THE JOURNAL

OF THE

BOARD OF ARTS AND MANUFACTURES

FOR

UPPER CANADA.

EDITED BY THE SECRETARY OF THE BOARD.

VOLUME VII.

TORONTO:
PRINTED FOR THE BOARD OF ARTS AND MANUFACTURES FOR UPPER CANADA,
BY W. CHEWETT & CO., KING STREET EAST,
1867.

BOARD OF ARTS & MANUFACTURES FOR UPPER CANADA,

FOR THE YEAR 1867.

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THE JOURNAL
OF THE
Board of Arts and Manufactures
FOR UPPER CANADA.

JANUARY, 1867.

THE NEW PATENT ECONOMIC GAS.

It is one of the objects of this Journal to announce any new discoveries which may be of use to society at large, and to explain as far as possible what advantages may be offered by putting them into practice.

During the last few months, journals of more or less notoriety have occasionally made allusion to a new invention known as "Ensley's Patent Economic Gas." Notwithstanding the good authority under which some of these accounts have been published, we have always been inclined to look upon glowing statements of wonderful discoveries with a certain amount of incredulity, and so for some time we regarded this. Latterly, however, owing to the confidence with which the merits of this new gas have been proclaimed, from sources worthy of all credence, and especially from the undisputed fact that a town in Canada has actually been lit up with it, preconceived theories with regard to the invention appear to have been established, many of which when originally propounded were regarded with apprehension and suspicion.

The primary object of this invention is to produce an illuminating gas. The secondary object is, at the same time and with the same apparatus, to manufacture certain saleable and valuable products, namely, charcoal, tar, turpentine, pyroligneous acid, bone black, ammoniacal liquor, and other valuable substances. The patent covers the right to manufacture these articles from vegetable and animal matter, either separately or combined.

The materials best suited to the purpose are pine wood and bones. From the former gas has been made, but of a kind unfit for general use owing to its want of carbon, which is essential to impart the proper colour and brilliancy, on account of which defects, wherever it has been tried, it has generally been laid aside. The effectual meeting of this difficulty is what we conceive to be one of the chief merits of Mr. Ensley's patent. To attain this object he adds to the wood gas a quantity, equal to from thirty to fifty per cent., of gas made from animal matter. The best material and that most easily obtained for this purpose is bone, which not only yields a large amount of gas, but also affords, by means of the apparatus used, a large proportion of residuum in the form of ammoniacal liquid and bone black. These two commodities are manufactured in large quantities in many cities and towns of America, and are extensively used and known as fertilizers (the bone black being the principal ingredient in Coe's superphosphate of lime), and they will always find a ready market for this and other purposes.

The promoters of this patent contend, and say they are prepared to confirm by actual experiment, that which may appear at first sight to be almost incredible, namely, that the residuum of the wood and bones taken from the retorts are sufficiently valuable to defray more than all the cost of material and other expenses of every kind in the manufacture of the gas, thereby *leaving the receipts for the gas itself all clear profit.*

The following is a short history of Mr. Ensley's discovery, as published by the assignees and present proprietors of the patent, Mr. John Moffat, of London, and Mr. T. D. Ledyard, of Toronto:

"Mr. Ensley's discovery that illuminating gas and the other valuable substances could be easily extracted from common pine wood and bones, was, like many other valuable discoveries, at first regarded with much suspicion and distrust by the public, and many popular prejudices and fears had to be overcome before its commercial value and importance were fully appreciated. The test of practical success has, however, now stamped it as one of the most important inventions of this age of scientific discovery.

It is many years ago since, by a series of experiments, Mr. Ensley first demonstrated that it required but a very simple and economical apparatus to extract in large quantities not only gas but also tar, turpentine, charcoal, &c., from the common pine wood and roots which abound in almost every part of the United States and Canada. The gas, however, produced from these materials, although good, yet wanted one of the most valuable properties of a bright, light, viz., carbon. That property Mr. Ensley discovered, could be easily extracted from bones and refuse animal matter of all kinds, and he accordingly proceeded to mix a portion (say one-third) of the gas produced from this matter, with that produced from the wood, until he had a bright, steady light, perfectly free from smoke and smell, and quite as good as that produced from good coal.

Having satisfied himself of the genuineness of his discovery, he constructed a small model of the apparatus he proposed to use, and endeavoured to obtain the assistance of several eminent men to enable him to bring the invention under the notice of the public. He received, however, no encouragement from those to whom he addressed himself, and at length, after repeated failures to enlist the sympathies of influential men, he became disheartened, and suffered the model to remain idle for a number of years.

It was not until the beginning of this year that Mr. Ensley at length succeeded in attracting public notice to his valuable discovery. It happened that Mr. John Moffat, of Komoka, Canada West, was at that time endeavouring to introduce an economical light into his Seminary in the Village of Komoka, and seeing the commercial value of Mr. Ensley's invention, immediately entered into arrangements whereby the discovery might be properly developed and brought into public notice. The result was, that an apparatus costing about $500 was erected last May (1866), at the Seminary in Komoka, with a gasometer containing about 600 cubic feet of gas, more than sufficient to illuminate the entire building. The success of this first experiment is testified by the report of the committee appointed to investigate it by the Board of Trade, and also by the other gentlemen of the City of London, C. W., who visited the works on the 16th May, 1866. The apparatus is still in successful operation, and can be inspected by any one who chooses to visit the Seminary for that purpose. Komoka is a station on the Great Western Railway of Canada, situated ten miles West of London, and midway between the Suspension Bridge and Detroit.

A public trial of this wonderful discovery was made in the city of Detroit. Having disposed of the patent right for the State of Michigan, an apparatus on a larger scale, containing 2,400 cubic feet of gas, was erected in Detroit, and on the 27th July, 1866, and three following evenings, the Board of Trade Hall in that city was brilliantly illuminated, the light being declared by all present to be equal to that of coal gas.

The patentee and promoters of Ensley's patent economic gas, do not claim that extracting gas and other materials from wood and animal matter is altogether new; the merit of the invention lies in discovering a proper combination of vegetable and animal matter, to produce a good illuminating gas, and at the same time to develop all the valuable substances in the material used. The construction and combination of the apparatus, and the elements employed, are, however, *entirely new*, the inventor having obtained patents for them both in the United States and Canada. The small cost at which the apparatus can be constructed, will bring the luxury of gas-light within the reach of small towns and villages, and also of those living in detached dwellings. Hotels and manufactories, which at present have but imperfect means of illumination, can also, by means of this invention, be economically and brilliantly lighted. This invention is also worthy the attention of gas companies in cities and towns, as it may be used either separately or in connection with coal gas."

It is quite recently, within the last few weeks and since publication of the above, that the town of Cobourg has been lighted with this gas. The proprietors of the patent, as has often been the experience of proprietors of other good patents, found numerous objections and difficulties raised as to the practicability of using the gas for towns, where it would have to travel through miles of pipe, although they had established the fact of its being suitable for factories, where the gas had not far to travel from the works, as in the Komoka and Detroit experiments. In order to meet these objections, negociations were opened with the Cobourg Gas Company, an institution which had for years provided but a poor investment for its shareholders, and finally agreed to rent their works from them for the purpose of establishing, by actual demonstration, that the new gas possessed all the qualities claimed for it. The result has proved all and even more than was anticipated. Not only were the various residues produced as and in the quantities it had been asserted they would be, but the gas itself turned out to be superior to that formerly used, and there is probably *no town in America so well lighted at the present time as Cobourg.* The objections which had been raised as to the travelling properties of the gas were undeniably set at rest, as the lights at the extremity of the pipes, over a mile and a quarter in a direct line from the gasometer, but, owing to the circuitous course of the pipe, nearly *three miles* in reality, *burned as brilliantly as those at the works.* It is in this particular that most gases (excepting that from coal), which are otherwise good, have invariably failed to succeed.

At Cobourg, the gas is not only better than that which the consumers have been accustomed to, but already the manufacturers of it have been enabled *to reduce the price from* $3 50 *to* $2 50, with the prospect of a still greater reduction.

The accuracy of the following statement of proportions of the different residuums are vouched for by Mr. Moffat, the lessee of the Cobourg works:—

Memorandum of cost of manufacturing Gas from Ensley's Patent, as demonstrated by practical test at Cobourg, from one cord of pine wood and 1000 lbs. of bones.

1 Cord pine wood	2 00
½ Ton bones	4 00
¾ Cord hard wood for fuel, at $3 per cord	2 15
Cost of labour	2 00
	$10 15

Amount of gas produced 15,000 cubic feet, making the cost 67⅔ cents per thousand feet, *without taking into account* the sale of the residuums—estimate of cost and proceeds of which are as follows:—

DR.

Cost of wood, bones and labour, as above. $10 15

CR.

40 bushels charcoal, at 5c.	$2 00	
50 gals. tar, at 8c.	4 00	
12 " oil of turpentine, at 20c.	2 40	
770 lbs. bone black, $1 per 100 lbs.	7 70	
½ brl. ammonia,	1 00	
		$17 10

Brought forward	$17 10	
Less cost of separating turpentine and tar from the pyroligneous acid	2 00	
		$15 10

Leaving a net profit on the residuums of $4 95 and the *gas free.*

Persons acquainted with the value of charcoal, will admit that the price at which it is estimated is very low indeed at five cents a bushel, as the cost of manufacturing it in the usual manner with pine at $2, and hardwood at $3, cannot be less than 10 to 12 cents per bushel. Then the proportions of tar and turpentine, according to Professor Croft's analysis, would be from 20 to 30 per cent at least over the above estimate, and the other estimates have been made with the same liberal discount.

The cheapness of material, the value of the residuums, reducing as they do the cost of the gas, will admit of a corresponding reduction in the present high prices—probably in many cases to the extent of one-half, and even at that figure it would appear that the investment must be more profitable than those in ordinary coal gas companies. Next to cheap food, a cheap illuminator is a great desideratum for the people, a boon which seems to be afforded by this very valuable discovery.

In Canada and the United States, where all the materials for the manufacture of this gas can be readily and cheaply procured, and where the gas heretofore used costs from $3 to $8 per thousand feet, there appears to be little doubt but that it must come into general use. It is adapted to large cities and towns, to small villages, and also for hotels, seminaries, and other establishments where there is a large accumulation of bones and other refuse animal matter and offal, all description of which are equally suitable for the manufacture of this gas. Some of these institutions have to pay thousands of dollars annually for gas which they can, by this new discovery, make for absolutely nothing.

It may be thought that in some places where the materials are expensive, that promising results, such as the above, would not be arrived at; but this opinion is not necessarily correct, as it must be obvious to all that the value of the products and residua of wood and bone, as of all other crude material, must be regulated and proportioned to the price of these articles. Thus the *results would be very much the same at New York, Boston, or Montreal,* as they have proved themselves to be on *a smaller scale at Cobourg.* As an instance of this, pine has been valued at Cobourg as above, at $2 a cord, and charcoal at 5 cents a bushel. In Boston, where pine is worth $7, charcoal readily brings from 25 to 50 cents a bushel, according to quality. Bone can be bought for $8 a ton in Canada, and the price of bone dust is $20; whereas in Boston, bone is worth $25, and bone black $75 to $100 a ton. It has been suggested that sufficient bone might not be procurable to keep the gas works supplied. On this score there need be no apprehension, as may appear from the fact that about *five hundred tons of bone* would be sufficient to supply the gas works of a city of *twenty-five thousand inhabitants* for the year. But bone is not the only waste animal matter that will answer the purpose. *All kinds of garbage and animal offal, hundreds of tons of which go yearly to waste* in such a town as that referred to, and which can be had for the taking away, are equally as suitable, and the same quantities and proportions suffice, but of course they will not yield the same valuable residuums.

There are several favourable features in connection with this matter which have not yet been mentioned, and which give this gas a great advantage over that produced in the ordinary way—wood and bone being twice as readily consumed as coal, the gas is more readily generated from it, consequently the cost of labor, fuel, and works, are correspondingly reduced, and operations can therefore be carried on with much less capital than usually required.

The estimated cost of erecting apparatus, works and pipes, for a town burning say 2,000 lights, is $10,000 gold; the estimated returns from which would be as follows:

2,000 lights, at an average of three feet each per hour, one hour and a half per day, would consume 9,000 feet of gas per day, or 3,285,000 feet per annum, at $2 per thousand, would produce a net profit of $6,570 per annum.

As the residuum from the pine and bones will *more than pay working expenses,* the above returns are net profit, and show a dividend of more than 65 per cent. on the capital actually invested, and this with gas at $2 per thousand feet, which is at least 30 per cent. lower than the usual price in Canada.

It is a simple and not expensive matter to *alter ordinary gas works* to answer the new process; and while the alterations are proceeding, the manufacture of coal gas *need not be interrupted for an hour.*

It is just one month since the gas was introduced so successfully at Cobourg, and we understand that arrangements are on foot for introducing it in other localities, both in Canada and the United States. Some of the places mentioned are

Montreal, Ottawa, Belleville, Dundas, Ingersoll, and Prescott. Already several towns in the United States, where coal gas is very expensive, are making enquiries; and a contract has been entered into for the erection of works with at least one extensive factory, namely, that of Chickering Brothers, the renowned piano manufacturers of Boston. This establishment is expected to be lighted with the new gas on or about the 10th of this month. This fact alone goes far to show the high esteem with which this new invention is regarded; and should its introduction at this factory give the same satisfaction it has given at other places where it has been tried, this new and cheap gas will no doubt before long come into general use.

THE ANNUAL EXAMINATIONS, AND EVENING CLASS INSTRUCTION.

In another portion of this number, we publish the Board of Arts programme of the next annual examinations, to which we beg to direct the attention not only of the youth for whose *special* benefit they have been established, but of parents and employers of youth in the various industrial pursuits. These examinations, modelled after the examinations of the London *Society of Arts*, were organized by the Board in the year 1863, and continued in 1864 and 1865.

The number of candidates, papers on different subjects, and certificates awarded were as follows:

	1863.	1864.	1865.
Number of Candidates	7	17	11
Papers examined on different subjects	9	43	27
First class certificates awarded	1	6	4
Second " " "	2	11	6
Third " " "	4	19	5
Silver medal awarded	1	0	0

From some cause or causes, the volunteer movement no doubt being one, no candidates presented themselves for the examinations in May 1866. This is to be regretted, as there can be no doubt of the benefits accruing to all engaging in such exercises, and the studies necessarily preparatory thereto.

A paper published under the auspices of the *Glasgow Athæneum*, in the year 1858, in reference to the examinations of the *London Society*, contains the following paragraph:—

"If any thing were wanting to enforce the benefits accruing from the Society's examinations it might be derived from the approbation signified by the great number of Master Manufacturers, Railway Directors, and Bankers throughout England, and of the leading commercial firms in London and in the Provinces, which have declared their readiness to accept the certificates of the Society as a guarantee of proficiency."

The number of candidates at the examinations of the Society referred to, is constantly increasing, year by year; and we hope the same will be the case with the examinations of this Board, so soon as their usefulness is properly appreciated. A short time since we received a communication from "a *Working Man*" of this city, in which he says:—

"I was looking over some of the numbers of your Journal—the articles on the Board of Arts Examinations drew my attention, and I read them. I think that these examinations are calculated to be very beneficial to young men, but I was sorry to see that very few had entered the lists; and I began to think of some plan to make them more successful.

I think that if you had a more enticing reward they might be successful. Could not some of our merchants be coaxed into giving a small amount each, towards buying a good prize? say a rifle or shot-gun, which I think would take very well; or could not the worthy Directors of the Mechanics' Institute be induced to offer a life-membership in their excellent institution, as a reward for the one who obtained the greatest number and highest grade certificates? Or if this would be stretching their generosity too far, let it be a membership for one or more years, as they may see fit."

In an article upon this subject, in the Journal for August 1864, we wrote as follows:—

"It is to be regretted that the financial circumstances of the Board do not allow of the awarding of prizes of an actual money value to the successful candidates, as is the case in connection with the examinations of the London Society of Arts, whose system is in other respects pretty closely followed. We would fain hope that some of our men of wealth, having the interests of the industrial classes at heart, may follow the good example set by John Macdonald, Esq., M.P.P. for Toronto, in founding a *Bursary* in Toronto University College for the benefit of the sons of working men, and endow a Board of Arts EXAMINATION FUND for the benefit solely of the working classes. We fully appreciate the generosity of Mr. Macdonald in making the endowment above referred to, and in the name of the working men return him thanks; but liberal as the act is on his part, it is not calculated directly to benefit to any appreciable extent those who are intending to follow mechanical pursuits—the sons of mechanics studying the learned professions will be benefited, but not mechanics themselves, as instances are rare indeed of Graduates of Universities following any of the ordinary industrial occupations."

"An endowment of such an Examination Fund as is above indicated would directly reach the parties for whom intended, and lead to such a course of private studies, or to connection with Mechanics' Institutes evening classes—which are now with so much benefit being organized in some localities—as would gradually elevate the character and capabilities of our artizans, and redound to the credit and prosperity of the Province."

