Value and economy of fuel.

1. *Fire.*—Ought an English wife to know anything about fuel or not? Should she know that there is good and bad coal?—that what is sold to her as best coal is oftener bad coal than good?—that bad coal produces smoke and flame and not heat, and that one

wastes money and the other uses it? Ought a woman to know this knowledge, or is it beneath her?

I must answer once for all, that I do not think any household knowledge of this sort is beneath any well-bred, well-born woman. When of two things you have to choose, whether you will do the better or the worse, it seems to me you have a grave responsibility. It seems to me, if you choose the worse, or don't choose, you are to blame. It seems to me then, that a woman should know good coal from bad, or she may waste her husband's earnings. But next, if she buys only the best coal, comes the question: Is there a right way of using the coal and a wrong?

Wise treatment of fuel.

Ought an English wife to know how to use good coal; to use it to the purpose for which it is bought; to use it for light, cheerfulness, ventilation, warmth, cookery, cleanliness; or to use it to waste, smoke, discomfort? Is any knowledge necessary for that? Cannot anybody make a good fire?—keep a good fire, prevent smoke, maintain cheerful heat, warmth without waste?

Verily, there are few women who know this: the art to make, to maintain a good fire without excess, without waste, without smoke. Much science goes to understand a fire. 1. What is fuel made of? 2. What feeds the fire? 3. What wastes the fire? 4. What regulates the fire? 5. What makes flame? 6. What wastes heat? 7. What preserves and maintains heat? 8. What spreads it equally round a room? 9. What creates smoke, draughts, rheumatism, and colds?

It is not the work of a moment to understand and answer all these questions. A wise housekeeper should have asked them all, and got a good answer to each;

that is one element of English home, health and comfort. Can every English housekeeper solve all this?

2. *Food comes after Fire, or with it.*—To feed her household well, agreeably, wholesomely, without stint, without waste—there is a technical problem of home life. What does each kind of food cost? What parts of food are the more wholesome, the more nutritious? What kinds of food do harm?—to the young, the middle-aged, the old? What quantity should be cooked, so as to give plenty without waste? What is the real value of each kind of food compared to its price? What is the price of food bought wholesale and bought retail? What is the true weight of good kinds of food? How do I know good food from bad? How can I tell adulterated food from pure and wholesome food?

Value of food:

Money value;

What are the wholesome ways of cookery? What kinds of cooking render wholesome food more or less nutritious, palatable? What dishes are comely, elegant, clumsy, gross, vulgar? How can I use the least sum of my husband's earnings in housekeeping, and yet never make him feel in want of anything?

Health value;

Strength value.

Shall I be told that all these things come by intuition, by experience, by practice? That they are for the servants to study, not for the mistress? That in every English household they are already perfectly well done? If I am assured that this is already known and done, I have only to admit, that no technical education in housekeeping is required by Englishwomen.

Cookery:

But I fear the truth is less pleasing; that many an Englishwoman sorely feels, that that part of her education is at least not perfect. But I fear that many more Englishwomen and Englishmen do not know

Waste;

the truth about cookery and food. English food is often of the best materials in the world. English fuel is also of the best. English cookery, as a whole, is wasteful in the extreme, both of food and fuel. It is the fault of the Englishwoman; her want of technical education. She neither knows what is right, what is wrong, nor can she teach her servants what she herself is so ignorant of—the art of nutritious, wholesome, elegant, economical cookery.

Frugality.

Family clothing:

3. *Clothes.*—Should the mother of a family know anything about her own clothes—her husband's—her family's? What sort, quality, price of stuff, they should be made of? What stuffs wear well? what wash well? what wash out? Which parts wear out first? How to make these parts last the longest? What sewing holds? How many yards of stuff go to each piece of dress?—how much for lining, how much for trimming, how much for shaping, how much for sewing?

