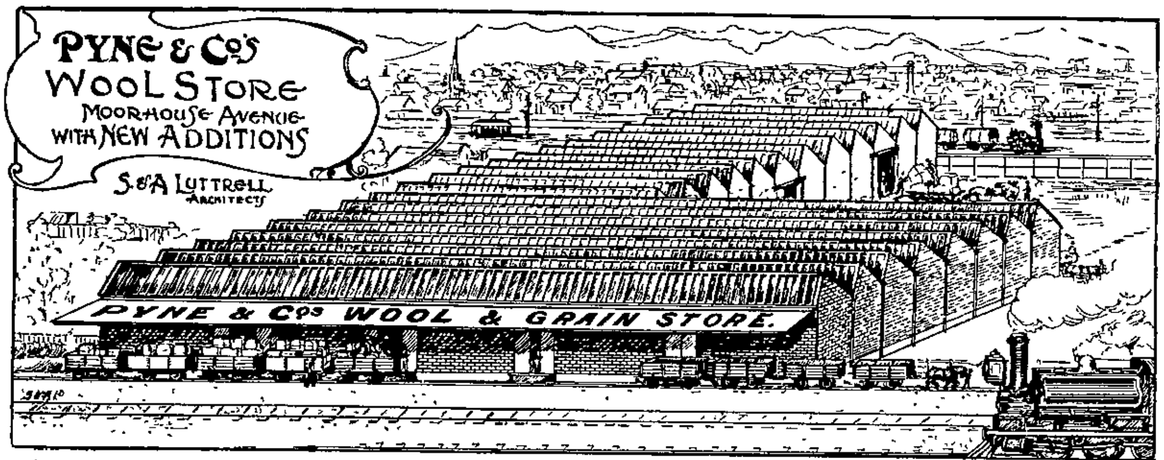


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No 1—Tuesday, November 22nd, 1906.
No 2—Thursday, December 13th, 1906.
No. 3—Wednesday, January 9th, 1907.
No. 4—Monday, February, 4th, 1907.
No. 5—Thursday, February 28th, 1907.

**Offerings Last Season, 13,000 Bales.**

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**Horse Sales** at Tattersall's, every Saturday.
**Weekly Sales** at Rangiora.
**Fortnightly Sales** at Leeston.
**Monthly Sales** at Kirwee, Darfield, Sheffield, Coalgate, Dunsandel, West Melton, Springston, Hawarden, Waikari Scargill, Methven and Rakaia.
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The Gas Producer Plant that secured Gold Medal against all competitors at the Royal Agricultural Society's Show, at Derby, England, June, 1906

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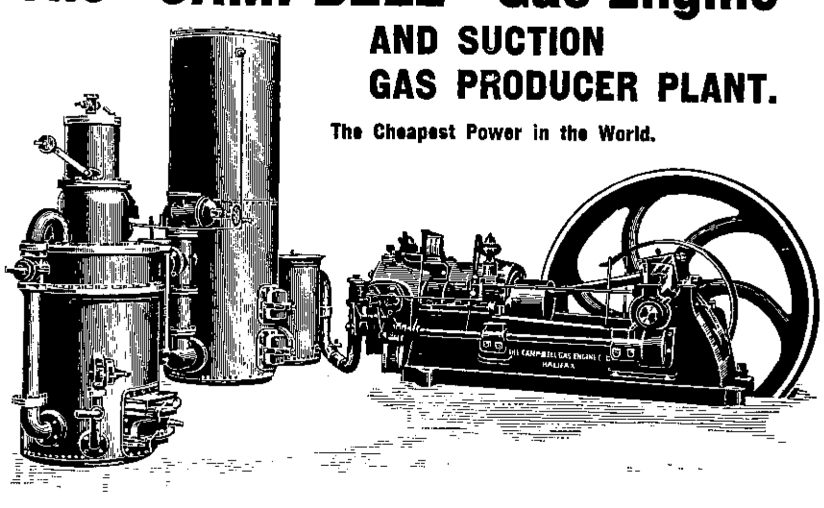

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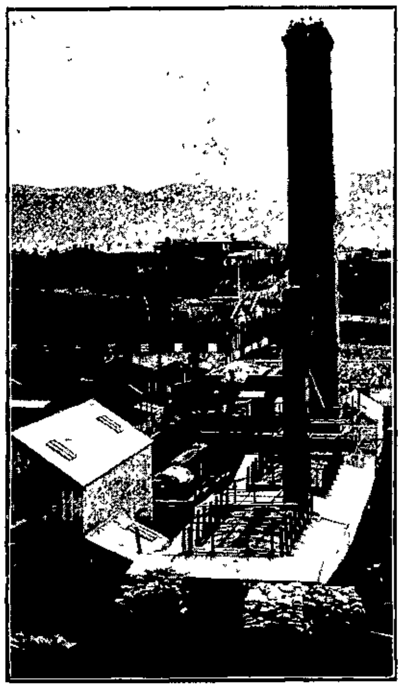

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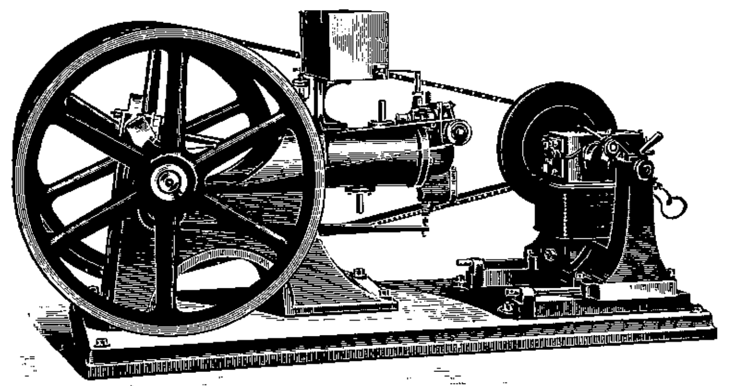

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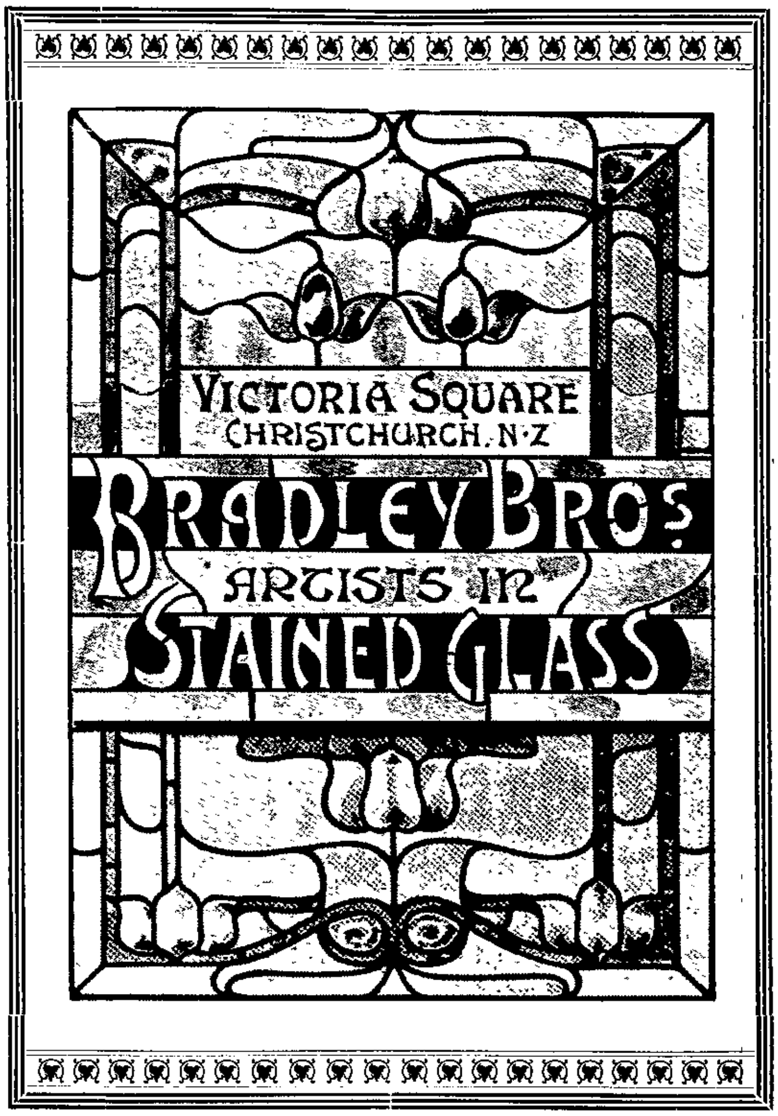


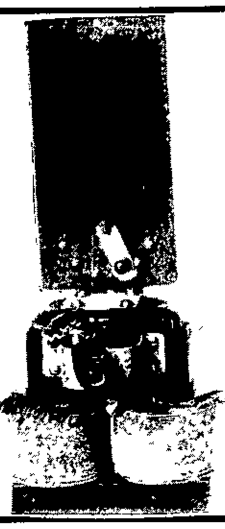

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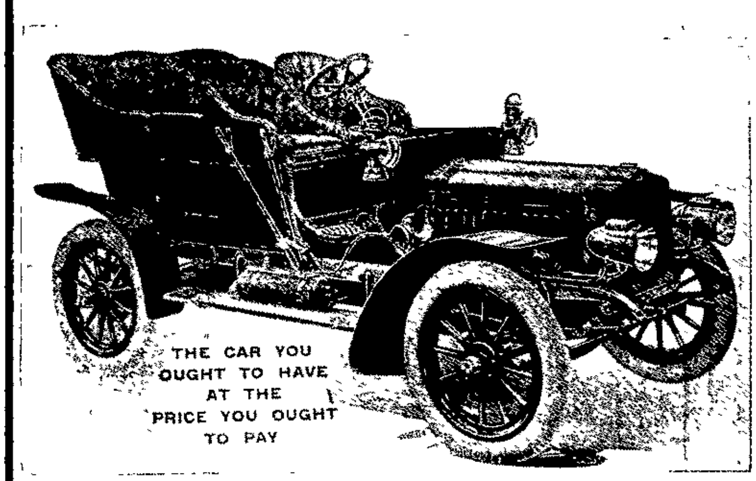


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NO BREAKING OF BOTTLE.
NO NEED FOR TURNING UPSIDE DOWN
ACTS AT ONCE BY TURNING KEY.