We would again express a hope, either that such a fund may be founded by private individuals, or that the Board may soon have such an appropriation as shall enable it to establish prizes in money and medals, in addition to the usual certificates. Youths engaged in laborious mechanical or other industrial pursuits, for from 10 to 12 hours each day, are naturally but little inclined to devote the spare hours of their evenings to close study—it needs generally some inducement other than the advantages to be derived from the attainment of knowledge for its own sake. These inducements furnished even at the public expense, the country would reap the benefit in the increased intelligence and skilled labour of its operative classes.

Of the 35 candidates presented for examination during the three years referred to, 15 were from the Toronto and 20 from the Whitby Mechanics' Institute. We are not aware that in Upper Canada any other of the Institutes have had evening classes organized, although it is quite probable some few may have been in operation, that we have not heard of.

The Toronto Mechanics' Institute has, at various times, since its organization in the year 1831, had such classes in existence; but it was not till the year 1862 that it had any well devised scheme for their organization and continuance. The statistics of its classes for the five years ending with the current session, are as follows:—

Subject.	No. Pupils.				
	1862-3.	1863-4.	1864-5.	1865-6.	1866-7.
Book-keeping ... . Penmanship..................	34	58	46	61	74
Arithmetic and Mathematics	23	6	14	20	38
English	44	21	8	19	00
French............................	30	10	18	16	16
Elocution..........................	nil	nil	5	10	12
Phonography........................	nil	nil	nil	43	11
Architectural and Mechanical Drawing....	10	20	7	16	13
Landscape figure and Ornamental Drawing.....	9	nil	7	15	14
Total number............	150	115	105	200	178

May we not hope that a goodly number of candidates from this Institute, and some others, may fairly be anticipated for the ensuing final examination?

KRUPP'S STEEL WORKS.

In the December number of the last volume of this Journal, occurred a paragraph taken from the *Scientific American*, giving statistics of Krupp's Works, and locating them in Essex in England. We noticed the error at the time, but by an oversight failed to correct it before going to press. On page 309, of the same number, we referred to Krupp as a non-English manufacturer.

Mr. L. Meyer, of Harpurhey, in a communication directing our attention to the error, says:—"I have seen the same blunder in the *Leader* and *Globe*, and several other papers, and would hardly believe it possible to be copied so often without correction. Mr. Krupp, a German, has his great steel works not in 'Essex, England,' but at Essen, a town of about 8,000 inhabitants,* in the German District of Dusseldorf, Prussia—the neighbourhood is famous for its rich coal mines, worked by between 3 and 4,000 miners (or pitmen). Besides the great steel works of M. Krupp (the same who got the first prize at the Exhibition in London, for the largest piece of cast steel ever made), many other factories flourish at Essen and its vicinity."

An interesting series of articles descriptive of this establishment is commenced in another portion of this number.

THE SEVENTH VOLUME.

The present Number commences the seventh volume of the Journal. The endeavour will be in the future, as it has been in the past, to render it as worthy of the support of thinking and practical men as the time at our disposal and the means of the Board will permit. Mechanics and others interested in the progress of the Industrial Arts and interests of the Province, are requested to forward useful and practical information for its pages, or to make suggestions for otherwise increasing its usefulness. It is forwarded to nearly all last year's subscribers, from whom no notice has been received to DISCONTINUE. Parties not wishing to be subscribers for this year, are requested to return the present (January) number. Subscribers in arrears are requested to remit to the Secretary of the Board.

TO MEMBERS OF THE TORONTO MECHANICS' INSTIUTE.

The Directors of this Institute have made arrangments to publish monthly, on the cover of this Journal, a complete list of new books added to their Library during the month. Members of the Institute subscribing to the Journal will thus have regularly placed before them a monthly printed supplement to the Institute catalogue.

Subscriptions of members of Mechanics' Institutes, and of Literary and Agricultural Societies, when paid through their respective Secretaries or other officers, 50 cts. per annum. Non-members, 75 cts. per annum.

* There are now, according to the Mechanics' Magazine, 10,000 hands employed in this establishment alone.—[Ed.]

Board of Arts and Manufactures
FOR UPPER CANADA.

ANNUAL MEETING OF THE BOARD.

Notice.

The annual meeting of the Board will be held on Tuesday the 29th inst., at 2 o'clock P. M., in the Board Rooms, Toronto Mechanics' Institute; when the report of the retiring Committee will be presented; and Office-bearers elected for the ensuing year.

The members of the Board are:—the Minister of Agriculture, the Chief Superintendant of Education, Professors of Physical Sciences in Universities and Colleges, Officers of the Provincial Geological Survey, Presidents of the incorporated Mechanics' Institutes, one Delegate from each Board of Trade, one Delegate for every twenty Mechanic members of every incorporated Mechanics' Institute or Working Men's Association, and one Delegate for every twenty members of any incorporated Arts Association in Upper Canada. [See Provisions of Statute in last Number of Journal.]

Secretaries of these various bodies are requested to notify their respective Delegates.

W. EDWARDS, *Secretary*.

January 1st, 1867.

ANNUAL EXAMINATION OF CANDIDATES.

This Board proposes to hold its Fifth Annual Examination during the third week in May next, under the rules and restrictions laid down in the annexed programme.

The examination will be open to all members of incorporated Mechanics' Institutes or Library Associations in Upper Canada, who are not students of any college, graduates or under-graduates of any University, or certified school teachers; or who are not following any of the learned professions.

Copper-plate certificates of three grades, printed on parchment for pocket use, or reference, will be awarded to successful candidates; indicating, respectively, "Excellence," "Proficiency," and "Commendableness." A beautiful lithographed Diploma, for framing, will also be awarded to holders of first and second class certificates.

PROGRAMME.

Local Committees.

1. The Managers of Mechanics' Institutes and Library Associations desirous of co-operating with this Board, in promoting the education of such of their members as have not been able to avail themselves of the benefits of academical instruction and distinction, but who are now engaged in classes or evening schools, or other means of self-improvement, are invited to form local committees for the purpose of conducting the necessary preliminary examinations; and to assist and co-operate with the examiners appointed by the Board. Each local committee must consist of at least three members, and should be composed of such persons as would give their time and earnest attention to the subject.

2. The local committees will supervise the working of papers which the examiners appointed by the Board will set for the final examination.

Preliminary Examinations by Local Committees.

3. No candidate will be admitted to the final examination without a certificate from his local committee, that he has satisfactorily passed a preliminary examination in the subjects in which he wishes to be examined by the Board.

4. The preliminary examinations may be either wholly written, or partly oral and partly written, as each local committee may think best; and must be held sufficiently early in the year to allow the results to be communicated to the undersigned on or before the first day of May, 1867.

5. The "pass" to the final examination should not be given to any candidates whom the local committees consider not to have a reasonable chance of obtaining certificates from the Board.

Final Examination by the Examiners appointed by the Board.

6. Forms containing the names of the candidates "passed" by the local committees, and the subjects in which they wish to be examined, must be returned to the undersigned not later than the first day of May, 1867.

7. The examiners appointed by the Board will set the requisite papers for the final examination, and these will be forwarded to the local committees. The local committees will see, and certify to the Board, in the form which the Board will furnish, that the papers are fairly worked by each candidate without copying from any other, and without books or other assistance; and will return the worked papers to the Board.

8. The final examinations will be conducted by the means of printed papers.

9. The Examiners will award certificates of three grades, but certificates of the first grade will be awarded only to a high degree of excellence.

10. The final examinations will be held simultaneously on the evenings of Tuesday, Wednesday, Thursday and Friday, of the third week in May next.

11. Judgment will be passed by the examiners appointed by the Board, and the awards of certificates will be communicated to the respective local committees.

12. To indicate the portions of the subjects that will be taken in the examination, certain text-books are suggested for some of the departments. In other departments, where no text-books are named, the treatises in general use in the schools and colleges in Upper Canada are recommended; but it is distinctly to be understood, that in so doing no opinion is pronounced as to their comparative merits. Real knowledge, however, or wherever acquired, will be accepted; and the exposition of a subject in the candidate's own words will be preferred by the examiners.

I. Arithmetic.

Fundamental rules of Arithmetic; Proportion, Simple and Compound; Practice; Interest; Fractions, Vulgar and Decimal; Extraction of Square and Cube Roots.

The Examiners will take into account not only the correctness of the answers, but the excellence of the method by which they are worked out, and the clearness and neatness of the working (which must always be shown.)

II. Book-keeping.

Book-keeping by Single and Double Entry; Drafts of the various forms of Bills of Exchange, Promissory Notes, Invoices, &c.; and an accurate knowledge of the various books used in the counting-house.

III. English Grammar and Analysis.

Grammatical Analysis of sentences in Prose and Poetry; Composition on a given subject.

IV. Geography.

Political Geography. General Questions in Ancient and Modern Geography; Maps drawn from memory; Explanation of Geographical Definitions; Mathematical Geography; Physical Geography; Outlines of Physical Geography.

V. Penmanship.

Business Hand. An even round hand, without flourishes, will be preferred.

Specimens to be selected by the local committee, and forwarded to the Board, on the same conditions as specimens in department IX.

VI. Algebra.

Algebraic Fractions, Square and Cube Root, Simple and Quadratic Equations, Single and Simultaneous, Ratio and Variation. Candidates should be prepared to give explanations of Elementary Principles and proofs of Fundamental Propositions.

Text Books.—Colenso's Algebra or Bridges' Algebra.

VII. Geometry.

A facility in solving geometrical theorems and problems, deducible from the first four books of Euclid, will be expected on the part of those who desire to obtain certificates of the first or second class.

Text Books—Euclid, Books I, II, III & IV,

VIII. Principles of Mechanics.

The Properties of Matter, solid, fluid and gaseous.

Statics: The composition, resolution and equilibrium of pressures acting on a material particle; constrained particles; machines; attractions.

Dynamics; gravitation; collision; constrained motions; projectiles; oscillations.

Rigid Dynamics; Motion of a rigid body about a point; of a free rigid body; of a system of rigid bodies.

Hydrostatics: Pressures of fluids; equilibrium of floating bodies; specific gravity; elastic fluids; machines; temperature and heat; steam; evaporation.

Hydrodynamics: Motion and resistance of fluids in tubes, &c., waves and tides.

Pneumatics: Mechanical properties of the air; the barometer.

Text Book—Silliman's Natural Philosophy.

IX. Geometrical and Decorative Drawing and Modelling.

Orthographical Projection, or Geometrical Drawing of Architectural or Engineering subjects, Machinery, &c.

Linear Perspective.

Original Designs.

Models of figures, groups, foliage &c., connected with the Fine or Decorative Arts.

The local committees will select, and forward to the Board, such specimens of Drawing and Modelling as they may deem worthy, and which they shall certify to be the work, solely, of the candidate named, who may not be an artist by profession.

X. History.

Outlines of Greek and Roman History; English History from the Norman Conquest; Canadian History.

XI. Trigonometry.

In Plane Trigonometry the solution of plane triangles, and the use of logarithmic tables, &c.

Spherical Trigonometry, Napier's Rules, Solution of Spherical Triangles.

XII. Mensuration.

The calculation of the areas and circumferences of plane figures bounded by right lines or arcs of circles. The superficial and solid contents of cones, cylinders, spheres, &c. Measuring and estimating artificer's work.

XIII. Practical Mechanics.

The Application of the Principles of Mechanism to Simple Machines. The Steam Engine.

Text Books—Lardner on the Steam Engine; Nasmyth's Elements of Mechanism, with Remarks on Tools and Machinery (*Weale*); Bourne's Catechism of the Steam Engine.

XIV. Conic Sections.

Analytical Conics, including the equations of the straight line, the circle, the three conic sections, and the general equation of the second degree. The Principles of Projection, Orthogonal and Central.

XV. Chemistry and Experimental Philosophy.

Physical. Elementary laws of heat, light and electricity, in connection with chemical action.

Inorganic. Chemistry of the Metalloids and Metals, laws of combining proportions, volumes of Gases, vapours, &c.

Organic. Composition, properties and decompositions of alcohols, acids, &c.

Candidates are expected to be able to explain decompositions by the use of symbols. Questions illustrative of general principles will be selected from the following amongst other trades and manufactures; Metallurgy of Lead, Iron and Copper; Bleaching, Dyeing, Soap-boiling, Tanning; the manufacture of Coal Gas, Sulphuric Acid, &c.

Text Books—Fowne's Manual of Elementary Chemistry; Croft's Chemistry; Elements of Chemistry (*Chambers' Educational Course*); Tyndall's Lectures on Heat.

XVI. Geology and Mineralogy.

The properties and distinctive characters of the commonly occurring Minerals and Metallic Ores; the structural characters, conditions of occurrence, and classification of Rocks generally.

Text Books—Dana's Manual of Mineralogy, and Dana's Geology.

XVII. Animal Physiology and Zoology.

The general principles of Animal Physiology. Practical application of them to health and the wants of daily life.

Text Books—Agassiz and Gould's Introduction to Comparative Physiology; Paterson's Zoology; Carpenter's Animal Physiology, 1859 (*Bohn*); Lardner's Animal Physics (*Walton & Maberly*).

XVIII. Botany.

Vegetable Physiology. Classification of Plants; Leading principles of Morphology; Scientific and applied Botany.

Text Books—Gray's First Lessons in Botany; or George Bentham's Outlines of Botany.

XIX. Agriculture and Horticulture.

Theory and Practice of Agriculture and Horticulture.

Text Books—Johnston's Elements of Agricultural Chemistry and Geology; Youatt's Treatises on the Horse, Cattle, Sheep and the Pig; Sipson's Agricultural Chemistry; Buist's (Robt.) American Flower Garden Directory; and Family Kitchen Gardener; P. Barry's Fruit Garden; and Smith's (C. H. J.) Landscape Gardening, &c.

XX. Political and Social Economy.

A general knowledge of the Commercial, Financial and Statistical History of the United Kingdom and of Canada, will be required.

XXI. English Literature.

Shakspeare's "Tempest;" Milton's "Paradise Lost," Books I & II; Spencer's "Faerie Queen," Book I; Cowper's "Task;" Pope's "Essay on Man;" Wardsworth's "Excursion," Books I & II; Macauley's "Essays;" Bacon's "Advancement of Learning," Book I; Addison's "Spectator;" Johnson's "Rambler;" Craik's "History of the English Language;" Trench on the "Study of Words."

N. B.—Candidates may select any two of the authors in the above list.

Candidates are recommended to make a very careful study of the text of the authors they may select. The questions on each author will be divided into two sections, the first intended to test the candidate's acquaintance with the text, the second his knowledge of the subject matter, and his critical and literary information. Full marks will not be given for answers to the second section, if those to the first section do not prove satisfactory.

XXII. French.

Questions on any portion of the French Grammar (To be answered in French, if possible), and an extract from a contemporary French writer to be translated into English.

An English extract to be translated into French, and a list of idiomatic expressions to be rendered from French into English, or *vice versa*.

XXIII. German.

Schiller's "Wilhelm Tell." Grammatical and Critical Analysis of.

Goethe's "Iphigenie Auf Tauris."

Goethe's "Egmont."

Composition on a given subject.

Pieces from each of the above works will be given for translation. Every candidate must translate one piece. First class certificates will be given to those only who translate well from English, and write in German a good Essay relating to German History since the Reformation.

XXIV. Music.

Theory of music. Notation, the modern modes, intervals, time, signatures, the stave, transposition, modulation, terms and characters in common use.

Elements of Harmony.

XXV. Ornamental and Landscape Drawing.

Ornamental Drawing of Natural or Conventional objects.

Landscape Drawing in pencil, crayon, water colours, or in oil.

Specimens to be selected by the local committees, and forwarded to the Board, on the same conditions as specimens in department IX.

Terms of Admission to the Final Examinations.

13. Every candidate for examination must be "passed" by a local committee, and must be a member of, or student of a class in, an Incorporated Mechanics' Institute or Library Association in Upper Canada.

14. The examinations will be held at the rooms of the respective institutions reporting candidates. Instructions as to the particular evenings upon which the respective subjects will be taken up, and all the necessary forms for returns to the Board, will be furnished by the undersigned, so soon as candidates are reported by any local committee.

W. Edwards,
Secretary.

TORONTO MECHANICS' INSTITUTE.

The Toronto Mechanics' Institute has in operation classes for the study of Arithmetic, Book-keeping, Penmanship, Geometrical Drawing, Ornamental Drawing, Elocution, Phonography, and the French Language, comprising in all 178 pupils. The term for instruction is five months, each class meeting twice a week. Fees varying from $2 to $4, for the term.

TRADE MARKS.

Trade marks registered in the office of the Board of Registration and Statistics, and open for inspection at the Library of this Board.

(*Continued from page* 314, *Vol. VI*)

B. & W. Rosamond & Co., Almonte, C. W. Trade mark:—A Ram's Head. Vol A. folio 149, No. 585. Dated November 3rd, 1866.

Henry Lyman, Ottawa. "Lyman's Universal Pain Reliever." Vol. A, folio 148 No 646. Dated November 29th, 1866.

W. & F. P. Currie, Montreal. Trade mark:—A Crown with inscription, "W. & F P. Currie." Vol. A, folio 153, No. 647. Dated November 30th, 1866.

Evans, Mercer & Co., Montreal. Trade mark:—Escutcheons of the cities of London and Liverpool, surmounted with crest of Beaver. &c. Vol. A, folio 150, No. 653. Dated December 1st, 1866.