Choice of materials;

Cutting and shaping;

Should the head of a household know how to make anything with her own hands—out of her own head? to cut out, to shape and fashion, to use a sewing machine; to sew, embroider, mend? Should she know all about children's clothes, or nothing? Perhaps the Englishwoman we speak of may never want any of these knowledges; she is born above all these things. But may I ask: Is it of no use to know thoroughly the things our servants have to do, or our shopkeepers? Should we not know when we are well served? when we are ill served? to distinguish between those who do well, and those who do ill; teach our inferiors, if they don't know; criticise their blunders, detect and correct their faults? Is it beneath the head of a household, to add to the pride of birth and

Sewing, embroidering, mending.

the power of wealth, the excellence of superior intelligence and knowledge? Would it diminish your respect for a stately dame of a noble house, to know that she spared her husband's purse, and looked carefully after her own household? I know of a Queen of ancient race, who taught her daughters to wash their own lace; for as she wisely said, "My dears, you never know what you may come to!" Was she a foolish or a wise mother?

All about clothes I think woman's work and woman's duty: price, stuff, shaping, sewing, durability, washing, ironing, and mending. A woman who cannot do all these things, and teach them to servants and daughters by example and precept, has not to my mind got a good technical education.

Knowledge of laws of health and disease: Prevention, not cure.

4. *Health.*—There is no such physician as a wise wife or mother. Not to cure disease: that is a doctor's work: but to prevent disease, or to stop it at starting. What are our gravest illnesses?—neglected colds, indigestions, head-aches. Who first finds out that we are ill? Who knows what has caused our illness? Who first takes alarm? Why should not every wife know the early symptoms of disease, the cause, the cure? There—not by the sick bed, or in the hospital, but there, by the family fireside, the kindly mother should wisely watch the first symptoms of disease, wisely give the early warning, wisely apply the simple cure. Which is better in the house, a wise wife, or a perpetual physician? There is no technical training so valuable to a woman as that which shall enable her both to keep the doctor out of the house, and to send for him the moment he is wanted.

Religion.

5. *Religion.*—The cradle is the altar of the family; there the infant hears its first hymn of praise, dreams

its first dream of Paradise, wakes to see an angel face beaming over it. Our religion is our first mother love, our Christianity the earliest recollection of our mother tongue. But on this not a word more. Our mothers, and sisters, and wives, are all taught their Christianity, from their youth up. This part of an Englishwoman's technical education is perfect.

Family education and training is special woman's work.

6. The most important part of the Englishwoman's home duty is still to come. The character of the next generation of Englishmen and Englishwomen is to be of their mother's forming. Nearly all the education that forms character is mother's teaching—home education, family training. School may modify, but cannot supersede this first apprenticeship to human life. The world may cover and obscure the marks of mother's breeding: that early growth can never be uprooted!

If, then, the mother's teaching founds the future character, sows the early seeds of feeling, plants the first roots of principle, settles the tendencies and aims of life, grounds habits, prunes error, weeds out follies, checks faults, develops hidden talent, encourages native energy to steady application, and makes good the weak places of the young human creature—what after thought, and pains, and toil, and painful undoing and still more painful regret, may not a wise mother spare her children's lives! What glorious privileges may she not confer on these young human souls, making of them treasures for their friends, their home, their country, and their God?

Woman's education should consist of that of all her children.

All, then, that a child should learn, its mother should know and be able to teach. Not that a child should be tied to its mother's apron strings. But it is certain that the better the mother is able to teach the child at home, the better that child will learn at school, and work in the world.

Perhaps these are axioms and platitudes—I should be glad if I might call them so. Unhappily, most mothers know nothing of all the many things children most want to know in home life. What mother knows the name of every flower, what it is good for; what fruit it grows, what it is good for; what it feeds, what it kills, what soil it loves, when it blows, when it seeds, how it should be cared for? What child well trained won't want to know, won't be able to remember such familiar things? What mother knows the name of every bird—what tree it builds in, what sort of nest it builds, how the nest is lined, what shape, colour, and number of eggs it has; how long it hatches, at what season, what like the young birds are, what is their food, when they learn to fly, and when they leave their home; where they go in winter, where they find winter food in store, and where they shelter in rain, and storm, and snow; what language they use, and what they say to one another? What child would not delight in such a story; what mother would not delight to tell it, if only she knew? What mother knows the names of all the stars, and what they are, and where they go, and what they do, and what they are good for? What the sun is good for, and what it does to the moon, and to the earth, and to the waters of the sea, and to the air, and to the ground, and to plants, and to flowers, and to fruits, and to corn, and wine, and oil?

Virtue of mother's teaching.

All nature is a book—a child's book. Its mother is nature's best interpreter, if only she first knew!

A mother's teaching, home education, family training —what a wide field of mother's work—all a child should know; all *that* its mother should be able to teach.