For Factories, Workshops, Warehouses, Churches, Hotels, Shops, Places of Amusement, Household Use.

Any capacity from 3 to 50 gal. Large Sizes set on wheels; very suitable for Borough Councils, Factories, etc., especially those outside fire brigade radius.

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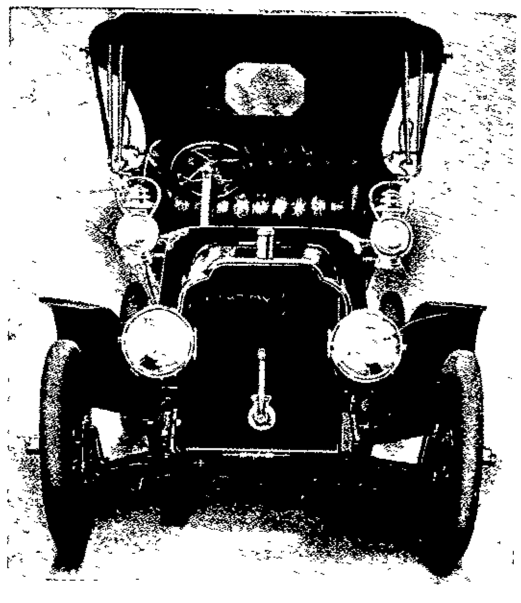

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We invite careful inspection of Ford Models "N" and "K."

The Ford—— Model "N" has a four cylinder engine of 15-h p. Speed, 40 miles an hour

**Price .... £225.**

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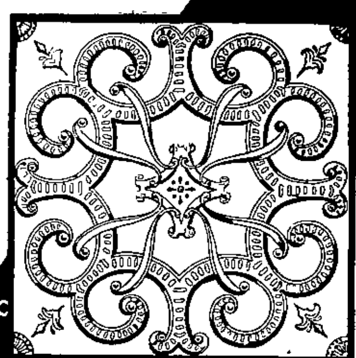

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For Flat Roofs

**THE PARAFFINE PAINT COY., San Francisco.**

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# PROGRESS

With which is Incorporated

THE SCIENTIFIC NEW ZEALANDER.

VOL. II.—No. 2. MONTHLY.] WELLINGTON, N.Z., DECEMBER 1, 1906. [PRICE: 6d Per Copy; 6/6 Per Annum posted, or in advance 5/-

## Progress

*With which is Incorporated*

The Scientific New Zealander.

*Published Monthly by Baldwin & Rayward, Patent Attorneys, 71 Lambton Quay, Wellington, N.Z.*

PROGRESS *will be mailed regularly every month to any address in the colony on prepayment of the Annual Subscription*—6/6 per annum posted, or in advance, 5/- *To Australia or United Kingdom,* 5/6 in advance.

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*All communications to be addressed:* "The Editor, PROGRESS, Progress Buildings, Cuba street, Wellington." Telephone 2234.

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## N.Z. INTERNATIONAL EXHIBITION.

**THE greatest exhibition ever held in the southern hemisphere was opened by His Excellency the Governor, Lord Plunket, at Christchurch, on the 1st ulto.**

**The importance of the event to the colony has yet to materialise in the form of increased trade, and it is within reason to predict that New Zealand will benefit by her splendid strenuousness to an extent which passes the present comprehension of her people.**

**As an Advertisement for the colony the New Zealand International Exhibition forms an immediately-paying medium that is only possible at intervals of generations. As an Educational Factor the event overshadows the dissemination of mere theories that sharpen the brain without satisfying; while for the nonce New Zealand enters the lists as the young and virile champion of a great people amongst the nations of the world.**

It is now seventeen years since the last international exhibition was held under southern skies, and it is only fitting that the New Zealand International Exhibition of 1906 should eclipse all former colonial efforts. That it does there can be no question, for it is the largest British Exhibition held since the first international affair of 1851. The Glasgow Exhibition of 1901 excelled ours in one respect only, viz., the machinery section, and to the everlasting credit of Scotchmen be it recorded that their exhibition was the only one since 1851 to make a substantial profit, viz., £73,000. It is admitted by authorities that the New Zealand International Exhibition has exceptional attractions insofar as the variety of its exhibits is concerned; and yet it is no mere bazaar, no haunt of idle gossips, or butterfly pleasure seekers. It is, in fact, an event of the utmost significance to New Zealanders, whether they be in the political arena or in the artisan and mechanical world; and to prove of the fullest service to the colony it should be visited by at least seventy-five per cent. of the population. Everywhere heavily laden stalls pay eloquent tribute to the wealth and progress of our own manufactures, and everywhere the eye is constantly arrested by exhibits interesting, costly and unique. In the great Machinery Hall a thousand wheels are whirling, a thousand cranks revolving. It is a fascinating picture, and in the throbbing, pulsing engines we read the story of the mechanical triumphs of the 20th century.

The New Zealand International Exhibition comes at a time when the world is still young in scientific knowledge, and when the torch of science is being carried in direct paths by courageous pioneers. It comes to mark the wonderful prosperity that has fallen to the lot of our island colony, and there is every indication that this prosperity will continue.

We hope to hear that the fullest encouragement, in the form of travelling facilities, has been given to the people of our own colony, the Commonwealth, and further away still, in order that they may be enabled to attend and profit by the great event.

### The Question of the Gas Turbine.

IN the *Engineering Magazine* Prof. S. A. Reeve, writing on this subject, points out that the gas turbine must work on the Brayton or Joule cycle rather than the Otto; that there is no thermodynamic reason why the gas turbine should not be a success; but that the obstacles in the way of the gas turbine lie in two directions, viz., in the necessity of starting from very high initial temperature for expensive working, and in the difficulty of compressing the gas to the high pressure needed to get high temperature. A temperature of over 4,000° is needed for good efficiency in order to get high velocity of the gas molecules on account of their small mass.

Prof. Reeve suggests that this high initial energy of the working fluid may be secured by injecting into the hot gas a quantity of water which will give molecules of steam and gas combined having considerable mass, and therefore not needing so great velocity (in other words, not requiring so high temperature) in order to have a high initial energy.

Prof. Reeve believes that the gas turbine is a machine immediately practicable both thermodynamically and mechanically, the great difficulty being the question of compression, and he believes that the difficulty in this direction will be solved.

### Constitution of the Earth.

THIS interesting question recently formed the subject of a paper by Mr. R. D. Oldham, at a meeting of the Geological Society, London. He points out that just as the spectroscope opened up a new astronomy by enabling the astronomer to determine some of the constituents of which distant stars are composed, so the seismograph, recording the unfelt motion of distant earthquakes, enables us to see into the earth and determine its nature with as great a certainty, up to a certain point, as if we could drive a tunnel through it and take samples of the matter passed through. After an exhaustive treatment of the question of wave motions through the earth, in the course of which many figures and calculations are cited, the author of the paper deduces that wave motion originating at any point in the earth will be propagated in all directions from it, and whatever the nature of these waves, their paths will be straight lines so long as the velocity of propagation remains constant; but if this varies the course of the wave paths will be altered according to the laws of refraction. These laws hold good, whatever be the nature of the wave motion, although in the case of elastic waves the rate of propagation is dependent on two factors—the elasticity and density of the medium through which they are propagated. From this it will be seen that any information which can be obtained regarding the form of the wave paths will indicate the changes, if any, in the rate of propagation, and thence in the physical condition, of different parts of the earth traversed by the wave paths which emerge at different parts of the surface. He comes to the conclusion that the interior of the earth, after the outermost crust of heterogeneous rock is passed, consists of a uniform material, capable of transmitting wave motion of two different types at different rates of propagation; that this material undergoes no material change in physical character to a depth of about six-tenths of the radius, such change as takes place being gradual, and probably accounted for sufficiently by the increase of pressure; and that the central four-tenths of the radius are occupied by matter possessing radically different physical properties, inasmuch as the rate of propagation of the first phase is but slightly reduced; while the second-phase waves are either not transmitted at all, or, more probably, are transmitted at about half the rate which prevails in the outer shell.