D. Crawford, Toronto. "Silver Bar." Vol. A, folio 152, No 678. Dated December 10th, 1866.

D. Crawford, Toronto. "Golden Bar." Vol. A., folio 151, No 678. Dated December 10th, 1866.

CATALOGUE OF BIRDS KNOWN TO INHABIT WESTERN CANADA.

Systematically arranged according to the method adopted in the Museum of the University of Toronto.

BY THE REV. W. HINCKS, F.L.S., &c.,
PROFESSOR NATURAL HISTORY, UNIVERSITY COL., TORONTO.

The occasion of drawing up this catalogue was the desire of the Board of Arts of Western Canada to exhibit at the approaching Paris Exhibition as complete a collection of the birds of the country as the time at their disposal would admit. With this object in view they wished first to know what birds had been observed in the country, and the information is here given from the best sources to which the compiler had access. The work is without doubt imperfect, but besides its immediate purpose it will serve as a guide for collectors and a basis for the labours of observers.

Some may be surprised that the arrangement and nomenclature are not those of the well-known and useful catalogue of the birds of North America by Dr. Baird, of the Smithsonian Institute; but, notwithstanding a certain degree of convenience in such conformity, we have preferred following the method in use amongst ourselves, and the names to which our public can refer in the principal museum of this country, that of the University of Toronto.

The nomenclature is that of Dr. George Gray, in his Genera of Birds, and although in some special cases change may be thought justifiable, it is presumed that from his extraordinary opportunities for obtaining information, and his known conscientious accuracy, his authority in respect to priority of names can seldom be set aside, whilst he has gone as far in the sub-division of genera as the prevailing opinion of zoologists will sanction, and even those who use other names will readily understand these and be able to identify the object.

The general arrangement adopted is one which has been proposed and defended in the *Canadian Journal*, and for which we would claim attention, though it cannot be shown to advantage in a mere local catalogue, where it would be useless to attempt noticing the sub-families, and large groups are altogether without a representative.

In the catalogue the birds we were unable immediately to procure are marked with an asterisk (*), and those sent in pairs are marked with a (†).

Key to the System.

ORDER I.—INSESSORES (Perching birds).

(The true representatives of the bird type of structure.)

SUB-ORDERS.

1. *Dentirostres.* 2. *Serratirostres.* 3. *Conirostres.* 4. *Tenuirostres.* 5. *Fissirostres.*

(The remaining orders contain the deviative forms of Birds.)

ORDER II.—RAPTORES (Birds of Prey).

ORDER III.—SCANSORES (Climbers).

ORDER IV.—RASORES, GALLINACEOUS BIRDS (Scrapers).

ORDER V.—GRALLATORES (Waders or stilted birds).

ORDER VI.—NATATORES (Swimmers).

INSESSORES (Perchers).

1. DENTIROSTRES (Toothed-billed birds).

FAMILY.—*Laniadæ* (Butcher-Birds).

1† *Lanius borealis* ....American shrike.
2 " *excubitoroides*..Loggerhead shrike.
3† *Tyrannus intrepidus* ... The King-bird.
4† *Myiobius crinitus* ......Great crested tyrant fly catcher.
5* " *Cooperi*.......Cooper's tyrant fly catcher.
6† " *virens* ....Wood pee-wee fly catcher.
7† " *nunciola*.......Pee-wee fly catcher.
8 " *Acadicus* ....Small green crested fly catcher.
9 " *flaviventris*...Yellow-bellied fly catcher.
10† " *minimus*......Least tyrant fly catcher, and nest of young.

FAMILY.—*Sylviadæ* (Warblers).

11† *Regulus satrapa* ....American gold-crest.
12† " *Calendula*.....American fire-crest.
13† *Culicivora coerulea*.....Coerulean warbler.
14† *Mniotilta varia* ....Black and white creeping warbler.
15† " *striata* ....Black poll wood warbler.
16 " *aestiva*........Summer warbler, or yellow bird.
17 " *Americana*...Blue yellow-back warbler.
18 " *petechia* ......Yellow red poll warbler.
19 " *Blackburniæ* Blackburnian warbler.
20† " *castanea* .....Bay-breasted warbler.
21 " *Pennsylvanica*. Chestnut-sided warbler.
22 " *Canadensis*..Black-throated blue warbler.
23 " *chrysoptera*..Golden-winged swamp warbler.
24† " *virens* ....Black-throated warbler.
25 " *ruficapilla*....Nashville warbler.
26 " *maritima* ....Cape May warbler.
27 " *maculosa*.....Black and yellow warbler.
28* " *formosa* ..... Beautiful warbler.
29† " *coronata* .....Yellow crowned warbler.
30 " *Pinus* ....Pine warbler.
31* " *Parus*.........Hemlock warbler.
32* " *celata* ....Orange-crowned swamp warbler.
33 *Trichas Philadelphica*. Philadelphian warbler.
34† " *Marilandica*...Maryland yellow throat.
35† *Parus atri-capillus*.....Black capped titmouse.
36* " *cristatus*..........Crested titmouse.
37 *Sialia Wilsoni* ....The bluebird.
38 *Anthus Ludovicianus*..American pipit.

FAMILY *Ampelidæ* (Fruit eaters or Chatterers.

(The *Tanagrinæ* are accounted a sub-family.)

39† *Ampelis garrulus*.......Bohemian chatterer or wax wing.
40 " *cedrorum*......The cedar or Cherry-bird, and young.
41† *Pyranga rubra* ....The red Tanager.
42† *Pipilo erythrophthalma* The Towhee bunting.

FAMILY *Turdidae* (Thrushes).

43†*Turdus migratorius* ...The robin, and young, and one white robin.
44† " *mustelinus*......Wood thrush.
45 " *fuscescens* ......Tawny thrush.
46† " *solitarius*...... Hermit thrush.
47 " *Swainsoni*......Olive-backed thrush.
48 *Sciurus aurocapillus*...Golden-crowned thrush.
49† " *aquaticus*......Water thrush.
50 *Mimus Carolinensis* ...Cat bird.
51† " *rufus* ....Brown or song thrush.

FAMILY *Muscicapidæ* (Fly-catchers).

52* *Vireo virescens* ....Greenlet.
53† " *olivaceus*..........Olive greenlet.
54 " *solitarius*..........Solitary greenlet.
55† " *flavi frons* ....Yellow-bellied greenlet.
56 " *gilvus* ....Warbling greenlet.
57†*Setophaga rutioilla*......American red-start.
58 " *Canadensis*.Canada fly-catcher.
59 " *mitrata* ....Black capped fly-catcher.

The sub-order *Serratirostres* not being represented in this climate we pass to

SUB-ORDER iii.—CONIROSTRES.

FAMILY *Corvidæ* (Crows).

60 *Corvus Americanus*:.. The common crow.
61 " *Corax* ....The raven.
62†*Cyanocorax cristatus*..The blue jay.
63 *Perisoreus Canadensis*:The Canada jay or whiskey Jack.

FAMILY *Fringillidæ* (Finches).

64†*Fringilla tristis*.........The American goldfinch or wild canary, and one in winter plumage.
65 " *pinus*.........
66† " *borealis*......*Linaria minor* (Aud.) *Ægiothus Linaria* (Baird's Cat) Lesser redpole.
67† " *hyemalis*.....Snow bird.
68†*Spiza cyanea* ....The indigo bird.
69**Ammodromus passerinus* ....Yellow-winged sparrow.
70 *Zonotrichia leucophrys*White crowned sparrow.
71 " *albicollis*..White throated sparrow.
72 " *iliaca*......Fox coloured sparrow.
73 " *graminea* .Bay winged sparrow.
74 " *socialis*....Chipping sparrow.
75† " *monticola*..Tree sparrow.
76 " *palustris* .Swamp sparrow.
77 " *melodia* ...Song sparrow.
78 " *pusilla* ...Field sparrow.
79 " *Savanna*..Savanna sparrow.
80†*Plectrophanes nivalis*...The snow bunting.
81† " *Lapponicus* ....Lapland bunting
82 *Otocoris alpestris* ......Shorelark.
83†*Carpodacus purpureus*.Purple finch.
84†*Strobilophaga enucleator* ....Pine grosbeak, and young.
85†*Loxia Americana*: .. .American crossbill.
86† " *leucoptera* ....White-winged crossbill.
87 *Coccothraustes vespertinus*.......................Evening grosbeak.
88†*Guiraca Ludoviciana* .Rose-breasted grosbeak, and young.
89* " *coerulea* ......Blue grosbeak.
90 " *cardinalis* .....Cardinal grosbeak (occa'l).

FAMILY *Columbidæ* (Doves).

91 *Ectopistes migratorius* Migratory pigeon.
92† " *Carolinensis*Carolina pigeon.

FAMILY *Sturnidæ* (Starlings).

93†*Sturnella Ludoviciana*.Meadow lark, and nest of young.
94†*Scolecophagus ferrugineus*......................Rusty grackle.
95 *Quiscalus purpureus*...Boat-tail.
96†*Agelaius phœniceus* ...Red-winged starling, blackbird or soldier-bird, and young.
97†*Molothrus pecoris*.......Cow-bird.
98†*Dolichonyx oryzivora*..Rice-bird or bob-o'-link.
99†*Icterus Baltimore* ....Baltimore Oriole, and nest of young.

SUB-ORDER iv.—TENUIROSTRES.

FAMILY *Certhiadæ* (Creepers).

100†*Certhia familiaris*......Common creeper.
101 *Troglodytes Americanus*......................Wood wren.
102 *Troglodytes hyemalis*...Winter wren.
103 " *arundinaceus*......................Marsh wren.
104 *Troglodytes aedon*......House wren.
105†*Sitta Carolinensis*......Carolina or white-bellied nut-hatch.
106 " *Canadensis* ......Canadian or red-bellied nut-hatch.

FAMILY *Trochilidæ* (Humming birds).

107†*Mellisuga colubris*......Ruby-breasted or Northern humming-bird.

SUB-ORDER v.—FISSIROSTRES.

FAMILY *Alcedinidæ* (Kingfishers).

108†*Ceryle Alcyon*...........The belted kingfisher.

FAMILY *Hirundinidæ* (Swallows).

109 *Hirundo fulva* ....Cliff swallow.
110 " *bicolor* ....White-bellied swallow.
111 " *rustica* ....Barn swallow.
112†*Cotyle riparia* ....Sand martin.
113 *Progne purpurea* ....Purple Martin.
114 *Acanthylis pelasgia*....Spiny-tailed or chimney swallow.

FAMILY *Caprimulgidæ* (Goat suckers).

115†*Chordeiles Virginicus*..Night hawk.
116†*Caprimulgus vociferus*.Whip-poor will.
117* " *Carolinensis*Chuck Will's widow (rare).

ORDER II.—RAPTORES (Birds of prey).

FAMILY 1.—*Aquilidæ* (Eagles and Buzzards).

118**Aquila chrysætos* ......Golden eagle.
119†*Archebuteo lagopus* ...Rough-legged buzzard.
120 " *Sancti Johannis*,......................Black buzzard (only a form of preceding).
121†*Buteo Americanus*......American buzzard, and young.
122† " *lineatus* ....Red-shouldered buzzard.
123† " *Pennsylvanicus*..Broad-winged buzzard.
124† " *hyemalis* ....Winter buzzard.
125 " *borealis* ....Red-tailed buzzard.
126 *Haliætus leucocephalus*Bald eagle, and two young.
127†*Pandion Haliætus*......Osprey or Fish-hawk.

FAMILY 2.—*Falconidæ*.

128†*Falco peregrinus* ....Peregrine falcon or Broad footed hawk, and young.
129†*Hypotriorchis Columbarius* ....Pigeon hawk.
130†*Tinnunculus sparverius*American sparrow hawk.
131 *Astur atricapillus*......American Goshawk, and two young.

132† *Accipiter Cooperi*.......Stanley hawk.

133† " *fuscus*.........Sharp-shinned hawk, and young

134* *Circus cyaneus* ....Common harrier.

135† " *uliginosus* ....Marsh-harrier (believed to be a state of preceding).

FAMILY 5.—*Strigidæ* (Owls).

136† *Surnia ulula* ....The hawk owl.

137 *Nyctale Richardsoni*...Richardson's owl.

138† *Nyctea nivea* ....The snowy owl.

139† *Athene passerina* [*A Acadica*] ....The little owl, and young.

140* *Athene albifrons* ....White-faced owl.

141† *Syrnium nebulosum*....Barred owl.

142 " *cinereum* ......Great cinereous owl.

143† *Ephialtes Asio*.......... Screech-owl, and young.

144† *Bubo Virginiana* ......Great horned owl.

145† *Otus Wilsoni*.... ....American long-eared owl, and young.

146† *Otus brachyotis*.........Short-eared Owl.

ORDER III.—SCANSORES (Climbing-Birds.)

FAMILY.—*Picidæ* (Woodpecker).

147† *Dryocopus pileatus*.....Pileated woodpecker.

148 *Picoides arcticus*........Arctic three-toed woodpecker.

149† *Picus varius*....... .....Yellow-bellied woodpecker.

150† *Picus villosus*............The hairy woodpecker.

151† *Picus pubescens*.........The downy woodpecker,

152 *Centurus Carolinensis*.The red-bellied woodpecker

153 *Melanerpes erythrocephalus* ....The red-headed woodpecker

154 *Colaptes auratus*........Gold winged woodpecker.

FAMILY.—*Cuculidæ* (Cuckoos.)

155 *Coccyzus Americanus*..Yellow-billed cuckoo.

156† " *erythropthalmus*...... ....Black-billed cuckoo, and nest of young

ORDER IV.—RASORES (Scrapers, Gallinaceous Birds).

FAMILY.—*Tetraonidæ* (Grouse).

157† *Tetrao Canadensis* .....The Pine grouse

158† " *Cupido*...........The prairie fowl (rare in Canada.

159† *Bonasa umbellus* ......The ruffed grouse.

160* *Centrocercus phasianellus* ....The sharp-tailed grouse (very rare—northern parts).

161† *Ortyx Virginianus* .....American quail.

FAMILY.—*Phasianidæ*.

SUB-FAMILY.—*Meleagrinæ*.

162 *Meleagris gallopavo*....The wild turkey (scarce).

ORDER V.—GRALLATORES (Waders).

FAMILY.—*Ardeidæ* (Herons, Storks, Cranes, &c.).

162½ *Ibis falcinellus* ....Glossy Ibis.

163† *Ardea Herodias*...,....Great blue heron, and young.

164 " *virescens* ....Green heron (rare).

165 " *Egretta*..........Greater egret, or white heron.

166 " *exilis* ....Least bittern.

167† *Botaurus lentiginosus* .American bittern.

168† *Nycticorax naevius*.....American night-heron.

169* *Grus Canadensis*.. ....Sand-hill crane.

FAMILY.—*Charadridæ* (Plovers).

170† *Squatarola Helvetica*..Black-bellied plover.

171† *Charadrius Virginicus*.American golden plover, and young.

172† " *vociferus*..Kildeer plover.

173 " *semipalmatus* ......Ring plover.

174† " *Wilsonius*-.Wilson's plover.

175† *Strepsilas interpres*.....The turn-stone.

FAMILY.—*Rallidæ* (Rails, Water-Hens, and Coots).

176† *Ortygometra Carolina*.Sora rail, and young.

177 " *Jamaicensis* Little black rail.

178† *Rallus crepitans*..,......The clapper rail.

179† " *Virginianus* ....Virginian rail.

180* " *elegans*. Great red-breasted rail.

181† *Gallinula galeata*......The water hen, and young.

182† *Fulica atra* ....The coot.

FAMILY.—*Scolopacidæ* (Snipes, &c.).

183 *Numenius longirostris*.American curlew.

184† " *Hudsonicus*. Hudsonian curlew.

185† *Limosa fœdoa*..........Great marbled godwit.

186 " *Hudsonica*.....Hudsonian godwit.

187 *Totanus flavipes*.........Yellowshanks tatler.

188 " *melano leucus*.Tell-tale tatler.

189 " *semipalmatus*..Semipalmated tatler or snipe.

190† *Tringoides macularia*..Spotted tatler, and young.

191† *Tringa canuta L.* ..... Red-headed sandpiper.

192† " *cinclus*..............Red-backed sandpiper, and young.

193* " *pectoralis*...........Pectoral sandpiper.

194* " *subarquata* ....Curlew sandpiper.

195† " *pusilla*...............Little sandpiper.

196* " *Schinzii*.............Schinz's sandpiper.

197 *Calidris arenaria* ......Sanderling.

198* *Hemipalma Auduboni* Long-legged sandpiper.

199† *Heteropoda Semipalmata* ....Semipalmated sandpiper.

200† *Philohela minor*.........The American wood-cock.

201† *Gallinago Wilsoni*......North American snipe.

202 *Macroramphus griseus*.The brown snipe.

203 *Recurvirostra occidentalis* ....The western avocet.

204 *Phalaropus fulicarius*..The great phalerope.

205* *Phaleropus hyperboreus* Hyperborean phalerope.

206 *Phaleropus Wilsoni*....Red-necked phalerope.

ORDER VI.—NATATORES (Swimmers).

FAMILY.—*Pelecanidæ* (Pelecans).