Seven years of home education.

7. I have spoken only of infancy, of the first six or seven years, when as yet the school is not, and the pedagogue has not entered on the scene. If the mother's work must now cease, how glad will she be if she has done it well, and how grateful her children ever after. But must it now cease? Can a mother after seven be of no more help to her boys or girls—teach them no more? Let the mother herself say: can she help her boys in the evening, or in the early morning, with their figures, their reading, their exercises? Can she help their geography, their geometry, their history? Can she hear them their Latin, or translate their Homer, or recite with them a Greek play? If so, what a proud mother! Happy boys! blessed home!

Seven years of school helping.

But the girls? For my part, I doubt much if girls blessed with such a mother need ever go to school, or could ever better themselves by it. I am quite sure that a man would far rather marry such a mother's girls than the best boarding-school miss of the most fashionable girls' school.

Mother's help in higher education.

8. But even if mothers do not or cannot teach all their children all they should know, of how great advantage to initiate, to choose, to watch the education. What teachers would grow up under the inspection of well-taught mothers for the education of their well-prepared children! Thus every knowledge of the mother proves a treasure to her child.

This high education of special use to the

In all this education for women, in what I have called a woman's technical occupation, I may seem to have forgotten two things:—the education of the wife of a common peasant or workman, and that of the lone woman who must choose a trade. I have not forgotten the working man's wife. It is for the woman whose husband works hard to earn money that I propose this special and superior education to enable her to spare and spend his money as well and wisely as he earns it. It is most necessary for the poor man's wife to know the value of money and the nature of money's worth. The cost, value, and wise way of using fuel is to her and hers a first need; the first principles of cookery are to her vital conditions of existence. She, above all, should know how to select good food, to cook it wholesomely and nutritiously, to mix good drinks, to buy cheaply, and to get good measure and exact quantities of all she wants; to make all her markets wisely and well; to buy all of the best, and all at a moderate price—that is her special wisdom. How to clothe her children, her husband, and herself with good lasting warm stuffs; to select them herself, to cut them herself, to sew them herself,—there is occupation, enjoyment, virtuous work. Then to be able to teach her children all she knows; to be able to train them to be wise, virtuous, and useful like herself,—there is work and also happiness; and then to be able to receive from them grateful help in return,—there is reward. Then look at the poor man's leisure in a home illuminated by such an educated woman. Look at an evening fireside, where books can be interestingly and well read aloud; where songs can be sung correctly and well in parts in which all can join; where stories can be well told and games of intelligence played, and where each can benefit by another's knowledge. See how the evils and gloom of a humble lot vanish before the sunshine of an educated mother's home-

poor man's wife.

An educated home.

organisation. It is to the poor man that the educated wife is the great prize of life.

The lone woman.

But the woman who has no husband and no home—what has she to do? That is the remaining question which I have not touched. I do not propose to enter at all upon the wide question—Shall women learn men's trades, and practise them as men do? The life of man is a hard struggle with dead matter, with rude elements, with rough men, with a hard world. Women's sphere is home: I have shown how home-work is enough for all a woman's time and all her faculties; but there is technical work still for lone women to do which is fit for them, and for which they are apt or apter than men. First, there is work to be done by a lone woman in helping a mother who has many children, and too much to do; this vocation of helping is the nearest and best to having one's own. Next, I consider the business of education a special woman's business. Dame-schools are out of fashion in England, because they were in fashion when women were uneducated; but now, if women were well educated, the great burden of juvenile education might rest with them: women have eminently the faculty of teaching children; if they do not know, and, therefore, cannot teach well, that is our fault, because we withheld education from them. I earnestly commend as technical occupation for women the profession of schoolmistress, and for it women's training must be identical with men's.

Education the special business of women.

But although the trades of men may, in many instances, be better done by women, I do not propose to enter into that question; to me, women's work is home work. I have shown how technical it is; how valuable and extensive, and what a wide technical education it requires. I practically desire that the same education which is given to boys to the age of fifteen shall bc given to girls. When boys go to technical schools or colleges I would also send women to technical schools and colleges, and there I should teach them all the varied knowledge which would enable a mother to do wisely and well all the duties which I have enumerated as going to make a good administrator of a home and a competent teacher of a family, and an able and wise spender and hoarder of her husband's earnings.