# Architecture and Building.

*The Architectural Editor will be glad to receive suggestions or matter from those interested in this section. Address: Architectural Editor,* Progress, *Progress Buildings, Cuba Street, Wellington.*

Twelve new workers' dwellings are in course of erection in Tennyson street, Sydenham, Christchurch. Contractors, J. Greig, and Dibnah & Gant.

* * * * * *

An up-to-date butcher's shop is in course of erection in Cashel street, Christchurch, for the Christchurch Meat Co. Contractor, C. H. Cox.

* * * * * *

A three-story brick building is in course of erection in Cashel street, Christchurch, for the Australian Widows' Fund Assurance Co. Architect, F. J. Barlow, A.R.I.B A.; contractor, W. H. Bowen.

* * * * * *

The new Presbyterian church at Ashburton is in course of erection. This structure is a brick building with a spire, and the contract price is about £2,700. Architects, England Bros.; contractor, W. Reid.

* * * * * *

Alteration and commodious wood-and-iron additions to the Carlton hotel, Bealey avenue, Christchurch, forming extra acccomodation during the Exhibition period, have just been completed. Contractor, P. M. Stewart, Papanui.

* * * * * *

A gothic roof of reinforced concrete has been built for a church in Belgium. It has a central span of 23 ft., and side spans of 11½ft. The concrete is covered with mortar and plaster mouldings.

* * * * * *

A two-story brick building with iron roof, to be occupied as a technical college and workshop, is in course of erection at the corner of Moorhouse avenue and Barbadoes street, Christchurch. Architects, Hurst Seager & Wood; contractor, H. Green.

* * * * * *

A three-storey brick building, facing the lane off Hereford street, Christchurch, for Messrs. Hement Bros., and to be occupied by tenants as offices, is in course of erection. Architects, Collins & Harman; contractors, W. Greig & Son.

* * * * * *

A large wood-and-iron building, adjoining the N.Z. Shipping Co.'s sheds, and to be occupied by the Massey-Harris Co. as a bulk store, is in course of erection at Lyttelton. The building has about 10,200 feet of floor space. Architects, Hurst Seager & Wood; contractor, J. Rowe.

* * * * * *

The contract for the additions that are to be made to the Central Public Library, Wellington, has been secured by Mr. W. G. Emeny at £1210. The unsuccessful tenderers were —J. Moffatt, £1288 10s.; A. Wilkenning, £1480; Martin, Hurrell & Snaddon, £1556; M'Lean & Gray, £1685 10s., Meyer & Illingworth, £1768.

* * * * * *

A two-story brick building for offices and store is in course of erection in Tuam street, Christchurch, for the Christchurch Brick Co. (T. N. Horsley). This building is constructed of red bricks, rock-faced bricks, and sand-lime bricks combined with terra-cotta. The ground floor is finished with paving bricks, and houses an electric elevator running to the upper floor. Architects, Hurst Seager & Wood.

* * * * * *

A large gathering assembled in the vicinity of Messrs. J. Nathan & Co.'s new building, Wellington, on the 24th October last, to witness a public demonstration of the efficiency of Humphries' Patent Safety Scaffold Bracket. Amongst those present were the Premier, Sir J. G. Ward, the Hons. Mr. Hall-Jones (Minister of Public Works), Mr. J. A. Millar (Minister of Labour), and members of both Houses of Parliament and the representatives of the Wellington City Council.

* * * * * *

In the big cities we always find the trouble that in a short time new buildings look old, and the old buildings look very dirty. In many places the buildings are cleaned on the outside or planed over in order to give it a cleaner appearance. In Berlin a steam cleaner has made its appearance and has given very satisfactory results. The whole outfit consists of a small boiler, and the man who cleans the outside of the building washes the whole front clean with steam.

In order to determine if brick clays, which have a medium percentage of lime, could be used for brick manufacturing, a Mr. Loeser conducted a number of tests. The principal tests were the mechanical separation by washing. He also tried the very intimate mixing by fine grinding. Of the two experiments the best results were obtained by washing, and it was distinctly shown in the experiments that the fine grinding of the lime had not the desired effect.

* * * * * *

In architectural beauty, in the splendour of its interior decorations, the Congressional Library at Washington ranks with the first great public buildings of the world.

As the illustration shows, the library building is rectangular in shape, with a central tower, from which run four internal wings. Three of these wings are filled with book stacks; the fourth is the entrance rotunda. Two of the book stacks are very large, each containing twenty-six miles of shelving.

* * * * * *

The ceramic school in Bunzlau had, in the summer of 1905, 86 students, and in the winter term of 1905–06, 66 students. The faculty has now seven teachers, with Prof. Dr. Pukall as director. The ceramic school of Hohr did not have as many students. The day course was attended by 44 students, while the night course had 49 students. As scholarships this institution received from the German Association of Ceramic Manufacturers 200 marks, while the Chamber of Commerce gave 100 marks and the County Commissioners 500 marks. The faculty consists of four teachers, two assistants and two shop assistants.

* * * * * *

It is sometimes thought that reinforced concrete is necessarily a fire-resisting material. This is by no means the case. It all depends upon the composition of the concrete. One of the resolutions adopted at the Milan International Congress deals with reinforced concrete, and is in the following terms:— (*a*) That the Congress considers that no reinforced concrete construction should be permissible in buildings intended to be fire-resisting, unless the aggregate be most carefully selected and applied in such a manner as to give substantial protection to all metal parts. That it is advisable, where reinforced concrete is intended to be fire-resisting, that every portion of the metal rods or bars contained therein be covered by not less than 2 in. of concrete, the aggregate of which must be able to pass through a sieve of not more than 1 in. in diameter and that Portland cement of great firmness only be used. (*b*) That, where feasible, all external angles should be rounded. (*c*) Any angle-iron needed for mechanical protection should be held in position independently of the concrete.

## Fireproof Buildings.

### A PLEA FOR FIRE-RESISTING METHODS OF CONSTRUCTION.

In the September number of the *Engineering Magazine* there is an interesting article by Mr. Joseph K. Freitag on fire losses in the United States. It is suggested, of course, by the San Francisco disaster, but deals with problems of importance to the whole building world. The author shows that the loss of life and property in the great dramatic catastrophe, which so startled the world, is equalled by the regular annual aggregate of similar losses in the United States, and much of this loss he thinks is preventable.

The remedy for these great losses in life and property is not to be found, the author thinks, in either increased insurance, or in improved methods of fire fighting. Insurance is a palliative, and not a cure, and the same may be said of fire departments. Neither reaches deep enough to effect the removal of the cause, and make impossible fires of any degree of magnitude. Of course, fire-fighting facilities will always be required to cope with incipient fires but the true underlying remedy for this great loss of life and property must lie in the universal application of fire-resisting methods to building construction—not in mercantile buildings in congested city areas alone, but in all schools, churches, places of amusement, hospitals, town halls and even in city and country residences.

#### Fire-resisting Construction to be Universal.

For the efficiency of fire-resisting construction varies with the universality of its adoption. No building can be considered as a unit, regardless of its neighbours, for as long as a modern fireproof (or fire-resisting, as it is now generally called by fire protectionists) building stands in the midst of highly dangerous inflammable neighbours, just so long is the term fireproof a misnomer, and highly misleading to the layman who thinks that because termed "fireproof" the structure is therefore proof against all fire damage to itself or to its contents. This was well exemplified in the Baltimore fire, where the structures which had been built after fire-resisting methods were found to have been gutted by fire, and to have sustained great damage, although still standing and capable of being re-used, at least as far as essential structural portions were concerned. But it must be remembered that no building erected of the materials which Nature has given us to use can be designed or constructed to withstand conflagration at its height.

#### Fireproof Cities Needed.

Fireproof buildings must stand in fireproof cities, for each added example of fire-resisting construction contributes just so much to the bulwarks protecting all. We know by ample experience that buildings can be and are being constructed which will safely withstand all that can reasonably be expected of them as to fire-resistance—namely, that under any ordinary conditions they will safely confine fire within the edifice or compartment where it originated, or safely exclude fire from any exterior hazard of not too great intensity. Their ability to fulfil these conditions has been fully demonstrated, both by buildings threatened by destruction from without, where the construction has prevailed against the attack, and in other cases where the fire resistance of the structure served to confine an otherwise dangerous fire to the compartment where it originated, almost without the knowledge of other occupants of the building. But individual examples are not sufficient. The practice of fire resistance must be so universal in building construction that no conditions could result in the spread of fire beyond the original premises, or at least, beyond immediate neighbours. Both the Paterson and Baltimore fires plainly demonstrated the ability of adequate fire-resisting structures to obstruct even conflagration in its path.