207* *Sula bassana*............Solangoose, gannet (Oshawa, C. W., accidental).

208 *Graculus carbo* ....The common cormorant,

209 " *dilophus*......Crested cormorant,

210 *Pelecanus trachyrhyncus* (*erythrorhyncus Gmellin*) ....The American pelecan, (accidental).

211 *Pelecanus fuscus*...... The brown pelecan (Hudson's Bay and Red River, in Canada, occasional).

FAMILY.—*Laridæ* (Gulls, Terns, Storm Birds, &c.)

212† *Larus Bonapartii*.....Bonaparte's gull, and young

213† " *argentatus*.......The herring gull.

214† " *zonorhynchus*...The American gull.

215† " *marinus*.........The great black backed gull, and young.

216 " *leucopterus*......White winged silvery gull

217 " *glaucus* ....The grey gull.

218 " *atricillus* ....The Amer. laughing gull,

219 " *Franklinii*......Franklin's rosy gull.

220* *Pagophila eburnea*....,The ivory gull,

221	*Xema Sabini*............	Sabine's gull.
222†	*Sterna Caspia*........	The Caspian tern, and young.
223†	" *macroura*.....	..The long-tailed tern.
224	" *hirundo*.........	The common tern.
225†	*Hydrochelidon plumbea,*	The black tern.
226*	*Stercorarius parasiticus*	The arctic skua.

FAMILY.—*Anatidæ* (The Duck Tribe).

227	*Fuligula collaris*........	The collared duck.
228*	" *cristata*........	The crested duck.
229†	" *marila*	The scaup duck.
230*	" *mariloides*.....	The lesser scaup duck.
231†	*Nyroca Americana*.....	The red-headed duck.
232	" *valisneria*	The canvas-backed duck.
233†	*Clangula Americana*...	The American golden eye duck.
234	" *histrionica* ...	The harlequin duck.
235†	" *albeola*	The buffel-headed duck.
236	*Harelda glacialis*.......	The long-tailed duck, (one old and three young, in winter and summer plumage).
237†	*Somateria mollissima*...	The Eider duck (rare).
238†	" *Spectabilis*...	The king duck (accidental), and young.
239*	*Oidemia nigra*	The black duck (rare).
240†	" *fusca*...........	The scoter.
241†	" *perspicillata*...	The surf duck.
242†	*Erismatura rubida*......	The spiny-tailed or ruddy duck.
243†	*Aix Sponsa*..............	The summer duck.
244†	*Mareca Americana*.....	The American widgeon.
245†	*Dafila acuta*	The pin-tailed duck.
246†	*Spatula clypeata*........	The shoveller duck.
247†	*Anas boschas*.	The mallard.
248	" *bimaculata*........	Brewer's Duck (rare, variable, almost certainly a hybrid between the preceding and following).
249	" *obscura*...........	The dusky duck.
250†	*Querquedula Carolinensis*....	The green-winged teal.
251†	" *discors*...	The blue-winged teal.
252†	*Chaulelasmus strepera*.	The gadwall.
253*	*Bernicla Brenta*........	The Brent goose.
254	" *Hutchinsii*....	Hutchins's goose.
255	" *Canadensis*....	The Canada goose.
256*	*Anser hyperboreus*.. ...	The snow goose.
257	" *coerulescens*	Supposed to be female of the above.
258	*Cygnus Americanus* ...	American swan.
259	" *Pasmori*	Pasmore's swan (may possibly be a state of the following).
260	" *buccinator*......	Trumpeter swan.
261†	*Mergus merganser*......	The goosander.
262†	" *serrator*.......	The red-breasted merganser.
263†	" *cucullatus*.....	The hooded merganser.

FAMILY.—*Alcidæ* (Divers.)

264†	*Colymbus glacialis*.,...	The great northern diver or loon.
265†	" *septentrionalis*.	The red-throated diver.
266†	*Colymbus arcticus*......	Black-throated diver.
267†	*Podiceps griseigena*....	The red-necked grebe.
268*	" *cornutus*......	The horned grebe.
269†	" *cristatus*......	Crested grebe.
270†	*Podylymbus Carolinensis,*	The pied-bill dobchick, and young.

FAMILY.—*Alcidæ* (Auks and Penguins).

271*	Arctica alle	The little Auk (rare).

Selected Articles.

INTRODUCTION OF BREECH-LOADERS.

A most difficult scientific problem, complicated by many questions of expediency, is now being placed before the military administration of every civilized country. Upon the different solutions of the question as to the best arm for infantry will, in such warlike times as ours, probably in a great measure depend the course of the military history of the next generation. The enormous expense attending a change in the weapons of a whole army is a good reason why any step now taken will not easily be retraced. All the gun makers of the United Kingdom, and all the breech-loader inventors of the world, are now on the *qui vive* since the publication of the War-office advertisement for a breech-loading rifle, to replace the present Snider-Enfield. The weight of the English breech-loader of the future is not to exceed 9 lbs. 5 ozs. without bayonet; it is to be 51 ins. long; the weight of sixty rounds of ammunition is limited to 61 lbs. 4 ozs.; the cartridge must carry their own ignition; and the gun should be able to fire at least twelve rounds per. minute. Very wisely, a prize has been offered for a repeating arm, and the last day for sending in the weapons intended to compete is the 30th of March next. Meanwhile, Enfield is at work day and night turning out the converted Snider-Enfields. Besides these, an order for some 25,000 of the Westley Richards form of breech-loader is being carried out. We should say that there is not much chance for the prolonged existence of this ingenious gun side by side with the many excellent American rifles with their admirable copper cartridge. As, however, the ordinary Westley Richards can be used with the common ammunition, the breech-loading guns now being made will probably be employed to work up the existing supply. The visitor to Enfield is surprised to see in course of manufacture, side by side with these improved implements of destruction, a number of smooth-bores—antique Brown Bessies, in fact. On inquiry, he is told that these guns are intended for Sepoy troops in India, in order to avoid offending them with the greased cartridges required with rifles. If this is true—and we have no reason to doubt the substantial accuracy of this answer to the question we made—it is strange that recourse cannot be had to some other lubricant than animal fat for cartridges intended for the black East India troops. Vegetable oil, paraffine, some composition of bees-wax, a dozen other lubricants, in fact, could be tried.

The immediate adoption of a converted arm has thus given time for a careful choice of a standard weapon. The French have been much quicker in their decision; but time will show whether their haste is speed. There have, indeed, been some rumors that the Chassepot gun, after having been accepted by the French Emperor, and after orders for large numbers have been given out, has lately been rejected. We believe however, that this is a mistake, or, at any rate, premature. The Chassepot breech-loader, the "invention" of a French government inspector of musketry of that name, is mainly an improved form of the Prussian needle-gun. Less work is thrown on the needle by its being made to ignite the powder from behind instead of in front; the joints are stated to be made with india-rubber; and the mechanism of the lock has been somewhat simplified. We understand that, in some of the extensive trials now being conducted at Vienna, the Chassepot gun gave wretchedly bad results. As usual very little is known of what is being done by the Russians, but it is stated they have adopted a breech-loader, invented, or at least introduced, by M. Thierry, a Frenchman. Several of the smaller countries of Europe have imitated the haste with which the French have come to a decision. Spain is stated to have taken up the Prussian needle-gun; Portugal has adopted the Westley Richards; and Denmark a gun the production of the country.

The advantage as to gaining time afforded by having some breech-loader or other, however bad, is again making itself felt in the course which is being quietly adopted by the Prussians. With the prescience of which the present Prussian administration has given such proofs, it has not merely been determined to give up the Zündnadel gun for a more modern weapon, but a carefully chosen military commision has been appointed to visit the United States in order to gather all the information possible about American breech-loaders, their use, and their results in the late war. With the guns that these officers are to bring back an extensive series of experiments will be gone through, similar to that now being undertaken at Vienna—which have resulted in the adoption of the Remington system—by their late adversaries. In this way they will not have to rely entirely upon private enterprise and competition for the guns brought before them; and they will gain information which could be obtained nowhere better than in a country where a gigantic war seems to have been finished with breech-loading weapons. In any case, the Prussians are still in advance of other armies in one important point, the consideration of which has been omitted in the many discussions in which it has been sought to account for their prodigious successes. For years, they have adopted a system of tactics suited to a breech-loader. In the royal Prussian "*Allerhöchsten*"—"Order respecting the exercise of troops in large masses"—the war tactics of the Zündnadel gun are defined under the following three principal heads;—"1. To draw the enemy into a small-arms engagement(*Fenergefecht*) and to hold him therein; 2, to get him, as much as possible, to place himself on a level plain; 3, to fight in deep ranks, but in such-wise that in order to obtain great and speedy results, a wider front can be formed at any instant."

A really remarkable phenomenon in the annals of invention is the exportation of such a number of different plans for breech-loading and repeating rifles from the United States. The Remington, the Peabody, the Berdan, the Snider, the Ball, the Spencer, are all due to American ingenuity. Many weapons under English names are substantially imitations of American systems. They all, however, resemble each other in one most particular point; they are all made to fire a metallic cartridge, consisting of a copper cylinder, open at the front end in order to take the rear of the bullet, and inclosing behind the explosive fulminate. These weapons hence furthur resemble each other in being provided with a steel pin for striking the fulminate inclosed at the back of the copper shell either at its rim or centre. The existence of so many ingenious forms of rifles for firing this admirable cartridge is probably mainly due to the ingenious policy of the American Government. As soon as the efficiency of the breech-loader was seen, no time was lost in replacing with it the old Springfield musket at first in the hands of the Federal troops. The first step was to determine the bore and kind of cartridge to be adopted. When this was done any form of breech-loader was employed as long as it could stand the not very severe tests of the government inspectors. Contracts were given out for two or three thousand guns, but no particular form of breech-loader was taken up officially; and up to the present, though each breech-loader inventor lives in hope, the United States Government have not yet officially settled upon any gun. And it is a question whether, having once settled upon a size of bore and the proportions of the metallic cartridge, it may not turn out the best policy to employ more than one form of arm, as was done by the Americans.

We have little doubt that the American metallic cartridge, whether of copper, or even of very soft steel, to be fired in a small-bore barrel, whether a breech-loader or magazine gun, will be the arm for Europe. The production of a practical repeater is only a question of time, and probably not of a very long time. England and Prussia being in possession of a breech-loader arm, however inferior to what may yet be produced, can afford to wait longer than those powers who, like France and Austria, have neither an antique needle-gun nor an arm of conversion.—*London Engineer.*

THE GREAT WATER TUNNEL UNDER LAKE MICHIGAN.

Our exchanges brings us, this week, accounts of the virtual completion of a work of American engineering, which, for boldness of conception, unerring skill, and uninterrupted success, deserves to be classed with the proudest achievements of the old world, or of any age.

The greatest produce market in the world, and the most energetic and enterprising city on even the American continent, Chicago has grown up in thirty-six years from a lair of wild beasts to a great metropolis, under some of the grossest natural disadvantages that ever taxed the resolution of any similar community. Its water supply—always miserable, since the drainage of a city begun to be mingled with the lake from which it was drawn—has been all this time growing execrable, until hardly fit to be tasted by man or beast. There the crystal waters of Lake Michigan, among the purest in the world, spread out before the tantalized citizen in all their beauty, beyond his reach, poisoned far along the shore by a ceaseless drench of abominations from the sewers of the city. It was impossible to conduct water from any point remote enough to be assured against this contamination; and in fact the shore water from whatever point must always continue subject to every variation of impurity from attrition with the banks and from the deposits washed down by streams and rains. The pure and undisturbed depths of the mid-lake were the only source from which a supply of clean water could be obtained. It was resolved to reach those depths by a tunnel under the bed of the lake, tapping its bottom at a distance of two miles from the shore. Surveys of the lake-bed by means of an auger inclosed in a tube, revealed the favorable circumstance of a continuous underlying stratum of hard blue clay. The contract for the bold undertaking was awarded in October, 1863, to James Gowan and James J. Dall, of Harrisburgh, Pa., at the sum of $315,139. They have already expended more than double this amount, mainly in consequence of the enhanced prices of labor and materials; and it is expected that, with all changes, improvements and finishing touches, the water-works will not be completed for less than $1,000,000. The contractors have as yet received no relief; but their splendid success warrants the expectation that the city of Chicago will not suffer them to go either unrepaid or unrewarded.

Work was begun at both extremites—the shore end and the lake end—of the tunnel. At the latter point the great engineering difficulty and triumph occurred. The violent storms on the lake, it was thought by eminent engineers, would make it impossible to fix a permanent structure in the waters. A huge wooden crib, or coffer dam, was built, like a ship, on the shore, launched, and stowed to its location. It was 40 feet deep, five-sided, 290 feet in circumference, and over 90 feet in diameter. Its angles were armored with iron two and a half inches thick. It had three distinct walls or shells, one within another, each constructed of twelve-inch square timber, caulked water-tight like a ship, and all three braced and girded together in every direction, with irons and timbers, to the utmost possible pitch of mechanical strength. The central area, or well, inclosed by the inner wall, was only twenty-five feet in diameter; leaving spaces about fifteen feet wide between the shells. Within these spaces were constructed fifteen caulked and water-tight compartments, which were filled with clean rubble stone, after the crib was placed in position. By this means the crib was sunk to the bottom, where it was firmly moored by cables reaching in every direction to huge screws forced ten feet into the bed of the lake. The water in which it was sunk was 35 feet deep, leaving five feet of the structure above the surface. This was in June 1865. The crib had cost $100,000; consuming 618,625 feet of timber, 65 tons of iron, and 400 bales of oakum.

The next business was to sink a water-tight shaft within the well of the crib, and into the bottom of the lake to a depth of some thirty feet further; making 66 feet in all below the surface of the water. Seven great iron cylinders were cast, each about 9 feet long, nine feet in diameter, 2½ inches thick, and weighing 30,000 pounds. One of these cylinders having been suspended in the well, another was placed upon it, the two were firmly bolted together with a water-tight joint, lowered, a third cylinder bolted to the second in the same manner, and so on until the shaft, a solid iron tube 64 feet deep, rested on the bottom, and forced its way by its own weight through the softer deposits into the hard blue clay beneath. The water was now pumped out, the top of the shaft was closed as nearly as possible air tight, and a powerful air-pump, driven by steam, commenced to exhaust the air also. As fast as a vacuum could be created, the atmospheric pressure, added to its own weight of over one hundred tons, forced the huge shaft downward into the bed of the lake with inconceivable force. Thus a depth was reached and secured, at which it became perfectly safe to carry forward the excavation, and complete the shaft to the level at which the tunnel was to begin. The loose rubble stone is finally to be taken out of the water-tight compartments, one at a time, and they will be re-filled with piers of solid masonry, laid in hydraulic cement, and united above the surface in some manner, so as to present an immovable front on all sides against the force of storms. A light-house is to surmount the whole.

The process of constructing the rest of the tunnel was simple, though interesting. Three sections of great cast-iron tubing, like that used in the lake shaft, were let into the earth by simply excavating beneath them, and letting them sink as the earth was removed. Having thus worked through the sands, and into the blue clay, the shaft was now narrowed to eight feet, and completed and walled in the ordinary manner to a total depth of 77 feet. This shaft was sunk four feet further below the surface of the lake than the lake shaft; causing a descent of two feet to the mile in the tunnel, to facilitate emptying it when required.

Both shafts having been completed, the excavation of the tunnel was commenced from both ends. On the 16th ult., the opposite gangs of workmen were within two feet of each other; and on the following day, the Board of Public Works formally broke through this last natural obstruction to the passage of the pure waters of the mid-lake into the city of Chicago. The accuracy with which the two lines of excavation met was an admirable engineering success. The centre lines coincided within nine and a-half inches, and the floors joined with a difference of only one inch. The tunnel is nearly a true cylinder, of five feet diameter in the clear, but worked two inches higher, vertically, on account of the key stone of the arch. It is lined with the best of brick and cement, 8 inches thick, laid lengthwise, in two shells, like toothing joints. The lining of the shore shaft consists of twelve inches of the same masonry in three shells. About 4,000,000 of bricks were used.

Ground was first broken on the 17th of March, 1864; and the work has been continued with but slight interruption, night and day, and at all seasons. A narrow railway was laid from the foot of each shaft, as the work progressed, with turn-out chambers for the passage of meeting trains; and small cars, drawn by mules, conveyed the excavated earth to the hoisting apparatus, and brought back at every trip a load of brick and cement. The men worked in gangs of five, at the excavation; the foremost running a drift in the centre of the tunnel, about two and half feet wide, the second breaking down the sides of the drift, the third trimming up the work to proper shape and size, and the last two loading the earth into the cars. The bricklayers followed closely, only a few feet behind the miners. About a hundred and twenty-five men employed in this work, in three relays, working eight hours each; the only cessation being from 12 o'clock Saturday night, to 12 o'clock Sun-day night. A current of fresh air was constantly forced through the tunnel by machinery. It is remarkable that no accident from earth, gas, or water, occurred in the whole course of the work, sufficient to interrupt its progress.