There is, perhaps, one more vocation in which a woman might use some technical knowledge: she might help her husband in his business. To do so she would have to receive a similar education and training to himself. I do not think this can be made the subject of special women's training; the woman who has received the education I have sketched will be so well prepared for the work of life, that it will be easy for her husband to give her such further special teaching as will enable a willing heart to lend a helping hand to lighten the burden of a husband's work.

CHAPTER XXV.

WILL ENGLAND CHOOSE TO BE EDUCATED ?

What are the chances for England's becoming educated ?—Why should another country be better educated than England ?—Education in other countries one generation ahead of England.—The time for the education of one generation is past and lost.—Whose fault was it ?—Look to the future.—I. Find a fit Minister of Public Education.—Many difficulties obstruct him.—English prejudice and apathy.— Will the aristocracy take an earnest lead ?—Why they should.—Difficulties in Commons.—The opponents of education.—A high class of teachers indispensable.—Distinguished men can be obtained.—The rank and condition of professors, teachers, and schoolmasters must be raised.—Working men will not accept inferior teachers.—The organisation of teaching must be complete and systematic.—The succession of technical schools, colleges, and universities must form a continuous series.—Success and failure depend entirely on finding a fit man to be Minister of Education, and making him strong.

After all that I have said, thought, and written on the nature, value, ways, means, and mechanism for educating the people of England for their future work and well-being, I cannot refrain from asking myself again and again this great vital question :—

What hope is there that the English people will become an educated nation ?

Will English statesmen give this education ?

Will the English aristocracy lead the people towards the bright future of an educated people ?

Will English commoners, merchants, shopkeepers, and manufacturers vote public funds adequate for public education ?

Will learned, scientific, experienced technical men undertake the teaching of the people ?

Will the people of England accept systematic, organised higher education, culture and training?

I frankly admit that I have often had to answer these questions to myself in doubt, and even despair. When I first saw an educated nation, my impulse was to rush home and say to my friends,—Let us, too, become an educated nation. Alas! how few responded—Let us go and do it! Nevertheless time and the tide of human progress, rushing past the shores of our island, have moved a few among us to thought, hope and a little action; but so little!—so feeble!—so few!

Education in some other countries is one generation ahead of England.

England, standing by idle, has allowed the education of one whole generation on the Continent to pass her unheeded. Seven years are enough for the largest technical education; seven more years are enough for apprenticeship and practical training. The whole generation of younger men on the Continent, who are exercising their skilled crafts, trades, and professions in educated countries, have received a high education and training from the organised schools of their Governments. These young men, now between the ages of twenty-five and thirty-five, are distinguishing themselves and their countries by the excellence of their work, the higher quality of their manufactured materials, the economy of their execution, the beautifulness of their designs. Ask these men whether they think they and their country have benefited by systematic technic education, and you will get for answer—that to it they owe all their success.

The time for the education of one generation is past and lost.

Poor England, standing by idle, is too late! Her working men, foremen, and masters, grown up uneducated, cannot now become educated,—we are too old to learn! We have lost a generation! Whose was the fault—whose is the blame? Why did not our statesmen foresee this? Why did not our aristocracy, already provided with special universities and schools for their own training, take care that we should have our technical universities and trades schools for teaching us our business?

Whose fault was it?

Why did not our Legislature provide as liberally for our education as other legislators for theirs? Why was the vote for education not increased, even at the cost of income-tax or by the sparing from wars? Why did not our masters and manufacturers foresee that our trade was going away to more skilled nations, and warn us in time? Why did not the learned warn the unlearned and teach them? Why did not wiser men teach and lead the people?

Look to the future!

All these and such questions might have been wise and timely; they are now too late, and now it is much better to deal with the future than to recriminate on the past. We have all been wrong; let all help to mend our ways. We have neglected one generation, let us at once set about the next.

I. Find a fit Minister of Public Education.

The first question then is—What chance is there that England will find a statesman sufficiently large-minded, large-hearted, able and willing to undertake the education of the English people? He must first be a patriot, for the task is neither easy nor pleasant. To tell people they are ill-educated, that they are no judges of what good education is—to tell them to submit themselves humbly to the schoolmaster, is a very unpopular task. We English have an instinctive hatred of schoolmasters, pedagogues, and professors, and he must love the people better than to care about their opinions who undertakes the office of national pedagogue. Besides, he must know the matters with which he has to deal. Such a patriot statesman it will be hard to find. I know only one or two such men, and I much doubt if the nation would accept them and give them the full powers necessary to success. Prussia had a Humboldt, or she might never have had a national education. Who will be our first Minister of Public Instruction, and go through with it, and get it done thoroughly and earnestly? He who does will earn and receive the reprobation of this generation and the gratitude of the next.