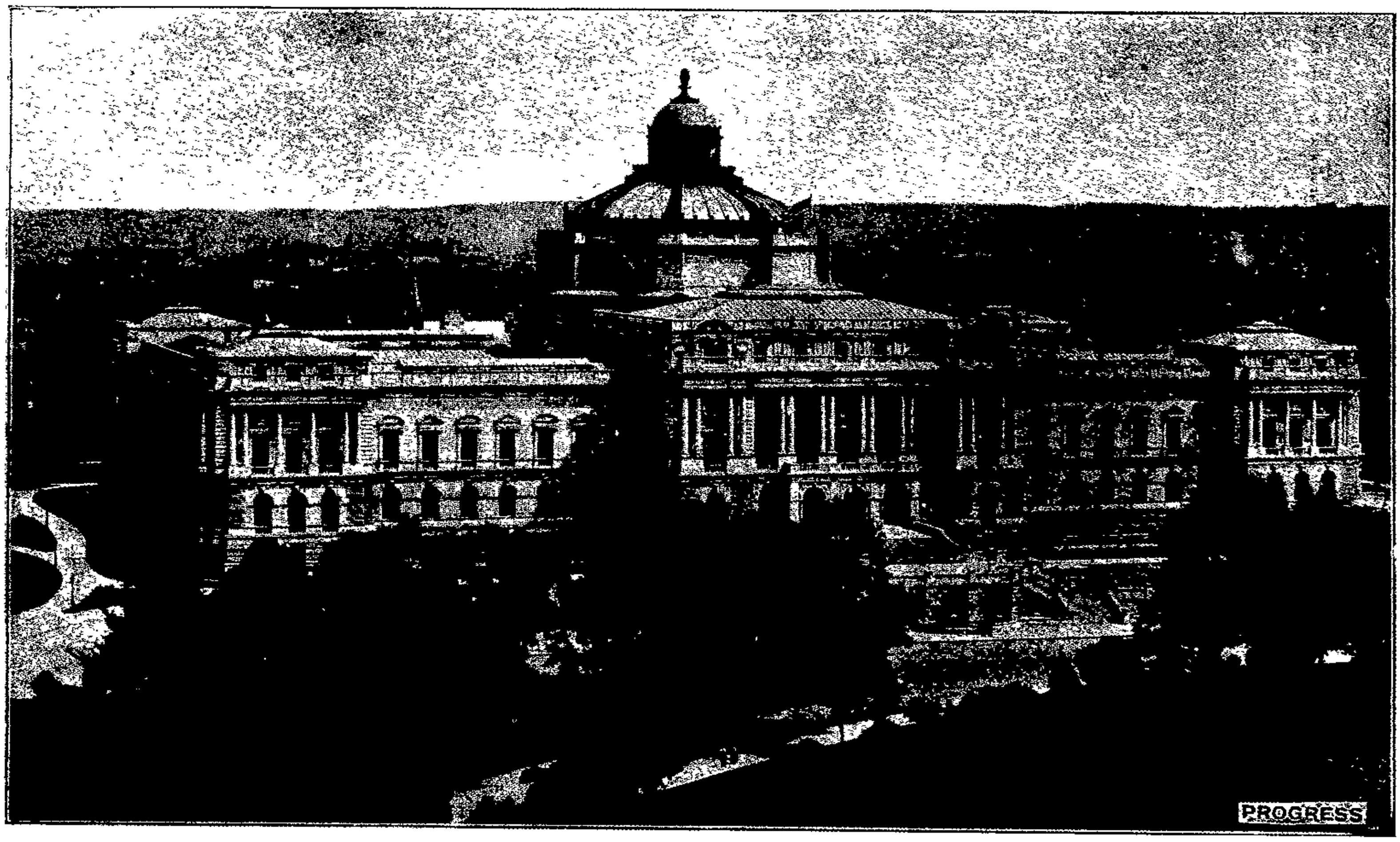
#### Europe and America Compared.

The author proceeds to compare fire losses in American cities with cities in England and Europe, to the great advantage of the latter. In American cities the fire losses are much greater than in most European cities, and this in spite of the fact that the daily number of fires is about the same, and in spite of the unusually marked superiority of American fire-fighting facilities. The real reason for the difference is to be found in the methods of building construction. While American cities have permitted the erection of "fire-traps" on every hand, Continental municipal regulations limit the height and area of buildings, and the character of the building materials, and generally enforce adequate fire-resistive construction throughout all city buildings.

In Europe it appears fires seldom spread beyond the building in which they originate whereas, in America, a small fire rapidly becomes a wide-spread conflagration. Mr. Freitag takes, by way of example, the Spanish city of Malaga, where the fire losses in 1890 amounted to but £1,000, with a population of 135,000 persons. The entire fire department was most primitive, about equal to what would be found in a small American town, say, fifty years ago; yet the prevalent mode of building of brick, stone, and iron, with heavy fire-walls between all buildings, has accomplished this most insignificant fire loss.

#### Supply and Cost of Material.

Naturally the scarcity of lumber for building purposes, and its consequent high price, has had much to do to bring about this status of building




UNITED STATES CONGRESSIONAL LIBRARY AT WASHINGTON. THE DOME IS COVERED WITH PURE GOLD.

methods; while in the United States lumber has been available, cheap, and most readily adaptable to building uses. But, fortunately in this respect at least, lumber has been steadily advancing in price until some grades have increased as much as 150 per cent. during the past few years, while steel, brick, stone, cement, and the clay products have been gradually decreasing in price, until there are good commercial, as well as civic, reasons to hope that the hitherto Utopian accomplishment of universal fire-resisting construction may soon replace the era of jig saw and wood frame. Independent of the added element of security against fire, fire-resisting construction of the proper materials will be found to be cheaper in the long run, decreasing repairs and insurance premiums, giving immunity from vermin, reducing the transmission of sound, and proving warmer in winter and cooler in summer than the older non-fireproof methods. At present prices adequate fire-resisting construction may be estimated about ten per cent. dearer than ordinary methods of building; but as the deterioration of a well built example of the former type has been estimated to be but one-tenth of one per cent. a year, while that of an ordinary wood joist structure is nearly four per cent. a year, this initial difference is soon overcome

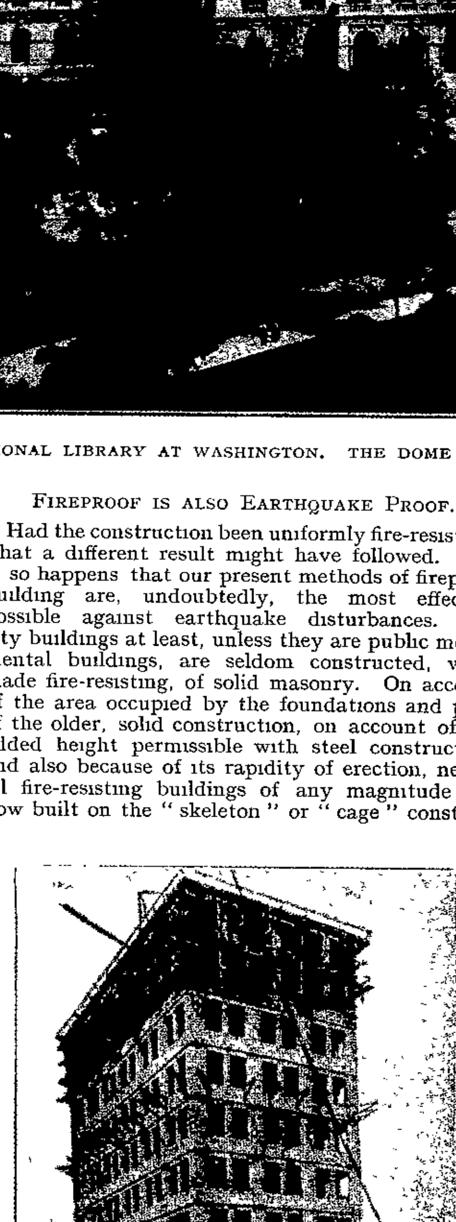
THE CASE OF SAN FRANCISCO.

It may be objected that the previous argument in favour of fire-resisting construction is all very well on general principles, but that it has no direct bearing upon the catastrophe at San Francisco, because, in this instance the loss was largely the direct result of earthquake. Even from the earliest accounts of the San Francisco fire this view may be rightly disputed, for reports so far received from the stricken city tend to show that comparatively little damage was done to the modern fire-resisting buildings by the seismic upheaval. The principal earthquake damage undoubtedly resulted to the flimsy non-fireproof buildings, which, in falling to destruction, started conflagration on every hand, through which the better buildings were made to suffer.

San Francisco has long been known as a particularly hazardous fire risk, and insurance officials have even gone so far as to say that it only was the excellence of her fire department that prevented a conflagration long since. To quote from a description of San Francisco written in 1905 "In San Francisco, for instance, there is little being done to improve the standard of construction It is notoriously a wooden city, yet insurance rates are fairly low, because, forsooth, the fire department is so excellent. That is like extolling the advantages of a certain locality as a health resort. It may be miasmatic; yellow fever may stalk amuck; its houses and streets may be foul, but, glory be, its doctors are skilful!"

FIREPROOF IS ALSO EARTHQUAKE PROOF.