Water is to be let into the lake shaft by three gates, on different sides, and at different heights. The lowest is five feet from the bottom of the lake; the next ten feet, and the highest fifteen feet. Flumes through the surrounding masonry, also closed by gates and gratings at their outward ends, will conduct the water to the shaft gates. All the gates can, of course, be opened and closed with pleasure. Chicago will boast—with how much reason unprejudiced water-drinkers must judge—of all other cities on the continent, the best supply of the best water, at a trifling cost for both construction and maintenance—if the work holds as good as it promises to—in comparison with some of her eastern sisters.

LIQUID STEAM FUEL.

The general results of the experiments carried out at Woolwich Dockyard, with the view of establishing the superiority of petroleum over coal as a fuel for steam purposes, led to several important conclusions. They showed that the most valuable oils for the purpose were those containing the largest amount of paraffine, and further that their steam-producing power above our best coal was fully *twice and a half.* The inflammable spirit and burning oil can be extracted from the crude with advantage, thus rendering it perfectly harmless. It was also shewn that steam could be got up with great rapidity and maintained with little or no labor. A clear, intense flame enveloped every portion of the boiler exposed to its action, and which could be lowered or raised at will, and maintained for any length of time. But, notwithstanding all these apparent advantages, the petroleum boiler experiments do not appear to have led to any practical result in the way of advancing the position of the oil as a steam fuel. Since the Woolwich experiments, however, Mr. Richardson has taken another step in the matter. He has invented a portable grate for burning petroleum, shale, crude, or heavy oil, residuum, or grease, creosote and gas-tar, without smoke. During his experiments, Mr. Richardson found the necessity for such an apparatus, by which the manufacturers and refiners of shale oil might use up the refuse of the oil-stills as fuel, instead of slack or coal in their retorts. The grate consists of two iron boxes, one within the other. The inner one contains the porous material, the steam-jet, and the oil, and in the outer box water is placed. As the water boils the steam mixes with the oil vapor; this burns, and thus adds to the amount of oxygen and hydrogen gases produced by the inner box.

In practice the grate is placed level in the furnace, the outer case being always kept full of water, as high as the funnel allows. Oil is kept constantly running in, but only in sufficient quantities to saturate the porous material. Residuum or solid cold cakes of the oil, may be placed within the grate in moderate quantities. Steam is let in when the oil is in full flame, the proper amount being indicated by the cessation of smoke. The proper quantity of oil can be constantly maintained in the grate, as a glass register always records its hight. The flame is extinguished by running out the oil and allowing the steam to play for a few minutes. In relighting it, if the grate is quite cold, hot water is run through the outer case, and a little spirit and burning oil used in the trough. The grate can be used either by itself or as an auxiliary to a coal furnace. Wherever a large, powerful, clear fire, making no smoke and equalizing the temperature throughout the whole furnace is an advantage, this certainly appears qualified to have a place. Steam would seem to be the grand agent in effecting the complete combustion of liquid fuel without producing smoke. The water vapour introduced in jets below the grate rises and is decomposed into its constitutents gases—oxygen and hydrogen. These burning with the vapors of the hydro-carbon cause the flame to become wholly decarbonized, and its temperature to be greatly increased. The several kinds of petroleum require a variable quantity of steam; thus the American requires very little. But then such is the volatile nature of this oil that it seldom vaporizes more than 12½lbs. of water to 1 lb. of oil. On the other hand, the British shale, crude, or heavy oil, creosote, or gas-tar, require more steam; but then some of these oils vaporize from 18 lbs. to 20 lbs. of water to 1 lb. of oil. The slack coal used by refiners offers a marked contrast to this, 1 lb. vaporizing only about 4 lbs. Water vapor, then, appears to be the key to the secret of utilizing liquid fuel with the non-production of smoke, and as soon as the public recognize this fact its extended use will doubtless ensue. Mr. Richardson is certainly paving the way to this condition of matters by the introduction of his portable petroleum grate.—*Mechanic's Magazine.*

Machinery and Manufactures.

MANUFACTURE OF CAST STEEL AT ESSEN.

(From the Mechanics' Magazine)

In close proximity to the main route from Cologne to Minden, on the right bank of the Rhine, is situated the little town of Essen, lying within a short distance of that of Ruhrt. Like all small villages and towns originally insignificant in size and population, Essen owes its present importance and increasing development to two causes. One is the presence of natural productions, and the other the skill and enterprise of a few individuals in rendering them subservient to the interest and welfare of mankind. The natural wealth of Essen consists in the possession of the same material which has been a means of bringing our own country into its present state of commercial prosperity. It is in the centre of a coal-bearing area, and large revenues are derived from this source, although the price of the coal varies from 7s. to 9s. per ton. A considerable traffic in wool is also carried on between this place and the merchants in Normandy. But the chief cause of the prosperity of the town is to be found in the enterprise and exertions of those who have established manufactories and workshops, and thus enable these natural endowments to be turned to good account. First in importance, in the number of hands employed, in their tone and prestige as a scientific mechanical establishment, in their extent and influence, stand the workshops of M. Krupp. Some idea of their mere size may be arrived at by considering that from first to last they cover an area of 500 acres. On the authority of "Les Grandes Usines," from which we quote, a very considerable difficulty is experienced in obtaining access to the engineering premises of M. Krupp. In fact, this gentleman is sufficiently candid to let it be known very politely, but at the same time very decisively, that one will not be permitted to go over the works, by affixing at their entrance notices, written in English, French, and German, that visitors are requested not to ask for permission, in order to save the proprietor the pain of giving, and themselves the mortification of receiving, a refusal. To us, who are so exceedingly good-natured as to throw open our armouries, and disclose all our warlike implements, and the secrets of their construction and working arrangements, to those who might, perhaps, in a month's time, be turning against us the knowledge so required and literally beating us with our own weapons, the policy of M. Krupp may appear somewhat too exclusive. There is, however, very little doubt that in the main that gentleman is right, and that independently of the trouble, danger, and inconvenience incurred by the advent of visitors to an establishment of this description, it is but natural that its proprietor should be jealous of exposing to prying eyes all those details of workmanship acquired at the cost of so much time and money, and upon whose union and maintenance depends the prosperity of the concern, and that of the 10,000 hands engaged in it. After forty years of incessant labour, study, and sacrifices, M. Krupp has been rewarded for his toil and patience by being able to produce and work solid masses of steel weighing upwards of 36 tons. The magnitude of such an operation will appear, when compared with the limit reached in France in similar matters. There it is seldom that a block of cast steel attains to the weight of 9 or 10 tons, and even when run of that amount it has to be left in the ingot, as there is no machinery suitable for working it up. So far as the production of cast and wrought iron is concerned, the French are not by any means behind the Prussians, but at Essen it is not a question of merely the production of either of these two. The elder M. Krupp had a higher aim in view when starting his works, and he has given all his efforts to the production of steel—that true engineering philosopher's stone of the present age—concerning the chemical composition of which there has been so much dispute, and so many and various opinions have been promulgated, and the physical properties of which have a range so wide, varying from the hardness of the highest tempered chisel to the softness of the finest thread. In addition to the special production alluded to the manufacture of most of the ordinary engineering applications of iron are simultaneously carried on, including axles, tyres, wheels, and every description of railway iron work. The character of the Krupp steel has become so well known that, besides its being used in our own country, it is frequently insisted upon by French, German, and Russian companies in their specifications relating to the employment of that material, notwithstanding the heavy duties existing between the different countries, and which one would naturally conclude would be more than sufficient to protect the home manufacturers.

Independently of the indomitable perseverance and ability of the originator of the establishment, the coal in its vicinity and even within its boundaries is of the purest kind and well adapted for its intended purpose. The very circumstance, however, of the presence of the required fuel in a proximity so close to the workshops was attended at the commencement with a serious disadvantage, viz., the procuring of hands, as all the available labour was absorbed in working the pits. In order to overcome this drawback and supply the deficiency it was necessary to despatch recruiting agents into all the minor states of Germany to engage labourers, large numbers of whom were obtained from the province of Hesse. The effect of the coal workings in creating a scarcity of labour for any new enterprise may be gathered from the fact that upon one of the many small branch lines constructed for the purpose of the coal traffic more than one hundred trains of twenty-five waggons pass daily backwards and forwards. The writer in "Les Grandes Usines" institutes some comparisons between the works at Essen and others of a similar nature in France by no means complimentary to his countrymen. He particularly notices the grave taciturn mode of the German workmen, as opposed to the lively and somewhat boisterous manner of the French, and maintains that five hundred of the latter nation would make more noise than as many thousands of the former. In entering the workshops one is immediately convinced of their predominant nationality by the serious demeanour of the men, their long porcelain pipes, which some of them never relinquish, even when carrying the heaviest loads; the elegant contours of the buildings, calling to mind the Gothic style of architecture and the curvilinear outlines of the windows, so different from the harsh straight lines characterising the appearance of these details of construction in French manufactories. We now pass on to the actual production or manufacture of the steel, the preliminary operation consisting of the puddling or partial decarbonisation of the melted mass. The *modus operandi* of puddling is too trite to require comment, although its practical difficulties are not by any means yet conquered. In producing the melted steel a small quantity of iron obtained from a particular ore is put into the melting pot and takes from the puddled steel its excess of carbon, and in so doing carbonises itself; the iron, ordinarily exceedingly difficult to fuse, melts and becomes incorporated with the steel. To accomplish the necessary fusion the melting pots or crucibles are arranged upon the grates of furnaces built in bricks of a most refractory description.

[A description of the mode of manufacturing the crucibles follows, which we omit.—Ed. J.]

One peculiarity in the system upon which the establishment of M. Krupp is conducted, and probably one of the secrets of its success, is that all new inventions, proposed improvements, novel processes, or modifications of others long recognized, are submitted to a searching ordeal previously to their being used in the workshops. There is, in fact, attached to the works what we might term an experimental workshop, combining in one all the essentials of the studio of the savant, the workshop of the mechanic, and the laboratory of the chemist. As may be readily imagined, it is replete with crucibles of every shape and size, furnaces, retorts, and scientific apparatus of every description, the majority of which are familiar to those interested in such matters, but some are of a particular construction, specially adapted for certain purposes, and are the invention of M. Krupp himself. If, in addition to the enormous size and scale upon which all the processes at Essen are carried out, we take into consideration the guarded manner in which admission into the works is obtained, as previously mentioned, it will not be surprising that many vague rumours and reports are in circulation in the neighbourhood respecting the *modus operandi* of the production of masses of metal so exceedingly beyond, in point of size and purity, the capabilities of other establishments. Treating all these exaggerated rumours as mere idle gossip, "Les Grandes Usines" considers that the extraordinary success attending the whole process is not so much due to the discovery or employment of any very novel method, as to the admirable organisation, division of labour, system of management, and perfect discipline pervading the whole operation, and is the result of the practical knowledge and experience of all concerned in it, from the superior intelligence of the foreman down to almost the most ignorant of the subordinates. On this point we are decidedly disposed to concur with our authority, and, were there any doubt on the subject, the fact that many excellently designed plans have been rendered completely abortive by carelessness and frequently culpable negligence on the part of those engaged in their execution, would corroborate the statement.

The building where the great castings are run holds about 1,200 crucibles arranged in furnaces by 4, 8, or 12, according to size, and the moulds to receive the melted metal are disposed in line along a trench situated between two pairs of rails upon which runs a movable crane. It will be at once seen that the moulds are placed in what we call the "six foot," when alluding to railways. The moulds of cast metal, always, without exception, of a cylindrical shape, are attached by trunnions to a heavy chain connected with machinery worked by hand labour. The capacity of the moulds varies from 100lb. to 36 tons; the latter being the extreme limit to which, at present, this branch of industry has attained. It is not at all impossible that this limit will be ultimately surpassed, provided the necessity should arise. The furnaces are arranged along the sides the whole length of the building, and are provided with means of access by galleries underneath in order that an inspection of their working condition may be made at any time. Constant practice enables the men who are charged with this particular duty to ascertain, by inserting a long iron rod into the melted mass, when it has arrived at the proper degree of fluidity. The excellent disposition of the means of access aids them in arriving at a correct conclusion on this all important point. The practical problem to be solved is the following:—"To deposit in the mould a continuous stream of melted steel sufficiently hot to cool without any sudden impediment, and to solidify into a mass perfectly homogeneous." If the steel in cooling solidified quickly, and caused, in consequence, the formation of a thin solid layer interrupting the process, the value of the ingot would be very considerably diminished, and in the majority of cases altogether lost. The operations, simple as they appear, could not be successfully carried out except by men who had undergone a long and progressive experience in all the various details, and each of whom could be trusted to execute with almost mathematical precision the especial duty falling to his charge. The foreman determines the position of the mould, assigning it in a manner so as to cause it to be commanded by as large a number of furnaces as possible. He also regulates the slope of the floor towards the trench. Upon these slopes are fixed the little canals or channels conveying the fluid into the usual hollow to be seen in the upper portion of every mould, and which is for the purpose of regulating and equalising the descent of the melted metal into the mould, as otherwise it would be too violent. These channels are strongly constructed of wrought iron, lined interiorly with fireclay to resist the enormous heat of their passing contents, and slightly widened out or bell-mouthed at the extremity next to the mould. The men are divided into gangs, each man being selected for that particular duty in which he most excels, and the signal having been given by the foreman the furnaces are opened, or, as it is termed, uncovered, and the momentous work commences. One of the men with a pair of pincers seizes a crucible, but instead of carrying it himself and emptying it into one of the channels, as is the custom in France, he transfers it to two of his fellow workmen, who in their turn convey it at once to a part of the shop floor left free for the purpose. In close proximity to this spot a regular line of assistants are drawn up two by two, almost in military fashion, quietly awaiting the advent of the crucibles. Directly one is deposited as above mentioned, the two at the head of the file advance and seize it with a double pincer having a large ring which clips round the belly of the crucible and retains it in a verticle position. Having emptied the contents into the particular channel assigned to them by previous arrangement they cast the empty crucible down a funnel into the cellars below the shop, and it is thus got rid of. Its duty for the time is done and its presence would only serve to encumber the floor and occupy space, every inch of which is too valuable to be taken up by empties. Thus disembarrassed of their load the two workmen dip their pincers into water to cool them, keeping them there for about a minute, and finally take up their place at the bottom of the file from which they started. As those in the ranks above them move off to perform their part in the routine, in process of time they become again the foremost of the file, and a repetition of the manœuvres continues until the running is brought to a termination. On considering the general features of this system it might at first be supposed that some of the men would be merely looking on while others were at work, but the admirable regularity and organization maintained throughout prevents any such waste of time or labour. Immediately that the two foremost men of the company have filed off with a crucible, another is deposited in unfailing succession and is instantly seized in its turn and carried off, and so on in unbroken continuity. The adoption of separate channels for each pair of men precludes all possibility of confusion and overcrowding, which might arise if the same channel served indiscriminately for carrying off the contents of any crucible. The whole process is especially distinguished by a remarkable absence of anything approaching to disturbance, noise, or confusion. The only cries heard are those informing the men in the galleries underneath the furnaces that the moment has arrived for clearing the crucibles from the particles of coke adhering to them, and for opening the furnace doors. Many other precautions suggested by long continued practice are faithfully attended to in order to ensure the success of the operations, and some minutes are all the time required to fill the vast cavity, containing as a maximum 36 tons of metal.

All labour may be classed under the two divisions of skilled and unskilled. In the latter nothing is demanded of a man but that he should be willing to use his hands, and the railway excavator or "navvy" furnishes us with as good an example as could possibly be instanced. In the former a man must be able to work with his head as well as his hands, although not to the same extent, because a considerable portion of the success of his trade or craft depends altogether upon himself individually. He can make either a bad or a good job of his work according to his willingness or ability. The workmen employed in the manufacture of cast steel, particularly on a scale so stupendous as that of M. Krupp, have need of peculiar qualities of address and of a degree of physical and moral force not easily to be met with in men of the class. The result is, that the number of men who are really capable of undertaking this description of work and gaining their livelihood by it is limited to an extent much smaller than what is generally believed. Out of every hundred hands who enter the foundry at Essen, forty of them at least, after remaining there for some time and giving themselves a fair trial, are forced to acknowledge to their great chagrin and mortification that they neither possess naturally nor are able to acquire the dexterity, the address, the skill in manipulation, and the unremitting attention indispensable to the successful execution of the details committed to their charge. They are consequently very unwillingly compelled either to quit the establishment altogether or accept some other description of employment more suitable to their disposition and physical endowments. There are, therefore, no comments necessary respecting the difficulty of obtaining a large number of hands for a branch of mechanical industry where awkwardness and inattention, carelessness and want of skill, may occasion, not only serious loss to the proprietor, but dangerous and sometimes fatal consequences to both the incompetent workman and his more skilful companions. The workmen who unite in themselves the requisite qualities are paid according to a scale of wages proportioned to their different positions and value in the establishment. It is mentioned in "Les Grandes Usines." as a proof of the health the foundry-men of M. Krupp enjoy, that they of all others require least assistance from, and make the fewest demands upon, the resources of the sick fund belonging to the whole institution in general As may be imagined they suffer rather at first from the severe and continual sweating produced by the nature of their employment, but when once, as we might say, seasoned, their health is in no manner whatever affected by it.