Many difficulties obstruct him.

I am anxious not to conceal the difficulties of the undertaking before us. The English mind is not prepared for systematic organised education, and no other is worth having. We have good fragments in England of education, but it is a chaos of mere fragments without organisation. We want a good paved road to knowledge, and we have only remains of a great Roman road, impeded rather than paved with occasional fragmentary blocks. These we are so used to, that although we would scorn to take a beast of burden over a Roman road, and though we provide county roads and parish roads for the ease of our horses, and though we provide railroads for the transport of our bodies and goods, we leave the minds of our countrymen to struggle without help over antiquated paths in search of mental food and mental wealth. I have just read in Motley's "History of the United Netherlands" a passage which admirably describes our state:—

English prejudice and apathy.

"Meantime there was apathy where there should have been enthusiasm; parsimony and cowardice where generous and combined effort were more necessary than ever; sloth without security."

Will the aristocracy take an

When I am asked whether the aristocracy will head the people, and lead them to the bright future of an earnest lead?

educated nation, I am almost disposed to think they might, as I am firmly convinced they should. 1. Most of our good English families have themselves received a good education, the best England has to give, and for that reason, knowing the value of knowledge, and that it is a treasure that grows by giving, I think the Lords might take the lead in the people's education.

Why they should.

Next, I think it would be both generous and comely in them to do so, for it is the land which has in past time borne the burden of teaching the people, and it will probably be the land which will still bear the burden. The Lords are still the great occupiers of the lands of England, and it would be comely, gracious, liberal, and possibly prudent in them to court the burden of educating the people, and to assume the lead and direction of so agreeable, so grateful a duty as to unite their own children and the next generation of the people in such a bond of brotherhood. Could young England have a more useful duty, a more agreeable occupation of the leisure they inherit, than the culture and training of an improved race of Englishmen? I offer the matter to their consideration. I think it would be a noble thing to become the aristocracy of a cultivated, refined, Christian nation! A noble boast to say we have made England the best educated nation in Europe! Better even to be able to boast of a matchless breed of men than of race-horses, bullocks, or hounds.

Difficulties in the Commons.

What will the English Commons do is a still more difficult question than the Lords. They are a mixed body, of whom prediction is hard. I have heard an English statesman say that they are incapable both of organising methodically any public interest themselves and of letting some one else do it for them. Our

Post Office is an organised public service, but what difficulty to get it done! How well it works—how ill we receive and requite its services! Then how many of our rich commoners are ignorant, unrefined men, who have made wealth by quite other means than personal qualities, abilities, culture, refinement, who are quite innocent of science, philosophy, and all the "ologies!" If you ask these men whether they don't think their workmen worth better culture, they frankly tell you no! They don't want education to enable themselves to make money—why should their people have better education than their masters? You ask another distinguished citizen manufacturer if he does not think a little technical education would help the English workman to compete better with educated nations abroad; he answers, with a laugh, that as long as our stores of cheap coal and cheap iron last, none need fear foreign competition! That man is a respected representative of a chief manufacturing city, and that is a true measure of the state of mind of many of our manufacturing and trading magnates. Judge then of the help they are like to give to the cause of working men's education, culture, and refinement. Go to the office of the Council of Education, and ask whether they mean to initiate a measure of public education, or organise systematic technical universities, colleges, and schools; they will tell you that it is for the people who want these things to initiate them, and then come to the Government; or they will tell you that the Commons so begrudge the present estimates that they dare not double them. Or the minister will tell you that for this year at least there can be no increased expenditure on education on a large scale, as they are busily engaged in cutting down the estimates, or are fully occupied in paying for that great national undertaking, the Abyssinian war.

The opponents of education.