Had the construction been uniformly fire-resisting, what a different result might have followed. For it so happens that our present methods of fireproof building are, undoubtedly, the most effective possible against earthquake disturbances. Our city buildings at least, unless they are public monumental buildings, are seldom constructed, when made fire-resisting, of solid masonry. On account of the area occupied by the foundations and piers of the older, solid construction, on account of the added height permissible with steel construction, and also because of its rapidity of erection, nearly all fire-resisting buildings of any magnitude are now built on the "skeleton" or "cage" construction, so called because the vital steel skeleton or framework, consisting of columns, girders, and floor-beams, when riveted together, partakes of the nature of a metallic bird cage—strong, rigid, and proof against distortion. The introduction of these methods in Chicago was the direct outgrowth of the necessities in the larger American cities for centralisation within limited business areas, thus requiring the extension of buildings into the air to secure added floor space. This need was also felt in San Francisco, and the last previous seismic disturbance of any severity in that city having occurred in 1868, the introduction of steel-skeleton buildings in Chicago and New York in the latter "eighties" immediately raised the question as to whether such construction could be made safely to withstand any earthquakes to which the locality of California might be subjected. The question was much discussed by architects, builders, and structural engineers, until, in 1890, the skeleton-construction Mills building was erected in San Francisco by Mr. D. O. Mills, as an evidence of his, or his architects', faith in the efficacy of this type of building. This faith was founded on the knowledge that steel frameworks of this character can be so designed as practically to permit of bodily overturning before failing in any portion. Indeed, in very high narrow buildings, exposed to severe wind pressure, it is no uncommon thing to anchor down the windward columns against possible overturning. Hence, in localities subject to earthquake, the only serious danger would be in the construction or safety of the exterior masonry walls, and this is accomplished by tying in the brick or stonework by metallic anchors attached to the steel frame. The Mills building was soon followed by other similar structures, until, in 1897, the nineteen story Spreckels building was erected, 300 feet high; and it is well to know that later accurate accounts completely show that these steel buildings were practically immune from earthquake damage, succumbing only to the wide-spread conflagration caused by the demolition of inferior, non-fireproof structures.




A FINE EXAMPLE OF CONCRETE CONSTRUCTION INGALL'S BUILDING AT CINCINNATI, O

The author concludes with a plea for the passing of more drastic building regulations by State legislatures.—*Carpenter & Builder.*

## Growth and Conversion of Timber.

THE natural growth of a tree not only indicates the nature of its wood as timber, but also its uses in various capacities in building and other work. It is not out of place to review the growth of the tree and its conversion, and use for various purposes, the most simple of which is the natural wood as used in rustic work. The terms in timber, however, would form a very respectable scientific dictionary. There are for instance: —

STRING AND CALIPER MEASURES.

The difference implied in the terms string and caliper measure, expressing two different modes of measurement, will be more easily understood when it is explained that the "caliper" is the measure used in determining the freight due to a ship for space occupied in her, and "string" is the measure by which the artisan or joiner is charged for the actual amount of convertible wood in the log or piece sold to him. A waney log, of course, occupies as much space in the hold of a ship as a perfectly square one, and therefore caliper, or extreme, is the just measure for determining the freight; but to buy by that measure is to pay for wood which is not obtained. It is contended that when timber is sold by caliper measure the difference between it and string is made up in the price charged; but that is a question which must be left to others to discuss. The difference between string and caliper measure is asserted to be about thirteen per cent.; but much depends upon the liberality of the broker in the case of string measure, and the keenness of the measurer, in the other case, in applying his calipers to the widest parts of the log.

"FAULTS" IN TIMBER.

"Burrs" or excrescences on trees, owe their existence to the crowding together of small germs, apparently the unsuccessful attempts at the formation of branches from one individual spot, whence it is supposed arise those bosses, or wens, which almost appear as the result of disease, and exhibit internally crowds of knots, with fibres surrounding them in the most fantastic shapes. Sometimes the burrs occur of immense size, so as to yield a large and thick slab of ornamental wood of most confused and irregular growth, and consequently the more valuable for veneers. "Foxey" wood is disfigured by dull red stains which indicate growth in a marshy soil, and are the signs of approaching decay. These stains are generally round the heart of the tree. Timber grown on loose soil is often what is termed "quaggy"—that is, the centre of a tree is full of shakes and clefts. Sometimes a shake will extend round a great portion of the trunk between two of the annual concentric layers, so as to divide them from each other. This is called a "cup shake," and the timber is said to be "cuppy." It is not attributable to the soil but is supposed to originate in the effect of frosts on the aqueous sap in its ascent. When the alburnum of a tree has been wounded, or a branch improperly lopped or damaged the subsequent growth of a tree will cover it, and it is then called a "rind gall," which, should the injured part have time to become decayed or partially so, or even sodded with the rains, will frequently cause excessive rottenness in the tree. "Doatiness," probably "dottiness," which is of a spotted or speckled appearance like small stains in the wood, is a disease generally incidental to the soil. "Spine" is the name given to the mature wood of a tree, the outer layer being called alburnum, or sapwood.

TWIST IN TIMBER.

The "twist" of the wood of many trees is a phenomenon well known to wood cutters, carpenters and others. Most trees show the obliquity of the woody fibre more or less. In certain species the twist is almost uniformly in the same direction, and in others both directions occur with equal frequency; while in not a few, no twist is distinctly discernible. Sometimes the same directions prevail in the majority of a species of a genus, or even of a whole family. In some instances nearly allied species of Europe and America twist in opposite directions. In a few instances the fibre of a young tree is twisted in one direction, and that of the old tree in the opposite direction. the observer being supposed to imagine himself in the centre of a coil, in order to ascertain whether the direction is to the right or left. The cause of the twisting is connected with the growth of the wood cells, of which the ends at their formation are horizontal, or nearly so, but which become wedge shaped as they elongate: but this is not sufficient to explain the higher grades of the obliquity, which sometimes reaches an angle of forty-five degrees.—*Carpenter & Builder.*

## Rules for Concrete Construction.

The National Board of Fire Underwriters in America have prepared, through their Committee on Construction of Buildings, a building code, designed to secure uniform building laws throughout the country. In the course of the Committee's report relating to this code some remarks are made about concrete construction which are likely to be of interest to the building trade in this country as well as in America.

Numerous inquiries regarding concrete construction (says the committee) by members of the Board and others lead the committee to attempt a word by way of explanation.—

Cement is recognised all over the civilised world as one of the most valuable adjuncts in building operations. Its manufacture has assumed vast proportions in New Zealand within a comparatively few years. In the construction of buildings, from cement and sand mixed being used for mortar in laying up stone and brick walls, or cement and sand and broken stone mixed being used as concrete for footings of walls and piers, the use of cement with other aggregates has enormously increased within the past fifteen or twenty years for floor filling between steel beams, for partitions, and still more recently for outer walls.

The great danger to be apprehended from the use of cement combined with other materials is its commercial mixture, and its use in freezing weather. With the best materials, good cement, clean, sharp sand of proper size sand grains, and small, clean, broken stone or gravel, become the careless or improper mixture of the several parts, in the hurry of building operations, the mixing being done more frequently by unskilled labour than by machinery. In cases where the mixture includes cement, ashes, cinders, and clinkers, or other partially carbonised material, with possibly some sand, the ashes frequently contain refuse vegetable matter, and these aggregates often being carelessly mixed, the result is an utterly unreliable product. Good and poor cement mixtures are alike affected in very cold weather by the free water in the mixture freezing before it becomes combined by crystallisation in the process of hardening, or setting, as it is called; the disintegration being due to the expansive force of ice. In the use of concrete constructed walls a variety of constructions have to be considered, solid concrete, hollow blocks of concrete, where the voids or spaces are as great or greater than the solid material, concrete combined with wire cloth or bars, commonly termed reinforced concrete, many of such devices being patented, and involving serious questions as to the proper allowance of strength to be given to the iron and to the concrete when the two are united.

It will be seen therefore that the task of formulating exact regulations for concrete construction is very difficult if not impossible. The National Board Code provides for the proper use of cement combined with other materials as far as the same are known or have been tested by authorities, although such tests have not included the supreme test of time, long outdoor exposure or fire or water—or all of these combined. Nature's verdict is often different from man's. The quality of cement that shall be used in the construction of buildings the mixture and kind of materials in making mortar and concrete, its use and thickness for various purposes, including the filling of spaces between floor beams, are fully and properly set forth. For reinforced concrete or concrete steel constructed buildings the code contains elaborate requirements believed to correctly embody the best known practice of to-day for this branch of the art of building.