As a rule, for the obvious purpose of avoiding night work, the meltings are so managed that the running takes place either early in the morning or during some after portion of the day. The prudence of this arrangement cannot be too much commended, as everyone is well aware of the wasteful expense incurred in carrying on night work, which amounts, in fact, to paying higher wages for less work. Accordingly the only men left in the works at night are those having charge of the maintenance of the furnaces, as the removal of the ingots is also effected in the daytime. In about two hours after being cast, the ingot, except when of excessive dimensions, is sufficiently solid to be lifted by the movable crane and taken away. Whenever it is intended to be worked at once it is put upon the railway traversing the workshops in every direction and conveyed by a locomotive to the particular shop where that description of work alone is carried on. Frequently it happens that very large ingots are not required to be at once put under the hammer, and then the following plan is adopted:—The ingot is removed from the mould and deposited in another part of the building reserved for such purposes, and is not permitted to become quite cold, To accomplish this by the construction of furnaces sufficiently large and numerous to answer for all the different masses of metal awaiting their finish, would have entailed an unwarrantable and ruinous outlay, so the difficulty is overcome in another manner. The ingots are covered with ashes and half-consumed *débris*, and a little wall of dry fire-bricks built all around to keep in the heat. The slow combustion of this otherwise valueless fuel prevents the block from getting cooled down below a certain point, and represents a kind of hot charcoal bath.

Recent events on the continent have amply demonstrated not only the advantage, but the absolute necessity, of a country possessing among its other resources an establishment similar to that at Essen. The same power, skill, and ingenuity which, when employed in the cause of peace, can contribute so largely and zealously to the welfare of mankind, can also, when enlisted on the side of war, produce weapons and warlike implements alike creditable to mechanical art, as destructive and fatal to the foe. In the ordinary condition of the workshops of M. Krupp the blocks of cast metal lying about—some just turned out of the moulds, others partly worked and awaiting their transportation to another portion of the premises—represent a value of about £170,000. This value, as our authority remarks, only holds for M. Krupp, as it is only in his establishment they can be finished and fitted for their intended purpose. In one sense it is the very worst description of stock one could possess, being not convertible, but this is a consideration of very little importance in mechanical works occupying the position of those in question, and whose maintenance is so essential to the prestige and interests of the Prussian nation. In order to forge and reduce into shape the enormous masses of metal intended generally for the construction of heavy pieces of artillery, or to form portions of the machinery of large men-of-war steamers, it becomes necessary to call into play the greatest mechanical invention in the whole establishment, viz., the celebrated steam hammer. The size of the castings to be operated upon far exceed the limited powers of any of the ordinary steam hammers. The celebrity of this famous 48-ton hammer has become a household word in nearly every mechanical workshop of a nature similar to that of M. Krupp, and it is questionable whether in the whole world there exists its fellow. The firm of Petin et Gaudet possess one of 14 tons; those at Creusot and Guerigny average about 12 tons; and "Les Grandes Usines" asserts that 20 tons is about the limit attained in England respecting the same machine. The following particulars will assist our readers in forming a correct idea of this stupendous implement:—The movable part of the hammer or striker is 12·31 ft. in length, has a breadth of 5·21 ft., and a thickness of 4·10 ft. Putting the weight of the metal at about 460 lb. per cube foot, it will be readily seen that the power is theoretically even beyond what has been stated.

So early as the year 1859 M. Krupp had the foresight to perceive that the ever-increasing exigencies of industrial and mechanical art would demand the production of masses of metal, whether steel or iron, exceeding in size and proportions anything ever previously attempted. It was while turning over in his mind the probably speedy occurrence of these demands that the immense advantage a mechanical establishment similar to his own would possess over all others in being provided with a machine suitable for working enormous masses of cast metal, presented itself forcibly to his attention. The idea once conceived, to a man like the proprietor at Essen, the carrying of it into execution followed as a matter of course. Had M. Krupp paid much attention to the opinion of others on the matter it is probable he would never have erected this valuable acquisition to his machinery department. All those to whom he communicated his intention considered it in the light of a futile and foolhardy project, and not to be entertained by a man of sound sense. Many savants and scientific men declared that a hammer of the proposed power could not be made, and, even if it were actually constructed, it would be impossible to set it going. As a last consolation to the inventor, it was predicted that, supposing it were, by an extraordinary stroke of good luck, put *au courant*, it would, by its own violence, knock itself to pieces and every thing belonging to it. In spite of these sinister prophecies, M. Krupp commenced the construction of his enormous hammer, and the result showed his calculations were well founded. A brief description of a work unparalleled in size and the amount of capital invested in its erection will be found interesting. The hammer was built upon what may be called a triple foundation. The lowest consisted of masonry of a very strong and solid description. Upon it were placed, arranged in joist fashion, a number of enormous oak trunks, obtained, for the most part, from the forests of Northern Germany, including the well-known timber of Teutbourg, mentioned and eulogised in the time of the Emperor Augustus. Upon these oaken joists was placed the uppermost foundation, consisting of cylinders, cast in segments and solidly bolted together. These carry the bed-plates, or base proper, of the anvil. The anvil is not a fixture, as would naturally be imagined, but is movable, and is continually being removed and replaced by new ones. The necessity for this incessant changing arises from the fact that it is always destroyed after a short term of duty by the blows it receives; and, moreover, its shape must be varied to suit the different forms of the pieces subjected to the action of the hammer. A clear space of about 10 ft. is left all around the anvil—a very unusual, although a very convenient arrangement. It arises more from the manner in which the columns supporting the hammer are disposed than from any absolute design or intention. They are separated by a space of about 22 ft., thus forming a kind of arcade, having a height of 16½ ft., causing the force of the blow to be further augmented by the impetus derived from a fall of rather more than 9 ft. These columns are of cast iron, having a thickness of 9·75 in., and a circumference of 19·39 ft. They are slightly flattened at the top to allow of the attachment of horizontal iron girders, which serve to maintain in a vertical position the guides or grooves in which the hammer works. These girders are evidently, in addition to their more immediate use for holding the guides immovable, for the purpose of stiffening the whole combination. Although it is difficult, without the assistance of diagrams, to arrive at an exact idea of any compound structure, yet there is no doubt a strong resemblance between the frame, if we may so express it, of M. Krupp's hammer and that containing our ordinary gas holders. The columns, vertical guides for determining the path of motion, and the connecting horizontal girders at top are manifestly identical characteristics.

One of the most important details in the erection of the hammer lies in the foundations of the hammer proper being distinct from those of the anvil, and consequently the vibrations resulting from the percussion affect but very slightly those parts most intimately connected with the machinery of the structure. There is very little doubt that the success of the project has been mainly due to these excellent precautions, and that but for them it is possible the predictions respecting the damaging action of the concussion upon the contiguous parts might have been fulfilled. The cylinder and piston constituting the motive agents of the machine are fixed upon pillars standing upon an isolated foundation as above. The diameter of the cylinder is 6·03 ft., a very fair size for a principal instead of an accessory engine. With the exception of the iron columns and other permanent portions of the structure, all the separate parts can be replaced at a moment's notice, duplicates being always at hand to avoid the prejudicial delay arising from fracture of any of the component parts. Thus a duplicate cylinder is always ready to be substituted for its predecessor in case of any accident rendering an immediate change requisite. A second hammer, or, more correctly, the striking part, or hammer head, is kept in stock to replace a damaged one. Such a contingency is, however, of rare occurrence and only happened once when the head, unable to resist the shock, cracked across. A large assortment of anvils is arranged systematically in line before the workshop, and in their immediate vicinity the broken head of the hammer, which appears to be preserved as a kind of curiosity. It is rather remarkable that the crack did not take place in the actual striking part, but higher up, in a corner and close to one of the pins fixing the head in its socket. The vicinity of the crack to a pinhole is, however, sufficiently explanatory of the reason of the failure occurring at that point. The head of the hammer is not in one piece, and its fabrication was not the least difficulty to be overcome. The lower or striking part is of cast steel, which was allowed to first partially cool, and while in that condition a melted mass of iron was run on to it and in cooling became incorporated with it. All the component parts of the hammer, as well as those of the other large machines, were made in the workshops themselves, which possess an iron foundry on the same scale of magnitude as the rest of the premises. It contains, among others of lesser proportions and capacity, several cupolas capable of holding nearly 50 tons each of melted metal, and machinery in proportion for manœuvring the necessary operations attendant on the running. The skill and ability of M. Krupp and his subordinates, whether displayed in the selection and examination of the ores—all of which undergo a searching ordeal before being approved of—or in the more practical operation of melting and running the metal, have rendered successful at Essen castings which could not even be attempted elsewhere, not perhaps so much on account of the complexity of the models as from their immense size and solidity, which are the especial characteristics of the productions of M. Krupp's foundry.

It must not, however, be supposed that castings exhibiting considerable delicacy and sharpness of outline cannot be produced at Essen; quite the reverse, for those who have the good fortune to obtain the *entrée* are shown a cast plate containing in bas-relief the principal monuments of Germany. These representations are all produced by the one operation of casting without any after planing, chiselling, or filing whatever, and consists of cathedrals, castles, mausoleums, and public buildings, rendered with a purity of delineation one would scarcely suppose compatible with the density of the material employed. The artist was engaged for more than a year in preparing the mould, and the effect is the more extraordinary as the ground is a cast-iron plate and not the surface of a bronze medal. An ornamental clock surmounted by a garland of fuschias, a chandelier with branches of foliage, and a variety of handsome domestic appendages, are also turned out in the same material, called Sayn metal, whose grain appears nearly equal for the purposes of ornament to that of bronze, and considerably superior to that of zinc. As may be easily conjectured, all the accessories of the great hammer are on a scale equally stupendous and massive, the walls of the workshop in which it is erected being considerably stronger than those of the adjoining shops. The vibration caused by each blow spreads itself over a large area of surface, and the sound of the concussion, which rises above all the various noises and din going on in every direction, is an infallible indication that the *gross marteau* is busily at work. Having satisfactorily solved the problem of the actual construction and working of the hammer, M. Krupp turned his attention to perfecting the machinery destined to transport the blocks to be acted upon, to and from the necessary *locale*. At each of the four corners of the frame he erected a movable crane capable of sustaining individually a safe load of nearly 50 tons. That there might not be the slightest chance of a failure occurring in any of these machines while an incandescent mass of metal of the above magnitude was *in transitu*, they were each of them tested to eight times the safe load, or to about 400 tons. Exactly behind each of these cranes, and belonging, as it were, to them respectively, is a furnace with a bottom movable on rails. This movable sole is of firebrick, built upon an iron frame or "lorry," supported upon small massive disc wheels, and can thus be run in and out of the furnace as required. The dimensions of the furnace are about 10 ft. by 8 ft. The ingot being brought into the shop by a locomotive is lifted by one of the cranes on to the "lorry" and run into the furnace. When raised to the proper temperature for being operated upon by the hammer the business of forging commences, and the whole process is conducted with the same degree of regularity, order, discipline, and certainty attending all the operations carried on in the establishment.

Having alluded to the process of forging a solid steel ingot weighing upwards of thirty-six tons, we will now briefly describe the *modus operandi* practised at Essen. It will be remembered that the ingot is undergoing a slight re-heating, or, rather, a conservation of its previous high temperature, in a furnace, the bottom of which is movable. The diameter of the mass of metal averages about 6½ feet. Directly the furnace door is opened, a chain, already attached to the sole, is tightened, and partially draws out the "lorry" with the ingot upon it. The crane, one of the four belonging to that particular furnace, is slewed round so as to command the block, and heavy chains, armed with long fangs, are passed securely and safely round it. The heat emitted from the surface of the block does not permit of an approach, even by the workmen, nearer than 7 ft. in distance, and amateur observers are compelled to keep farther—a good deal farther—off. The block being once well gripped by the holding chains, the lorry upon which it rests is drawn clean out of the furnace; another chain is then attached to the hinder part of the mass, and the whole apparatus is brought *vis-a-vis* to the anvil, upon which a rapid semi-rotation of the crane deposits the ingot to be operated upon. Once there, the machinery erected for the purpose lifts and turns it about until the exact point which the foreman desires to be first struck is presented to the hammer. The foreman presiding over this important detail of workmanship is, as may be easily anticipated, an old and experienced hand. Thirty-five years of constant practice in this particular branch have endowed him with a superiority only to be acquired by similar means. Commencing with the smallest hammer in the establishment, he has been advanced, as new and larger ones were successively erected, to the duty of superintending their operations, until he has finally reached his present responsible position. All being in readiness, the foreman gives a signal, and the hammer descends quietly, just touching the place to be afterwards struck, in a manner analogous to that in which a smith taps a piece of iron he is forging to indicate to his assistant where to strike. A second signal brings down the hammer with a force which causes a small earthquake, and the spectator recoils instinctively. The blows once commenced in earnest continue without intermission, the block being turned and adjusted as required without any apparent effort. In removing the ingot, so many as a hundred men together are occasionally employed to work the leverage of the large pincers, and our authority notices the vivid contrast between the cries, shouts, and noise attending similar operations in France on a much smaller scale, with the *sang froid*, the silence, steadiness, and business-like manner of the workmen at Essen, who appear to be quite dwarfed by the enormous proportions of the machinery around them. While the forging of one mass of metal is going on, there are three others heating in the other three furnaces, ready to take successively the place of the first when the operation is finished. A few blows of this gigantic hammer suffice to produce the desired effect upon smaller masses of metal, whether steel or iron, including large anchor flukes and the cranked axles of marine steam engines. The *gros marteau* works day and night, for it has to pay the interest of the capital expended upon its erection and maintenance, and in order to do this it must return the manufacturers profit upon nearly £120,000, a duty it faithfully fulfils. During a period of incessant action, extending over five years, the only delay ever incurred was occasioned, as already mentioned, by the cracking of the hammer block, which was replaced by a new one in less than three weeks, and the machine started again. In addition to this stupendous engine there are forty-two other hammers doing duty in the workshops at Essen. Some of these are 20 ton hammers, and the others range from about 10-tons to the smallest size. The majority of these owe the force of their blow to simply the weight of the hammer, aided by the momentum of its fall, but several are also assisted in their action by steam pressure.

M. Krupp, who from his own office can take in at a *coup d'œil* everything that goes on in the vicinity of the *gros marteau*, has already foreseen that the progress of scientific and mechanical art may ultimately demand a power exceeding that already at his command, and he has already meditated the construction and erection of a 100-ton hammer. The difficulty becomes reduced to a matter of finance. Would an engine of a magnitude so extreme repay the outlay of about a quarter of a million, required to erect it? So soon as the proprietor of Essen can solve this question satisfactorily in his own mind, he will doubtless set about solving it in a practical point of view. There is, however, another means of arriving at the same end, which has not escaped the penetration of M. Krupp, and which, in all probability, will usurp the place of steam hammers reaching dimensions and proportions beyond what have already been attained to. We allude to the hydraulic press, and it is questionable whether the next huge forging instrument erected at Essen may not be constructed upon this well-known principle.

Among the numerous varieties of work turned out of M. Krupp's establishment, one of the most usual description, and one for which there are constant orders on hand, is the manufacture of steel tyres, both for waggons and locomotives, the latter especially. As this process is considered one of the curiosities of the establishment, we will give a brief description of it, and it must be borne in mind that there is a vast difference in conducting the operation when it relates to the working of steel instead of the ordinary malleable iron. The first step consists in cutting from an ingot of about 3 tons weight a certain quantity of metal, according to the size of the tyre to be made. In general, the quantity cut off varies from 3 cwt. to 8 cwt. To cut a piece out of a block of metal nearly 10 in. thick, is not so easy as may be anticipated, and it is performed by placing a cutting edge on the block while red-hot, and driving it through by a few blows from one of the smaller-sized hammers. The piece thus cut off is forged into the shape of a rectangular prism, slightly rounded at the extremities, raised to a red-heat, placed upon an anvil, and a portion of it driven out by the action of a very thin wedge, leaving an oval-shaped hole in the central part about ¾ in. in breadth, the minor axis constituting that dimension. After one or two blows from the hammer to flatten down the metal, which has spread out a little in a lateral direction, a wedge is introduced into the oval aperture, then another, until the metal assumes the form of a very elongated lozenge. It is now raised upright, with the longer axis vertical, and, being struck once or twice, takes the shape of a rough square. To bestow upon it a circular form, it is placed under a hammer whose anvil is split from top to bottom, thus allowing the unformed tyre to enter the aperture and be supported by a large mandrel placed in the gap. This piece of mechanism acts as a kind of secondary anvil, and, by being hammered upon it while in a rotary state, the metal commences to assume a correct circular contour. It is again hammered on a solid anvil in a horizontal direction, to take out all the angles which might have been formed, and to bring the particles of the metal in closer contact. The next step is submitting the semi-formed tyre to the action of the rolls, which are of a special description, and were once, for a long period, used only at M. Krupp's establishment. They are rather complicated in construction, and, while pressing the ring of steel in every direction, one of the cylinders determines the shape of the flange, a detail indispensable to all wheels designed for running over rails. The exact regulation of the action of the rolls demands the attendance of experienced workmen to manage the different screws and levers in connection with the machinery. There is one peculiarity worth noticing in the workshop where these operations are carried on, and in which it differs from the majority of other mechanical works. The furnaces, instead of being constructed above ground, are built underneath, in a manner similar to those in the steel foundry, which we have already described. Like these, they are also furnished with machinery and gearing to render their working convenient and rapid. The tyre, for we may now so call it, is re-heated in one of these furnaces, and placed horizontally upon a large plate or disc, in the centre of which there is a cylinder, constructed of segments. The action of an hydraulic press causes this cylinder to gradually enlarge its circumference, and consequently to stretch the tyre until the required dimensions are accurately obtained. While the tyre is still undergoing the above tension—to speak metaphorically, while it is still on the rack—it is subjected to the *peine forte et dure*, consisting of a series of numerous and heavy blows, having for their object the discovery of any flaw, crack, or other unsoundness which might have happened to the metal during the vicissitudes it underwent in its manufacture. A searching examination is made when it is cooled down, and if satisfactory, it is handed over to those whose duty it is to give it the finishing touches by cleaning it of scales and clinging *débris*, in which last process the labour of children is employed, a very unusual spectacle in the premises at Essen.