It wants then an able, wise, patriotic minister, strong in power, to carry the education of the people against ignorance, parsimony, and fear of unpopularity. If the aristocracy help him they may do much good, for we continue to vaunt our democracy and to be the most aristocracy-loving and fearing people in the world. I don't think the commercial, trading, shopkeeping, financing representatives of the people are in favour of a high education for their constituents. Educated constituents might choose other sorts of representatives. To that I agree ; they probably would.

But there are, happily, in the House of Commons, educated and refined men, who value the culture they possess, and who can foresee the blessings which an educated nation would enjoy, especially a nation consisting of so fine a race as the English people. The nature of the very highest sort is theirs. But the culture to make that nature noble we have withheld. There are many cultivated men who feel all this as strongly as I do, and will stoutly stand by the able minister who undertakes the work.

A high class of teachers indispensable.

Whether the work of teaching the English nation can be got done by men of a high class in character, condition, ability, culture, science, and refinement, is a matter of first importance but of serious difficulty. Pedagogy is an unpopular profession. Gentlemen don't like to turn schoolmasters. Schoolmasters are ill-received in English society ;—I much doubt if their wives are received at Court. I fear they are set down as of the trading class who open shops for selling lessons. I have spoken with excellent schoolmasters on their social condition ; I think their social condition is quite unworthy of the English nation. We deem the teachers of our children lower than shopkeepers,—we rank them as menials merely; I have known the parish schoolmaster rebuked by the parish parson because he rode on horseback for exercise instead of going afoot. If we don't change our opinions and our ways about the condition and value of a schoolmaster, our teaching will not thrive.

Distinguished men can be obtained.

Distinguished and learned men have been and are schoolmasters. The aristocracy, who are themselves educated men, know that none but superior men can give to their sons superior training; they therefore take for the masters of their boys eminent men. And how do they obtain them? They reward them with social rank, good emolument, church preferment, and deaneries and bishoprics. That is fit and right;—a good pedagogue is like to make a good parson. What then could be wiser than to follow, in the national education of the English people, the pattern set by the flower of the land? Let eminent and educated and refined men be made the teachers of the people; let them be well housed, well paid, well rewarded, well promoted; let us take care of their children, and we may expect them to take good care of ours. Our schoolmasters should be pattern men, and we should show our children our profound respect for the men whose teaching we wish them to value.

The rank and condition of professors, teachers, and schoolmasters must be raised.

The rank of the schoolmaster must therefore be raised before we can raise the education of our children, and the same condition is essential to the people's willing acceptance of the education we offer. The working people of England are not satisfied that the teaching we give their children is likely to be of use to them in practical life; mere reading, writing, and counting, are not useful to the working man;—it is waste of time to read that for which you don't care, to learn writing when you have nothing to write, and to learn counting and have no accounts to keep. Workmen's schools at present do little for workmen's children. But if technical schools for workmen's apprentices be once instituted which teach them the principles, instruments, methods, and economy of their business, all the aspect of education will change. When learning makes a good workman and man of business, all will be willing and ready to learn. They will willingly learn to read, write, and count, if these three things be the conditions of being afterwards and thereby initiated into all the higher branches of the knowledge of their craft and trade.

Working men will not accept inferior teachers.

But it will never do to let the teachers of workmen's technical schools be inferior, half-taught, or ill-taught men themselves. They ought to know thoroughly and profoundly the sciences they profess, and they must also know thoroughly the various businesses to which their pupils will have to apply their knowledge. The teachers must therefore be superior men, who are practical men themselves and have mastered science, or who are scientific men, and have taken the trouble to make a careful practical study of the uses to which their science has to be put. Without the teaching be of this sort, I venture to say that the working men and men of business will not have it; and these schools ill-taught will fail, and deserve the failure. The trial has often been made, and has always failed, so far as my own observation extends.

The organisation of teaching must be complete

There is another obstacle in the way of success likely enough to cause failure if not foreseen and forethought. If the work be begun on a small scale, it will probably fail; if on a large scale, it may equally fail,—and the difficulty is to ensure success. The scale, however, for organising education is a critical point. If you establish single isolated schools, or a single isolated college, or if you try a bit of a technical university, it will probably fail, and deserve failure. Indeed, the result of trials of this sort of experiment on human beings is, and ought to be, exemplary failure. The education of the nation is either worthy of being so done as to command success, or it is not worthy of any experiment. Other countries have paid for the lesson and learned it. We have made the failures and not learned any lesson. A technical university created in its completeness cannot fail to be a glorious success. But its success depends entirely on its completeness; it is only as a whole that it can work. It is a complicated engine, but the bits of it taken separately will not work at all. The whole engine must be set agoing, and must be kept going until it has worked out its own success. **and systematic.**

The succession of technical schools, colleges, and university must form a continuous series.