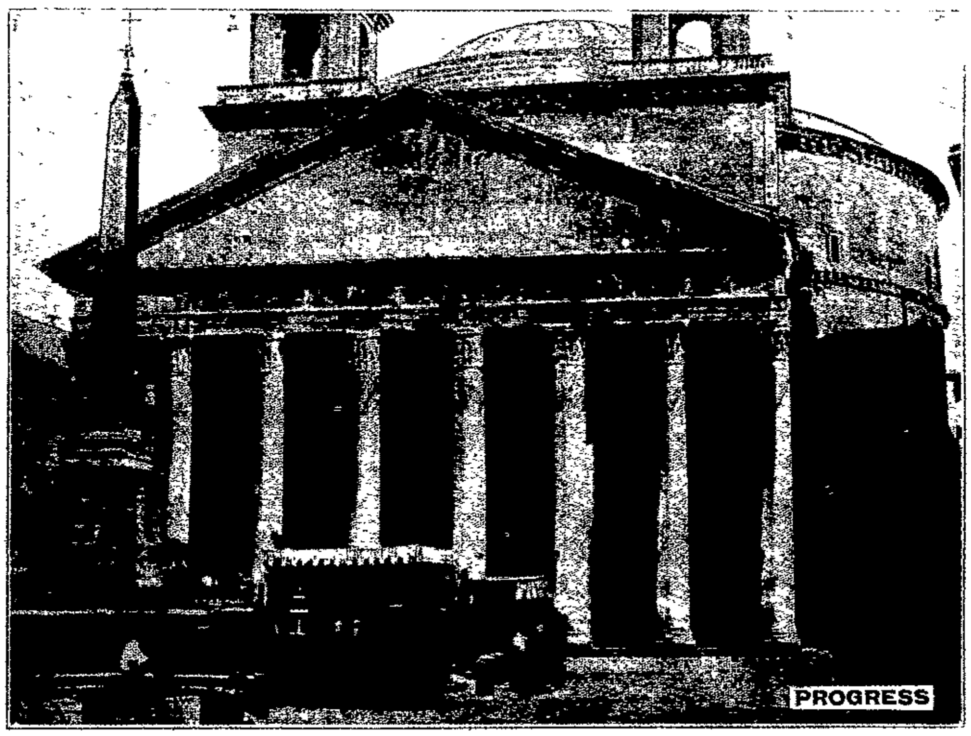
The entire code needs to be carefully and constantly watched and bettered as future experience may, and undoubtedly will, teach, but in perhaps no particular is more care and attention demanded than in matters relating to concrete construction and artificial mixtures. The committee is of the opinion that until the merits of concrete construction are more firmly established, it will be unwise to make any change in the code.

## Experiments on Concrete and Iron.

In the course of the construction of the East Boston tunnel the engineers of the Boston Transit Commission made some interesting experiments to determine how rusting of iron was affected by concrete. The results are reported in the Commission's Tenth Annual Report, as follows —

To Indicate Whether Iron Rusts When Embedded in Concrete.

Nine strips of sheet iron (2 in. x 6 in.) were cleaned till their surfaces were bright and free from rust. Then they were embedded in concrete, moulded into the form of a hollow cylinder, the outside dimensions of which were 14 in. x 20 in., the walls being 3 in. thick. This cylinder, when hardened, was kept filled with water, and was placed in the tunnel. At first the water percolated through the concrete very readily, but the amount of percolation gradually diminished so that at the end of about two months the cylinder became practically watertight. At the end of two years the sheet-iron strips were removed from the concrete and examined. They were found to be free from any rust, and in as bright condition as when placed in the concrete. The concrete was made in the proportions of 1 barrel of Portland cement, 9 cu. ft. of stone dust, and 11 cu. ft. of broken stone.

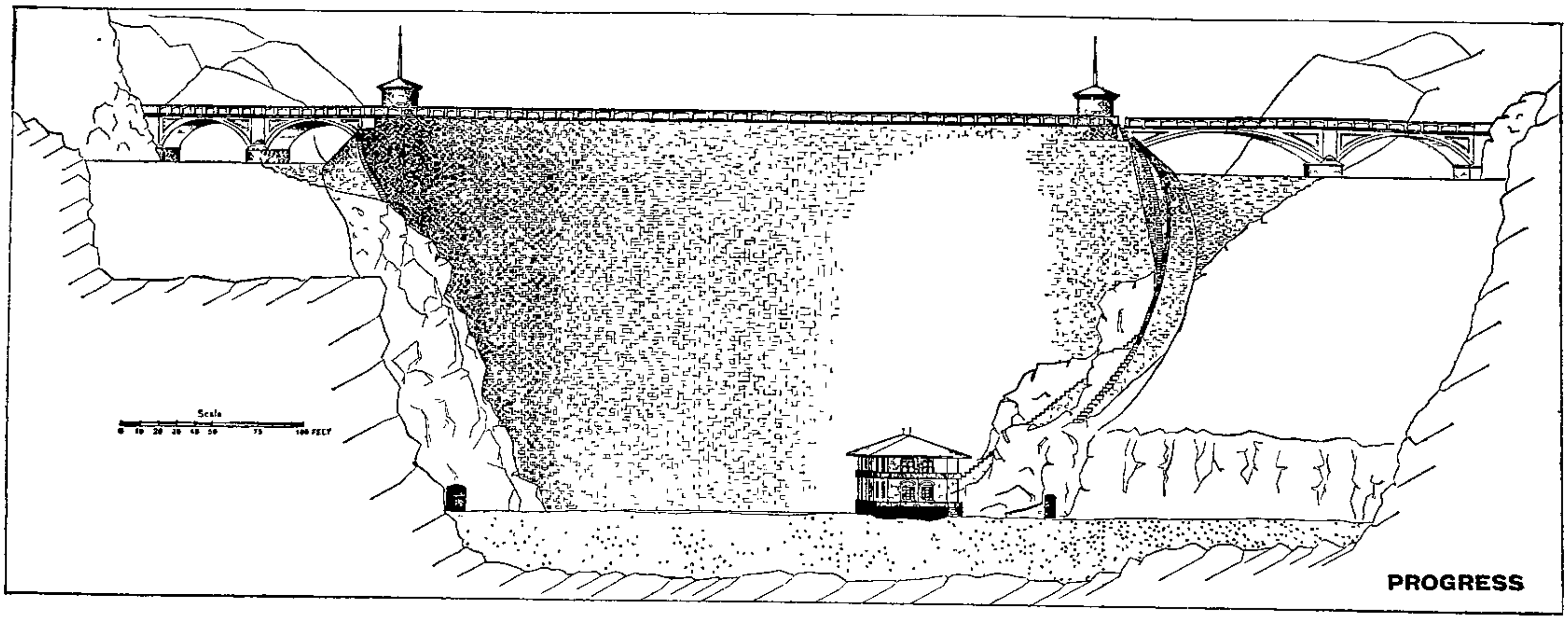



THE PANTHEON AT ROME. ONE OF THE BEST PRESERVED OF ROMAN ANTIQUITIES, DATING BACK 27 B.C. ITS DOME WAS BUILT OF CONCRETE.

To Indicate Whether Steel Imperfectly Cleaned is Preserved from Further Rusting by Embedding the Same in Concrete.

A square plate (4 x 4 x ½ in.), which had become badly rusted, was cleaned by filing till its general surface was bright, but the rust still remained in the numerous small pits. This plate was then surrounded by about 1½ in. of concrete, moulded in the shape of a square block. The concrete was proportioned as follows 1 barrel of Portland cement, 9 cu. ft. of stone dust, 11 cu. ft of broken stone.

The concrete block, when hardened, was placed in water for three or four days, then taken out and dried in air for three or four days. This process of first wetting and then drying was continued for two years, and then the plate was removed from the concrete and examined. The portion of the plate that was bright had remained unchanged. There was apparently no increase of rust in the small pits, but in some of them the colour had changed from the originally reddish brown to a yellow. Professor Norton, of the Massachusetts Institute of Technology, judges this to be merely a change in the composition of the old rust and not a formation of the new rust Two other pieces of steel treated in the same way gave the same results.




ELEVATION OF SALT RIVER DAM, ARIZONA.

## Greatest Dam in the World.

Fifteen years ago the highest dam in existence was the Furens dam (in France), the total height of which was 170 feet. Since then three very much larger dams have been built in the United States. These are the Croton dam in New York, the Clinton waterworks dam at Boston, and the waterworks dam at Denver, on the South Fork of South Platte river. Each of these at present holds the record in one respect or another: the Denver dam is the highest in the world; the Clinton impounds the largest amount of water; and the Croton dam contains the largest mass of masonry. But the Salt river dam, when finished, will exceed each of these in its own speciality; it will be higher than Denver; will exceed the Croton dam in masonry; and will impound twice as much water as all three dams put together. It will be 270 feet high from foundation to parapet, will contain 300,000 cubic yards of masonry, and will impound more than a million acre-feet of water—that is, more than enough to cover a million acres (1,500 square miles) to a depth of one foot. It will form a lake 25 miles long and one to two miles wide, covering an area of 14,000 acres. Its cost, with maintenance for ten years, will be about £800,000.

The dam will be thrown across a gorge—300,000 cubic yards of solid masonry, to be laid in Portland-cement mortar in a wedge-shaped section, 16 feet wide at top and 165 feet wide at bottom. It will tower 230 feet above the level of the present river bed, and penetrate 40 feet beneath it, giving it a total height of 270 feet. Two gigantic spillways, each 100 feet wide, sunk 20 feet below the crest of the dam, will provide an outlet for floods too great to be risked against the main body of the dam. When fully opened, these spillways will discharge 10,000 cubic feet of water per second—an enormous flow, but none too great, for these arid-land rivers, when they come down in their might, rival even the Mississippi in their volume. In 1891 Salt river discharged for a few days the almost incredible amount of 300,000 cubic feet per second—enough to fill the entire reservoir in one day. Only about half of this, however, came from the watershed behind the Salt river reservoir, the other half coming from tributaries entering below the dam site.

The reservoir behind the dam extends up both Salt river and Tonto creek, and can be made to hold almost any amount of water that is desired. Exhaustive surveys were made to determine its capacity, as few things are so deceptive to the eye as the area of a reservoir before it is filled.