It must not be supposed that the tyres of wheels constitute the only item of railway mechanism turned out of the workshops of M. Krupp; on the contrary, every description of constructive detail, whether fixed or movable, is there manufactured. For several years M. Krupp was engaged in conquering the difficulties and combating the obstacles attending the construction of solid or disc wheels of cast steel, as the rapid solidification of this metal renders it unsuitable for any complicated description of manufacture. In the premises at Essen there is now a foundry especially devoted to the manufacture of disc wheels in a single operation, and the casting has arrived at such a state of perfection that, beyond the usual amount of dressing, no after process is necessary to render the fabrication complete. As they are taken out of the moulds so are they ready for service. One advantage of this principle of construction is that all welds and joints are avoided, and the chances of fracture considerably diminished. Notwithstanding these manifest advantages, several railway companies decline to adopt them, and M. Krupp, in order to to be ready for any emergency, has appropriated a workshop for the production and forging of the spokes, naves, and felloes of wheels in iron.

There is very little doubt that cast-steel axles, whether straight or cranked, are becoming generally substituted for those of iron, either in wagons, locomotives, or marine engines. The remarkable feature in their manufacture is that they require machinery of tremendous power. An idea of the immense strength of the rolls may be gained by the fact that after leaving them the bar has sometimes a thickness of more than 10 in. Among the steel axles turned out at Essen, some have evinced proof of extreme solidity, and we select an example which was supplied to the Orleans Railway. It appears from a table compiled by order of that company, and giving accurately the number of miles run by the axles of several of their locomotives, that the one in question ran upwards of 170,000 miles during a period of nine years. The engine to which it belonged weighed 30 tons. In another table equally interesting is recorded the distances run by the tyres of the locomotives. M. Krupp has a rule of his own, according to which he guarantees that all the tyres coming from his establishment shall do a certain amount of work before being injured or requiring repair. The following formula will give in English measures M. Krupp's rule. Let W represent in pounds the weight of one of the steel tyres, M the distance in miles it is guaranteed to run, then,

$M = \frac{W \times 248{\cdot}55}{2{\cdot}2048}$. As an approximate rule sufficiently near for practical purposes, it may be stated that for every pound's weight of metal in the tyre it will run 113 miles. The following examples are mentioned. One tyre ran 43,000 miles and another 46,006, without requiring to be returned. It is recorded, as a just tribute to the excellence of the work at Essen, that England, for self and colonies, ordered, in 1865, 11,396 tyres and 564 axles. Among the largest orders are those from the Great Eastern Railway, the Patent Shaft and Axletree Company, the London and North-Western Railway, the Great Northern Railway, R. Morrison and Co., of Newcastle, the East Indian Railway, and Prosser & Son, of New York. The last quoted ordered over 2,000 tyres. In close proximity to the premises where the solid steel wheels are cast, is the workshop where the manufacture and testing of the steel blades destined for the springs of locomotives and carriages are conducted. There is nothing peculiar, or to call for especial notice, in this process, the only exception to the usual routine consisting in the employment of a huge lever worked by hand power in lieu of the vertical steam press more generally in vogue. A little to the right of the above are situated large rooms in which all the operations necessary for the production of cast steel rails are executed. Rolling, planing, boring, cutting, and other machines are disposed in an order the most favorable for rapidly and effectually doing their own share of the work. In the foreign mines a large demand for steel pump rods has arisen, and some have been sent from Essen forged in one solid piece 66ft. long. With few and rare exceptions, iron in the ingot or in bar never goes out of M. Krupp's establishment; it is all utilised there, and is only sent out in a form and condition fit to serve immediately some mechanical or scientific purpose. Railway plant and machinery, mining gear and marine machinery, constitute about three-fifths of the products of the steel cast at Essen; the remaining two-fifths are appropriated to less pacific objects, and necessarily demand an especial study. They comprehend the construction of cannon of all calibres, from the smallest specimen of light artillery to others throwing a projectile weighing upwards of 1,100lb. In our next we trust to give a *resumé* of what the efforts of M. Krupp have accomplished towards the production of implements of war.

Fibre of Stalk of the Hop Plant.

If as soon as its flowers have been gathered, the stalks of the hop-plant are made into bundles, and well steeped in water, then dried in the sun and beaten like hemp, a fibre will be obtained which, after having been combed, is admirably adapted for being spun into cordage.

Utilization of Waste Substances.

While considerable attention is being given to gun-cotton and nitroleum, a somewhat similiar substance is gradually making its way as an article of ordinary domestic use, entirely free from danger, and possessing such advantages as are likely to secure its general adoption. In the manufacture of Parkesine, fibrous vegetable matter of any and every kind—cotton and flax waste, and old rags, being, from their cheapness, the favorite materials —may be employed. These are first dissolved by acids, and they then yield what chemists call pyroxyline. Pyroxyline, however, as its name implies is highly inflammable, and indeed explosive, like gun cotton, and this dangerous qualification has to be neutralized. Mr. Parkes effects this by the introduction of either of various chemical ingredients, as iodine of cadmium, tungstate of soda, chloride of zinc, gelatine, several carbonates, sulphates, and phosphates. Collodion (as used by photographers), when evaporated so as to leave a solid residue, has been employed in the production of Parkesine, but it was found by far too expensive. The substances which have given the best results with the pyroxyline are nitro-benzole, aniline, and glacial acetic acid. By the use of various proportions of these substances, all consistencies of Parkesine, from the solid to the fluid form, may be obtained. The applications of Parkesine are, of course as numerous as its forms are various. In the fluid form it is available for waterproofing fabrics, and in this way it is very serviceable. In a plastic state Parkesine is useful in making tubes, etc, and for insulating telegraph wires. Where hardness and toughness are required, these desiderata are arrived at by the admixture of oils prepared with chloride of sulphur, the latter solidifies and makes them (the oils) non-adhesive. Again, by the use of resins, gums, stearin, tar, etc., modified preparations of the invention may be made to suit special applications. Parkesine, indeed, is a most accomodating material, and may be made as hard and brittle as glass, or as fluid and yielding as cream and of every intermediate consistency. It may have elasticity imparted to it to almost any extent or degree, and in this state it is likely to become a dangerous rival to india-rubber and gutta-percha, inasmuch as it will become, if it be not now, far cheaper than those useful articles of commerce, and answer almost all their uses equally well. Vulcanized India-rubber will find a sturdy competitor in Parkesine, for it may be manufactured with less of brittleness, quite as much hardness, and at a lower cost than that tediously manipulated substance. There is no refuse in the manufacture, the chips and cuttings being capable of remanufacture with the greatest facility. Parkesine will take any color, and may be given any degree of hardness; it may be made to imitate tortoise-shell, marble, malachite, or amber, and can be cut with a saw, turned in the lathe, planed, carved, engraved, stamped between dies, rolled into thick or thin sheets, worked into screws, shaped into moldings or cornices, etc. It is susceptible of a high polish, agreeable to the touch, and not disagreeable in smell. At a temperature of 340 deg. Fah., it is consumed, without flame, being decomposed and passing off as dense smoke, leaving but a dark colored ashy residue behind. It is now being manufactured for a variety of purposes, and is daily becoming more extensively known.—*Mining Journal.*

Colonel Berdan's New Rifle.

The American *Artisan* says, "Colonel Berdan has brought out another improvement in his already widely celebrated rifle, which seems destined to eclipse all that has yet been done in the way of converting the muzzle-loading musket into a breech-loader, as the improvement seems especially adapted for this purpose. Instead of the breech-piece formed in two parts, as in his former patent, it is made of one solid plug or piece of steel and closes in the same manner. Instead of the two joints of the former arrangement, there is in this but one joint. The breech is fastened in its place by sliding it upon a flanged piece of steel that is fastened longitudinally upon the top of the barrel. By pressing upon a small spring, the breech is easily removed for the purpose of cleaning, carrying in the pocket in case of rain, or it can be removed and thrown away if the soldier is liable to be captured, so that the enemy cannot take advantage of the rifles he may become possessed of.

The cartridges used are the "central fire," and made after a patent of Col. Berdan's. In many respects they are an improvement on the copper-flanged cartridge; when once fired they can be preserved for future use. It resembles the ordinary copper cartridge, except at the centre of the base there is an indentation, within which there is a raised cup on which a shallow percussion cap is placed. It is exploded by a blow from the hammer on a pin that passes through the solid steel breech-piece.

We witnessed a test of the qualities of this new gun a few days ago; and it exceeded all that we expected of it. For rapidity of fire it is unsurpassed. After being fired thirty or forty rounds, we examined the breech, and could perceive no trace of fouling or difficulty in manipulating the parts. As a proof of the security of the closing of the breech, it was fired by not closing it to its place within nearly half an inch; and we could perceive no difference in the firing. The hammer, in its descent, always forced it into place.

Gummy Oil on Leather.

In the earlier days, the oil used in the finishing of leather was neats-foot only; then we heard nothing of gummy leather; but as time rolled on, and neats-foot oil grew dearer, leather-dressers sought out some cheaper substitute, and the article nearest neats-foot oil was supposed to be the oil expressed from fish. The hide of the cow or the calf has a strong affinity for neats-foot oil, of course; even the hide of the horse absorbs this oil, and holds it. This oil does not gum, and will not, when once absorbed by the leather, exude to the surface. Not so with fish oil, however. This is something of quite another character. The oil of the fish differs as much, chemically, from the oil of the hoof of the ox or the cow as it does from that obtained from the vegetable world, which contains a still larger amount of gummy property, Fish oils are heating or burning in their character, and will ruin any leather they are applied to; the stock hardens, and finally cracks, through the effects of the stuffing, of which this oil is the main ingredient. If fish oil and neats-foot are mixed, the evil is lessened, and when tallow is incorporated, the bad results of the fish oils are partially warded off, but the application of fish oil to leather kills the substance, and is the prime cause of the gum which is found on the surface.—*Hide and Leather Interest.*

Smelting Titanic Iron Ore.

The London *Mining Journal* says, "a valuable discovery has just been made by a gentleman, a cheap process for smelting titanic iron ore, which has hitherto defied all iron masters and scientific men in the trade. It is well known that titaniferous ore is most valuable, on account of its hardness and tensile strength being five times greater than ordinary iron. This iron will be admirably adapted for plating on iron-clads, and also for rails, on account of its hardness and strength, and the discoverer will be prepared to test this iron against any other iron hitherto discovered for these purposes, or for making steel."

Useful Receipts.

Dyeing of Horn Buttons, &c.

1. Dull Black.—The buttons are boiled in a saturated sugar of lead, until the color has acquired the desired shade. According to the quality of the horn, this may take a quarter to half an hour. The buttons should then be washed with water, slightly acidulated with vinegar.

2. Iron Black.—The buttons, after being treated as stated in No. 1, are placed in a cold solution of an alkaline sulphuret. The result is, the buttons possess a bright, metallic lustre.

3. Pearl.—After undergoing the treatment of No. 1, the buttons are brought into diluted muriatic acid, containing 3 per cent of the strong acid. This weak solution produces, according to the duration of its influence, all shades, from the darkest blackish blue to the lightest white.

4. Silver-gray.—The buttons from No. 1, are placed in a solution of nitrate of mercury, saturated at a temperature of 140 degs.—170 degrees Fah. The treatment in this bath should last ten to twenty minutes, which, if cleanliness is observed, will produce most elegant results.

5. Chocolate Brown.—The buttons from No. 4 are boiled for about a quarter of an hour in a concentrated but thin solution of catechu.

6. Chocolate Brown Dark.—The buttons from No. 5 are placed in a warm bath of bicarbonate of potash, containing 3 per cent of the salt. With the duration of the treatment the color darkens.

7. Chocolate Brown.—The buttons of No. 5, are placed in a warm solution of sugar of lead, saturated at the common temperature. This color looks especially well in knife handles, etc.

8. Bronze Brown.—The buttons from No. 4 are placed in a solution of aesculine (the pigment of the horse chestnut), and treated and boiled as in No. 5.

9. Bronze Brown.—The buttons from No. 4 are boiled for quarter of an hour in a concentrated solution of green vitriol, and then in aesculine. The resulting bronze differs materially from the former, possessing great softness.

10. Light Brown.—The buttons from No. 4 are boiled in a solution of galls or pure tannin. This is especially adapted to netty designs, to which it imparts a silky lustre.

Upon the sensitive surface, produced by treatment No. 4, a great many combinations of colors may be produced.—*Scientific American.*

New Process for Staining Wood.

In a recent report of the "Proceedings of the Franklin Institute," we find described a process of staining wood, by Barton H. Jenks, that promises to be of some utility. In the manufacture of some articles, where there is an amount of wear, or the articles are subject to abrasion, the beauty of the finished article is soon gone by the surface stain being soon worn through, and then the original color of the wood appears, rendering it unsightly, and its value is consequently impaired. But when, as by this process, the color is made to permeate the entire body of the article, even if it be seriously injured, it can be easily repaired or varnished so as to hide the defect. The process is described as follows:—

"The wood to be treated is placed in a closed vessel, which is connected with an air pump, and the air is removed. The coloring fluid is then allowed to enter and permeate the wood, which it does in a very thorough manner, on account of the removal of all air from the fiber. The excess of fluid is then pumped out, or the wood is removed and allowed to dry in the usual way. The specimens exhibited were all of white pine, and were stained with the following substances:—

1.	Nitrate of iron	Warm grey, light
2.	Nitrate of iron and paraffine	Warm grey, dark.
3.	Sulphate of iron	Colder grey, light.
4.	Sulphate of iron and paraffine	Colder grey, dark.
5.	Sulphate of iron and logwood	Like 3.
6.	Sulphate of iron, logwood, and paraffine	Like 2.
7.	Chromate of potash	Yellow gray, light.
8.	Chromate of potash and paraffine	Yellow gray, dark.
9.	Bichromate of potash	Yellow gray, between 7 and 0.
10.	Bichromate of potash and paraffine	Very rich yellow gray.
11.	Logwood	Light orange.
12.	Logwood and paraffine	Dark orange.
13.	Aniline blue	Bluish slate.
14.	Aniline blue and paraffine	Bluish slate, dark.
15.	Aniline red	Violet, with yellow shade.
16.	Aniline red and paraffine	A little darker than 15.
17.	Aniline solferino	Rich purple.
18.	Aniline solferino and paraffine	Rich purple, darker.

"The blocks exhibited were sections cut from larger sticks after treatment, and they showed the color to have penetrated very evenly and thoroughly."—*American Artisan.*

Artificial Ivory.

Artificial ivory is now being made in France, from a paste of *papier mache* and gelatin. Billiard balls formed of this material, though hardly a third of the price of those made from real ivory, are yet so durable and elastic that they can be thrown from the top of the house on to the pavement or violently struck with a hammer, without injury. With this same paste, to which the name of Parisian marble is given among many other things, the finest and most complicated moulding for ceilings can be made, or capitals of columns can be constructed in any color so as to resemble the most valuable marbles.

White Paste which will adhere to any Substance.

Make the following mixture:—Sugar of lead, 720 grains; and alum, 720 grains; both are dissolved in water. Take 2½ ounces of gum-arabic, and dissolve in two quar s of warm water. Mix in a dish one pound of wheat flour with the gum water cold, till in pasty consistence. Put the dish on the fire, and pour into it the mixture of alum and sugar of lead. Shake well, and take it off the fire when it shows signs of ebullition. Let the whole cool, and the paste is made. If the paste is too thick, add to it some gum water till in proper consistence

Practical Memoranda.

To Prevent Rats from Damaging Leather Belting.

It is not an uncommon occurrence in factories where steam power is used, that during the night, or periods that the machinery is stationary and the shop abandoned, the rats will eat the leather belting, where it is accessible to them; for instance, where it passes through openings in the floor; cases have even happened that they gnawed holes in the floor just over the place where a belt was running horizontally in order to reach and eat pieces out of it.

Now, it is a singular fact that rats will not touch anything containing castor oil, or even only covered with it, and, therefore, to guard belting against the voracity of these animals, all we have to do is to touch it at every place where belting is exposed to their attacks with a brush previously dipped in castor oil.

The antipathy of the rats against this useful oil is really strange. Probably their instinct teaches them that it is injurious to them; but it is useful for man to know this in order to guard many substances against their voracious appetite.—*Scientific American.*

To keep Mercurial Steam Gauges Perfectly Clean Inside.