When our university is started it must from the first appear to be a failure. We have none of the machinery for preparing work for it to do. We have not the technical schools nor the technical colleges all through England which are required in order to prepare fit pupils for it. It will not do to send ignorant, unprepared students to such an university. Long systematic training is necessary even to enter there. Only the *élite* and talent which have sprung out of the lower schools can enter there. Nevertheless the university must spring into existence complete, for we want our superior teachers, our technical masters, to have there a complete training to fit them for training the scholars of the schools and colleges. To do this the courses of the university must be complete and perfect, not partial nor fragmentary.

On the other hand, the technical colleges and technical schools which train students for the technical university, cannot exist efficiently without the simultaneous existence over them of that university for which their highest and best pupils are to be prepared, and where these students are to find the highest reward and appreciation and consummation of their studies. Where they leave off, the university begins. Where the technical schools leave off, the technical colleges begin. Thus the whole national teaching must be one complete organised whole, or it will prove waste and failure.

What then is wanted is a powerful statesman; a strong will; a complete and organised plan of a people's teaching; a determination that, at whatever cost, the English people shall become in one generation the best educated nation in Europe,—and it will be done. Short of this is failure.

Success or failure depends entirely on finding a fit man for Minister of Education, and making him strong.

The conclusion, then, to which I am driven, is that the one thing we want is the right man fit to be Minister of Public Education;—that man to be made minister. The nation is, by its various representatives, to say England shall be a highly educated nation; the aristocracy to lead the van in education; the Commons to vote funds for cultivating our own nation, which shall bear some fair proportion to the sums voted for killing people of other nations. The education of the nation to be placed in the hands of able, distinguished, refined, and practical men, and the chaos of existing education to be rendered orderly, organised, and systematic. All this to be done by that one man—and that man to be sought for and found. It will not be done by a council of mediocrities, nor will it be done by a council of professors. One man must do it. Let us all agree to look for him—give him the work—and wish him good speed!

THE END.

BRADBURY, EVANS, AND CO., PRINTERS, WHITEFRIARS.

The Cheapest and Best of all English Cyclopædias.

The *Quarterly Review* says, "A work that, as a whole, has no superior, and very few equals of its kind; that, taken by itself, supplies the place of a small library, and, used in a large library, is found to present many points of information that are sought in vain in many other Cyclopædias in the English language."

The *Saturday Review* says, "Its great recommendation is not its comparative cheapness (though the cost only averages about 10*s.* 6*d.* a volume), but its originality, completeness, and general trustworthiness. We may express a hope that its enterprising publisher will have no reason to regret his considerable venture."

THE

ENGLISH CYCLOPÆDIA

Re-issue is now Complete, and sold as follows:

In 23 Vols.,	4to cloth	. .	with Index,	Price	£12 9*s.*
„ 12 „	„ half calf extra		„	„	£14 13*s.*
„ 12 „	„ half red Russia		„	„	£15 5*s.*

The ENGLISH CYCLOPÆDIA *can also be had in separate Divisions, each of which is a Complete Cyclopædia in itself.*

The *Times* says, "As regards the contents of this Cyclopædia, it is impossible to give any sufficient impression of an aggregate which includes somewhere or other all the information generally required upon every conceivable topic.

"The most complete Biographical Dictionary in the English language; whilst at the same time no work of a similar nature can even approach it in cheapness."

The *Examiner* says, "The cheapness and excellence of this Cyclopædia will secure to it wide circulation, and a permanent position."

The *Daily News* says, "In its completed form, the English Cyclopædia is destined, we are sure, to prove of immense value. It is well written, and its vast stores of knowledge are so arranged as to be readily accessible."

Macmillan's Magazine says, "Whoever wants an Encyclopædia, extensive and yet cheap, and compiled throughout on the principle of compendious and accurate information on all subjects rather than on that of collected individual dissertations, cannot do better than procure the English Cyclopædia' of Mr. Charles Knight."

BRADBURY, EVANS, & CO., 11, BOUVERIE STREET, E.C.