The three power sites of the Salt river project are expected to develop power, which, when transmitted by electric cable to the proper places, will pump enough to irrigate some 50,000 acres of land. This, with 150,000, or more, acres supplied direct from the stored water behind the great dam, will make up the entire irrigable land of the Salt river project—an area equivalent to one-third of that of the entire state of Rhode Island.

We are indebted to the *Technical World Magazine* for the illustrations of this great undertaking.

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The Trinity House authorities are placing a new foghorn signal at the Needles Lighthouse. It is a reed trumpet worked by compressed air, and will be heard eight or ten miles from the lighthouse.

## Hollow-Concrete Block Construction.

BY SPENCER B. NEWBERRY.

FIRST PAPER.

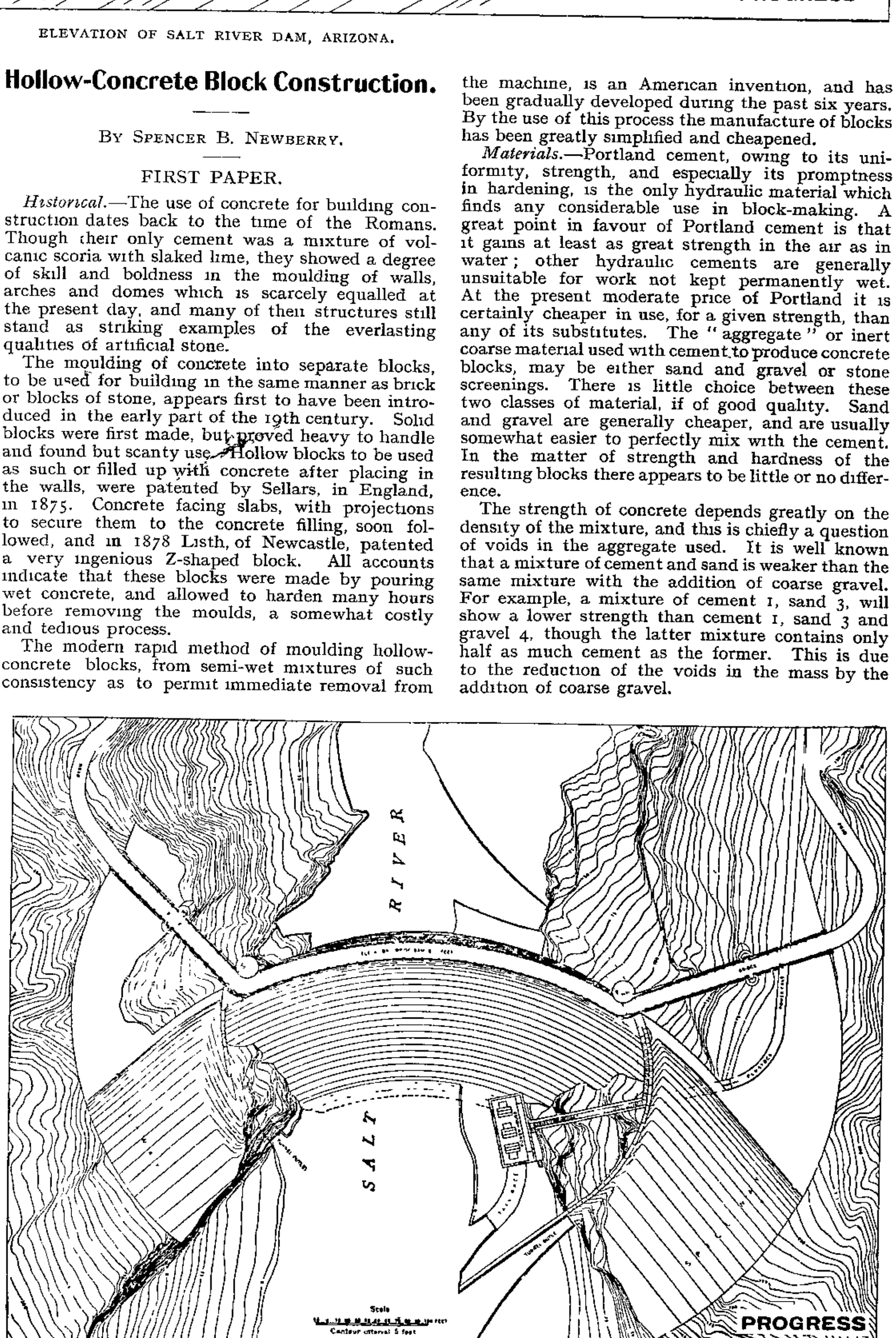
*Historical.*—The use of concrete for building construction dates back to the time of the Romans. Though their only cement was a mixture of volcanic scoria with slaked lime, they showed a degree of skill and boldness in the moulding of walls, arches and domes which is scarcely equalled at the present day, and many of their structures still stand as striking examples of the everlasting qualities of artificial stone.

The moulding of concrete into separate blocks, to be used for building in the same manner as brick or blocks of stone, appears first to have been introduced in the early part of the 19th century. Solid blocks were first made, but proved heavy to handle and found but scanty use. Hollow blocks to be used as such or filled up with concrete after placing in the walls, were patented by Sellars, in England, in 1875. Concrete facing slabs, with projections to secure them to the concrete filling, soon followed, and in 1878 Listh, of Newcastle, patented a very ingenious Z-shaped block. All accounts indicate that these blocks were made by pouring wet concrete, and allowed to harden many hours before removing the moulds, a somewhat costly and tedious process.

The modern rapid method of moulding hollow-concrete blocks, from semi-wet mixtures of such consistency as to permit immediate removal from the machine, is an American invention, and has been gradually developed during the past six years. By the use of this process the manufacture of blocks has been greatly simplified and cheapened.

*Materials.*—Portland cement, owing to its uniformity, strength, and especially its promptness in hardening, is the only hydraulic material which finds any considerable use in block-making. A great point in favour of Portland cement is that it gains at least as great strength in the air as in water; other hydraulic cements are generally unsuitable for work not kept permanently wet. At the present moderate price of Portland it is certainly cheaper in use, for a given strength, than any of its substitutes. The "aggregate" or inert coarse material used with cement to produce concrete blocks, may be either sand and gravel or stone screenings. There is little choice between these two classes of material, if of good quality. Sand and gravel are generally cheaper, and are usually somewhat easier to perfectly mix with the cement. In the matter of strength and hardness of the resulting blocks there appears to be little or no difference.

The strength of concrete depends greatly on the density of the mixture, and this is chiefly a question of voids in the aggregate used. It is well known that a mixture of cement and sand is weaker than the same mixture with the addition of coarse gravel. For example, a mixture of cement 1, sand 3, will show a lower strength than cement 1, sand 3 and gravel 4, though the latter mixture contains only half as much cement as the former. This is due to the reduction of the voids in the mass by the addition of coarse gravel.




PLAN OF SALT RIVER DAM, SHOWING THE LOCATION OF THE POWER HOUSE, POWER CANAL TAIL RACE AND CONTOUR OF THE RIVER BANKS.

As an example of this, the writer made the following experiments on two samples of gravel.

| | Wt. per cu. ft. | Pct. voids. |
|---|---|---|
| No. 1, sand and fine gravel | 127.5lbs. | 22.9 |
| No. 2, coarse gravel, nut to egg size .. .. | 100.9lbs. | 38.9 |
| Nos. 1 and 2, mixed, equal weights .. .. | 139.6lbs. | 15.5 |

Note the surprising increase in density on adding the coarse gravel. A concrete of cement with 6 parts of Nos. 1 and 2 mixed would undoubtedly have shown as great strength as 1 of cement to 3½ parts of No. 1 alone.

A good indication of the value of gravel or stone screenings for concrete may be obtained by filling a cubic foot box with the material and weighing it. A solid block of one cubic foot of limestone or quartz, free from voids, would weigh 165 lbs. The amount by which a cubic foot of gravel or stone falls short of this weight represents the proportion of voids, or empty spaces contained in it. For example, if a cubic foot of gravel weighs 130 lbs., the voids would be 35-165 of the total volume, or 21.2 per cent. A few trials will show that for best results the mixture must contain a large proportion of coarse material. Very few gravels will be found that are not improved by the addition of pebbles, and the greatest strength is obtained with material that contains comparatively little sand.

There is, however, another consideration which enters into the selection of materials for block concrete, and that is the appearance of the surface of the work. Unless a facing is used, a fair amount of fine material must be present to give the blocks an even surface. Nevertheless, it will be found that much coarser gravel or screenings may be used, with good results, than is generally supposed, and that the appearance of the work is not injured by the addition of a large proportion of coarse pebbles up to about ¾ inch, while the strength and density are greatly improved by this addition. A one-to-five mixture of cement and gravel, containing at least 50 per cent of pebbles remaining on an ¼inch screen, will be found better than a one-to-three mixture of cement and sand only.

As to the character of the sand and gravel to be used, there are many tests on record which show that rounded grains give greater density and strength than sharp irregular splinters, and that a small percentage of loam or clay does no harm providing the mixing with cement is thoroughly done.