General experience has shown that the mercurial steam gauges in the course of time often become dirty in their interior by mercury and its oxide adhering to the glass, so that it is very difficult to see the position of the surface of the mercury. The consequence is, of course, an uncertainty as to the amount of steam pressure. A simple and very effective remedy is, to bring on the surface of the mercury a little glycerin, this serves as a lubricator for glass and mercury, covering the surface of both, preventing their immediate contact, and consequently all adhesion, and keeping it always clean and bright. This simple remedy is spoken very highly of by all who have tried it.—*Ibid.*

Notes on Steam Engines & Boilers.

One of James Watt's engines, the second erected by Boulton and Watt in London, is still in excellent working order at Messrs. Coombe, Delafield & Co.'s brewery, Long-acre. It has a 24-inch cylinder, and 6-foot stroke, and works at a pressure of 10 lbs. per square inch.

As bearing upon the probability of steam boiler explosions by the admission of water upon heated iron, a simple experiment will show that the heat contained in a given mass of red-hot iron is insufficient to convert any part of its own weight of water into steam. A pint claret bottle may, when filled with cold water, be safely held in the hand while a red hot poker is thrust into it. If care is taken to keep the hot iron from actual contact with the glass, the bottle will not be cracked, and there will be no disengagement of steam.

The brasses of paddle-shafts always wear most on their forward sides.

Four steam engines were in existence in the year 1714, two of them being employed in the coal mines near Newcastle.

Cast-iron boilers were formerly extensively employed, and at the present time many boilers at work on the island of Cuba and elsewhere have flat cast-iron ends, although the boilers of 45-inch diameter are worked under a pressure of from 60 lbs. to 80 lbs. per square inch.

The seventh division of James Watt's patent of 28th of April, 1784, describes a steam carriage intended probably for common roads. The boiler was to be of wood, strongly hooped to prevent bursting, and having an internal metal vessel containing the fire.

Less coal is frequently consumed in steam vessels by working three, instead of two, boilers out of four, when it is desired to go under half power. This fact proves the advantage of large heating surfaces.

The application of felt to the outside of marine boilers has been sometimes found to accelerate their internal corrosion.

Not only is the resistance of tubes to collapse inversely as their length, but the resistance of cylindrical boilers to rupture from internal pressures bears some proportion, although contrary to that of their length. A cylindrical boiler, when subjected to gradually increasing pressure, yields first at the middle. It is believed by many that the strength of cylindrical boilers would be very considerably increased if hoops were shrunk at intervals around them.

A boiler, 3 feet in diameter, with plates of ⅜-inch iron, will burst at a pressure of 708 lbs. per square inch.

Dr. Ernest Alban at one time worked a steam engine, in London, to a pressure of 1,000 lbs. to the square inch.

Steam boilers constructed of wood were at one time employed to some extent.

Steam was conveyed in pipes to a distance of over 800 feet to drive engines which worked in the Great Exhibition.

The Giffard injector, when supplied with steam of 25 lbs. per square inch from one boiler, has forced water into another boiler against a pressure of 48 lbs per square inch.—*Engineering.*

The velocity of the sun has been estimated at 422,000 miles per day.

Statistical Information.

CORN RETURNS OF UNITED KINGDOM.

Comparative Statement

Of the Corn Returns of the United Kingdom, for the last five years, each ending 31st August. (Compiled by James Watt, Glasgow.)

PERIOD.	WHEAT—Qrs. Imports of Foreign Wheat and Flour.	WHEAT—Qrs. Computed Deliveries of British.*	WHEAT—Qrs. Total.	WHEAT—Qrs. Average Prices of British. s. d.	BARLEY. Qrs. Imports of Foreign.	OATS. Qrs. Imports of Foreign.	BEANS. Qrs. Imports of Foreign.	PEASE. Qrs. Imports of Foreign.	MAIZE. Qrs. Imports of Foreign.
Year ended 31 Aug. 1862	9,347,874	14,272,231	23,619,605	58 2	1,411,550	1,551,200	492,323	185,093	2,988,378
" " 1863	9,283,443	13,850,981	23,134,424	47 7	2,083,617	2,488,563	490,126	336,827	3,174,146
" " 1864	7,012,727	17,601,793	24,614,520	40 11	1,638,568	1,658,363	301,897	219,718	1,431,062
" " 1865	5,576,097	16,282,125	21,858,222	40 2	1,971,468	2,708,104	219,975	184,817	1,657,346
" " 1866	7,405,409	14,320,622	21,726,032	46 6	2,088,975	3,016,074	176,626	312,444	3,312,666
Averages of the above five years....	7,725,010	15,265,550	22,990,560	46 8	1,838,836	2,284,401	336,190	247,780	2,512,720

* Computed from the official weekly returns from 150 of the principal market towns in England and Wales; the quantities so returned being taken as typical (in a certain ratio) of the aggregate deliveries throughout the kingdom.

Remarks.

WHEAT.—It will be seen from the above returns that our imports of foreign wheat and flour during the twelve months ended 31st August last, amounted to 7,405,409 qrs., of which France contributed nearly two-and-a-half million of qrs., being about one-third of our entire receipts; the actual quantities received from the various countries, during the period stated, being as follow:—Wheat, from Russia (southern and northern) 1,968,010 qrs., Prussia 1,220,918, Denmark and the Duchies 205,547, Mecklenburg 194,453, Hanse Towns 189,011, France 1,098,869, Turkey and the Danubian Principalities 104,273, Egypt 5,094, United States 201,930, British North America 21,945, other Countries 640,031. Flour (stated also in qrs.), from Hanse Towns 79,356 qrs., France 1,310,449, United States 74,677, British North America 19,212, other Countries 71,634.

Miscellaneous.

DISINFECTANTS.

Polytechnic Association of the American Institute.

Prof. Tilman introduced this subject, the regular topic for the evening's discussion, in an article defining the signification of the term, and enumerating all the more valuable disinfectants now in use. This class of substances should not be regarded as synonomous with those chemical agents known as deodorizers, for the difference is essential; the latter may act as a palliative, or simply overpower, dissipate, or disguise the gaseous products arising from that which constitutes the cause of disease, while true disinfectants attack and destroy the very roots of the evil. Taking the four elements of the ancients as the type of division under which to rank the generally received disinfectants, we note, under the first, that the soil is capable of absorbing indefinitely, injurious vapors. This property, possessed by porous bodies in general, is held by charcoal in a remarkable degree; for not only does this absorb, but also, by bringing the particles into close contact, it hastens decomposition. Second, water, as a solvent, removes the source of disease, and, in connection with the soil and the air, constitutes the grand disinfectant of nature. Third, no better purifying agent exists than a plentiful supply of pure air. Among the gases, chlorine is the best known, which, chemically combined with lime, has been extensively employed. All the bleaching agents are also disinfectants; among these ozone is said to be the best. Sulphurous acid has, in all ages, been used and highly valued; it acts as a deodorizer, and by its antiseptic qualities impedes fermentation. Fire, lastly, is acknowledged as one of the best disinfecting agents known.

The generally received theory assuming the presence of some specific poison or deleterious matters in the atmosphere, was disputed by Dr. Bradley, who advanced a hypothesis, supposing that malarious diseases are produced not by any specific poison in the atmosphere, generated from decomposition of vegetable matter or miasmatic emanations of any kind, but from a cause negative in its character, viz., the want of the normal depuration of the animal organism. The matters in the human body which have served their purpose and have become effete, must be regularly expelled, or they act as a virulent poison within the system. Free perspiration under the stimulus of heat or exercise being among the most important functions by which the depurative process is performed, in the absence of such stimuli, another auxiliary, viz., the atmosphere, having an affinity for the exhaling matter, is required. In a healthy state of the atmosphere, such affinity is an active positive force of great power, but it may be sated in various ways; this occurs when the temperature of the air and the dew point approximate. An excess of carbonic acid has also a powerful effect in satisfying the power with which the atmosphere is otherwise endowed, of carrying of the effete carboniferous matters. During the spring aad early summer, carbon is assimilated by the luxuriant vegetation, and the atmosphere is purified, but later when plants begin to decline in growth, the air becomes charged in larger proportions with carbonic acid; to this, and to the fact of the greater amount of aqueous vapor in the air at this season, is due the prevalence of malarious diseases during the fall of the year. In crowded hospitals or ships, the atmosphere becomes charged with the refuse matters which have already served their purpose. The deleterious effects of inhaling these matters are small compared with the effects of depriving the air of its absorbing tendency. The conclusion, then, seems evident that malarious diseases are caused by the effete excrementitious matters of which the system has failed to be properly depurated, on account of the lack of an atmosphere having an affinity for such excretions, and the consequent deprivation of this auxiliary in the performance of the perspiratory functions. Any thing, then, that tends to desiccate or dry the air, or to enlarge its capability of absorbing and dissolving the fluids of perspiration, is a true disinfectant. Fire increaes the power of evaporation; chloride of calcium and other deliquescent salts, by their attraction for moisture, tend to dry the air, and hence stand so high as purifiers. By the application of water the pores of the skin are opened, and thereby healthy action in the performance of its excretionary functions is stimulated.—*Scientific American.*

American Commerce.

The New York *Times* in a recent article upon American commerce asks the question, "Is American commerce to be extinguished?" and goes on to show that at the present time England monopolizes the carrying trade of the world. He quotes from the report of the Secretary of the Treasury, and proves that the diminution of our carrying trade and ship-building has steadily fallen behind Great Britain at the rate of fifty per cent., and if this continues we shall soon cease to be a maritime nation. To quote from the report, we find that in 1860 the tunnage of American vessels engaged in the foreign carrying trade which entered United States ports was 5,921,285 tuns; in 1866, it was 3,472,060 tuns. The tunnage of foreign vessels that entered our ports was, in 1860, 1,353,911 tuns and in 1866 it amounted to 4,410,424 tuns. In 1860 the United States tunnage exceeded the foreign by 3,567,374 tuns, but in 1866 the foreign preponderated by 1,038,364 tuns. The tunnage of American vessels that cleared from American ports was, in 1860, 6,165,924 tuns, and in 1866 it was 3,383,176 tuns. The tunnage of foreign vessels that cleared in 1860 was 2,624,005, and in 1866, 4,438,384 tuns, showing a balance in favor of American vessels of 3,541,919 tuns, but in 1866 showing the amount of 1,055,204 tuns excess of foreign clearances

In speaking of the fact of the approaching sale of two steamers of the Havre line, the *Times* says:—

"They are apparently the last American steamers on any great line between New York and Europe. So ends our expected great commerce in American-built ocean steamers. Great Britain has a vast fleet of iron commercial steamers plying over every sea, built so cheaply and ingeniously as to drive out all competition. In the grand business-struggle of nearly a century to get possession of or to lead the commerce of the ocean, the United States, that seemed once on the point of victory, must now own to defeat. She is not only a commercial power second to Great Britain, but she seems destined to still further inferiority, and to be almost driven from the seas."

We must add the melancholy fact that, of about a dozen lines of ocean steamers that ply between our ports and the European cities, not a single vessel is now owned by Americans or sails under the American flag. England has quietly maintained that she was mistress of the ocean, and it has as quietly been laughed at upon *our* side of the Atlantic, thinking it was a foible of Britannia, but as facts and figures are stubborn things, then we have no longer any occasion to laugh, but to wake up to the sober reality.

The *Times* mentions that the orders for machinery from the Southern States and South America, that used to come to Northern manufacturers, are now filled in England, and it is said that soon river steamboats made in Great Britain, will be plying upon our rivers:—

"Mr. McCulloch wisely remarks," says the *Times*, "this is a direct effect of the high protective system, especially as applied to raw material. It must be remembered that such a tariff as we have now weighs upon every article that the manufacturer uses—his iron, brass, steel, wood, coal, and tools; and he not only has to compete with the cheaper labor of England, which he might do with the aid of ingenuity, but he has to work on raw products which are all far dearer than in England, owing to our exorbitant duties. More than this, the effect of such a high bounty as the present tariff offers is to encourage, with the American producers of the raw material, a carelessness, extravagance, aud want of business prudence and saving which gradually render their production more expensive. There is nothing which stimulates economy, ingenuity, invention, and care like open competition. The moment Government comes in to back up an interest with excessive duties it becomes wasteful, and soon loses the watchful care which before made it successful." — *American Artizan.*

Workingmen's Strikes and their Cure.

For some time back, a contest has been going on between the iron manufacturers in the North of England and their workmen. When, some time since, the price of iron became materially reduced, the masters found that they would have to manufacture at a loss, unless the cost of production were also diminished. The workmen refused to accept lower wages, and struck work, and at latest advices still maintained their position of voluntary inactivity, aided, as they were, by contributions from other iron districts. Now it is very evident, that while employers are losing the profits of their business, as well as a certain portion of expenses which cannot be stopped, the men are proportionately losing much larger sums, and the longer they refuse to work, the greater becomes their loss. In addition to the loss of masters and men, there is also the very heavy loss to the country at large in the stoppage of production, while the consumption of food, &c., goes on as usual. The loss is a very serious one, and with the other evils resulting from the contests between capital and labour, has attracted a good deal of attention in England, and much thought and consideration has been devoted to the subject. Mr. Fawcett, member for Brighton, lately made a speech at Leeds on the Co-operative Coal Company of Messrs. Briggs, in which he pointed out the great difficulties that surrounded the commercial position of England from the unsatisfactory relations existing between the classes of labourers and capitalists. He also pointed out what he believed to be the only certain way of palliating, if not remedying this evil, namely, by the growth of associations such as Messrs. Briggs' Coal Company, in which the interest of the capitalist and the labourer are to a certain extent identical, and in which the wages of the labourer, if too low, are supplemented by a share in the profits. The plan of the Coal Company is to pay, first, the regular rate of wages in the district, then 10 per cent, on all the capital of the company, and finally to divide the surplus between the capital and the labourer. This system, it will be perceived, is as nearly equitable as any arrangement can be. It gives to all those employed in the production, whether represented by capital, one of the great elements in production, or by labour, another of its chief elements, a similarity of interest, and a *pro rata* share in the profits. Mr. Briggs stated that the result had been not only to put a good bonus into the pocket of the labourers—a bonus of five per cent. on their wages—but to yield himself, as capitalist, a larger profit than he had ever before received, ever in the most prosperous years of the colliery's existence. This co-operation between capital and labour is only a variation of co-operative working societies, where the men themselves represent both the capital and the labour; but, as in the latter case, the efforts of the men are hampered by the smallness of their means at the commencement of their undertaking, we think the arrangement a better one where the capital is furnished, and the men, as in the case of the Coal Company above mentioned, given a certain share of the profits. They might also be allowed to invest their earnings in stock of the company, and thus give them a strong motive for the practice of economy and the virtues which are inseparable therefrom.

Several very important advantages are at once secured by the co-operative principle. Disputes between men and masters with reference to wages are almost of necessity entirely prevented, and production goes on steadily, up to the point allowed by the means of the company or the state of trade. The men are perfectly willing to receive wages, which would otherwise be low, when they are sure to receive back in shape of profits, the difference between their nominal wages and what they should in equity obtain. And let it be remarked, their earnings will always be larger in this way than in any other. Each man having a direct interest in the success of the whole, he will do his best, and more work by far will be accomplished than under the ordinary labour system, and the jealous watchfulness of all will prevent idleness or waste on the part of any one who may not be so industrious as the rest. Improvement both in the amount of work turned out and in the quality of that work, has always closely followed the adoption of the co-operative system, and Mr. Fawcett was not far wrong when he said that " he almost believed that the future existence of his country depended upon this scheme. If it be not extended, we might depend upon it that capital and labour, would, to a large extent, emigrate from this country. If capital went, where was our wealth? If labour so went, where would be the elements of our future greatness?"

Several co-operative societies have been formed in Canada, but with quite a different object in view. They have been formed with a view to economy of consumption, not of production, to furnishing food and clothing as cheaply as possible to their members, not to producing the wherewithal to purchase those necessaries. We should be glad to see co-operative working societies introduced into this country; and whether the capital were contributed by the labourers themselves or furnished by capitalists, the greatest economy of production will be secured. We would then have an opportunity of testing the great question of the profitableness to Canada of producing her own manufactures; of deciding whether the manufacturing interest should be fostered at the expense of other and much more important interests; whether even it would need any legislative help whatever; and if the experiment should prove successful, it would undoubtedly attract to this land, where the cost of living is so low, a large share of both capital and labour, which, together, are at the foundation of the material prosperity of every great nation.—*Trade Review.*

Colored Starch.

This, says a London paper, is the latest and greatest novelty of the season. It is made in pink, buff, the new mauve, and a delicate green, and blue will soon be produced. Any article starched with the new preparation is completely colored—dyed we should have said, but as it washes out, and the garment that was pink to-day may be green to-morrow, and buff afterwards we can hardly say "dyed" It is intended especially for those bright but treacherously colored muslins that are costly, wash out and perplex their owners. If the pattern has been mauve, they only need the mauve starch, if green, green starch; and they can be rendered one even and pretty shade, thus becoming not only wearable again, put very stylish. White anti-macassars, or lace curtains may also be colored in the same way, and infinite variety afforded.