Another material which may be used with advantage in block concrete is slaked lime. In poor mixtures, as 1 to 4 and 1 to 5, the addition of lime improves the strength and lessens penetration of water; it also makes the blocks whiter on drying. It is possible, also, to replace part of the cement used, perhaps one-third, by slaked lime, without loss of strength. The most convenient form of lime for block-makers' use is the dry-slaked or "hydrate" lime, now a common article of commerce. At present prices, hydrate lime costs almost as much as Portland cement, and there is no great saving in using it. However, it forms a simple means of improving the appearance and water-resisting qualities of the work, and a few experiments will convince most block-makers that it is a valuable addition to the mixture.

PROPORTIONS.

*Cement.*—The proportion of cement to be used will depend on the strength, appearance and impermeability desired. So far as strength is concerned, very poor mixtures, as one to seven or eight, may answer every requirement. Blocks made from such poor mixtures, however, absorb water like a sponge, and will not answer for the walls of dwellings, though they may perhaps be good enough for partitions, retaining walls, and buildings in which dampness is no objection. For dwellings, a poorer mixture than 1 to 5 is not to be recommended. Much depends, of course, on the character of the gravel or screenings employed With properly graded gravel or screenings, containing a large proportion of coarse material, a 1 to 5 mixture will be found better than 1 to 3 with cement and sand only. The writer would recommend a mixture composed as follows, by measure.

Cement 1 hydrate lime ½, sand and gravel 6.

This is practically a 1 to 4 mixture, and will be found to possess fair water-proof qualities, sufficient at least for dwellings which are to be furred and lathed. If plastering is to be applied directly to the inside surface of the walls it is necessary that the blocks shall absorb water only very slowly, so as to be only practically penetrated during a long-continued rain Such a result can be reached by giving the blocks a facing of richer material, perhaps 1 to 2, or by using a sufficiently rich mixture for the whole body of the blocks, such as

Cement 1½, hydrate lime ½, sand and gravel 5, or cement 1, hydrate lime 1, sand and gravel 5.

These should be effective with gravel or screenings of suitable character. The block-maker should experiment with the materials at his disposal, and thus ascertain what proportions are suitable for the special purposes he may have in view. Another method of producing water-tight blocks, which is effective with mixtures as poor as 1 to 6, is by the use of a special water-proof compound, invented by the writer.

*Water.*—The use of a proper amount of water is essential to good work, and in this respect many block-makers are extremely careless. It is well known that a fairly wet concrete is far better than a dry one, and that too much water is better than too little. A rather dry mixture may be more convenient to use, and may enable the maker to turn out a larger number of blocks in a day, but the resulting work will always be porous, weak and crumbling. On the other hand, the extravagant claims made for the wet process, in which the concrete is poured into the moulds and left for many hours to harden, are, according to the writer's experience, chiefly imaginary. It is perfectly practicable to produce concrete of the highest possible quality and still to remove the blocks at once from the moulds. The mixture must be as wet as it can be made without sticking to the plates, and without sagging or becoming distorted when taken from the machine. Blocks so made will be found at least equal in strength and hardness to any that can be made by pouring. They are also much more attractive in appearance, showing a rich, sandstone-like surface, instead of the dull, lifeless look which the wet process gives. As compared with blocks made from too dry a mixture, they are lighter in colour, denser, stronger and more impermeable.

The correct percentage of water varies with the materials, but is generally from 8 to 9 per cent. of the mixture, by weight. It will be found that a mixture containing much coarse gravel or stone may be made much wetter, without sagging or sticking, than one of finer material.

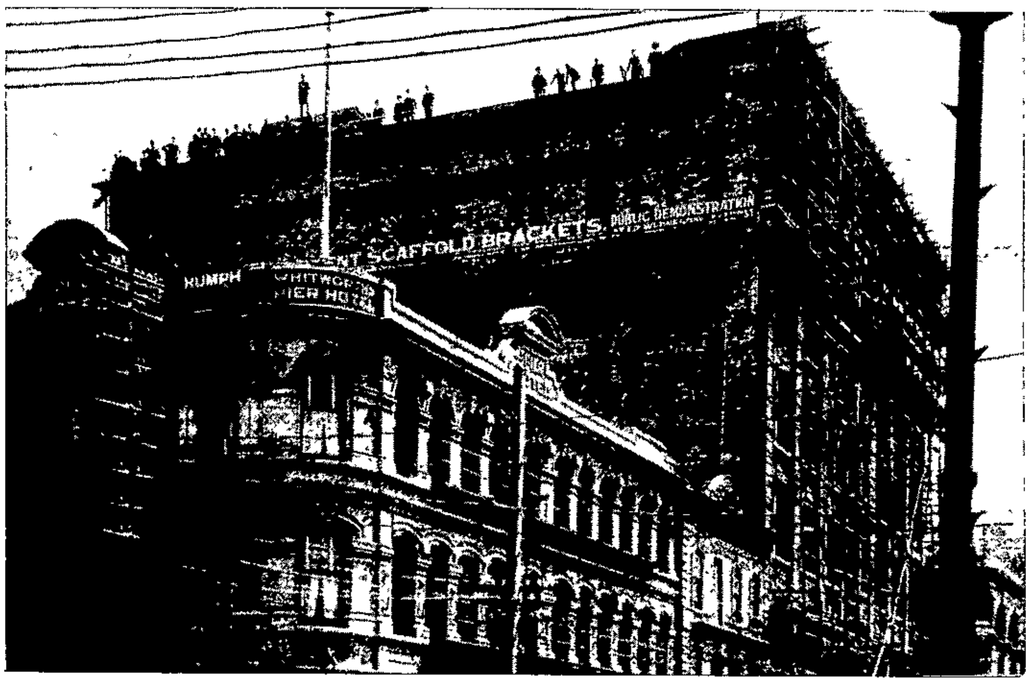
MANUFACTURE.

*Mixing.*—The materials, carefully measured, should be thoroughly mixed dry, then the proper amount of water added and the mixing continued. Thoroughness in this part of the operation will be found to pay for itself many times in improved work. Uneven colour or blocks results from imperfect mixing, and especially from varying the proportion of water. Use of a good concrete-mixer is far preferable to mixing by hand, both in saving of time and labour and in thoroughness of work done. Hand mixing by the use of a hoe must be vigorous and long-continued, or the full effect of the cement used will not be obtained. The inferior work of many small-scale block makers is largely due to this cause.

For the preparation of concrete for blocks, in which thorough mixing and use of an exact and uniform proportion of water are necessary, continuous mixing machines are unsuitable, and batch mixers, in which a measured batch of the materials is mixed the required time and then discharged, are the only type which will be found effective. The writer prefers a batch mixer of the intermittent pug-mill type, with hinged bottom discharge, as made by the Drake Concrete Machinery Co. of Chicago. If such a machine is purchased, extensible mixing arms of chilled iron, capable of being lengthened as the ends become worn, should be insisted upon. Another machine which the writer has seen in successful use is the revolving pan mixer with central discharge, made by the Elliott & Walker Co. of Wilmington, Del.

(*To be continued.*)

## HUMPHRIES' PATENT SCAFFOLD BRACKET.




HUMPHRIES' PATENT SAFETY SCAFFOLD BRACKET IN USE ON MESSRS. JOSEPH NATHAN AND CO.'S NEW BUILDING, WELLINGTON.

TEST OF THREE BRACKETS ON SIDE WALL OF THE PIER HOTEL, WELLINGTON, LOADED WITH 5¼ TONS OF RIMU, WHICH WAS CARRIED EASILY.

## Thermometer Worth £2,000.

The most expensive thermometer in the United States is in use at the Johns Hopkins University, Baltimore, Md. It is valued at £2,000 and is an absolutely perfect instrument. The graduations on the glass are so fine that it requires a microscope to read them.

# Our Industries.

## No. X.—The New Zealand Portland Cement Co., Limited.

PORTLAND cement is the basis for concrete as the moderns know it. And in that case, once again, the necessity of an ingenious engineer was the mother of invention. One hundred and fifty years ago an English engineer, John Smeaton, in attempting to construct a lighthouse upon Eddystone Rocks, found the need of a cementing material which would harden under water, and which would also develop an ultimate strength greater than that of ordinary lime. Through a course of experiments, he discovered that an impure, soft, clayey limestone, when burned, possessed the property of "setting"—becoming hard—under water. This was the beginning of hydraulic lime; and out of it grew the invention of true Portland cement, which is the finely pulverised product obtained after burning to the point of incipient fusion an intimate and properly proportioned mixture of calcareous and argillaceous materials—in other words, limestone or marl, and clay. In addition to Portland cement, there are also slag or puzzolana, and natural, or Rosendale, cements. Portland cement—so called from its resemblance to the stone found on the island of Portland, off the coast of England—on account of its higher and more uniform quality, is the material usually considered in speaking of concrete. Fifteen years ago concrete was used principally for foundations and sidewalks. It is estimated that during these fifteen years enough concrete walks have been laid to girdle the earth a dozen times.

With the changing conditions of building construction, however, Portland cement has become what has been termed the "liquid stone" of the present day, and we in New Zealand are as much concerned with its use in fire and earthquake proof structures as the people on the other side of the world. Consequently, it is not surprising to find that the manufacture of Portland cement ranks amongst our most important industries.

The rise and progress of the New Zealand Portland Cement Co. affords an interesting example of the expansion and possibilities of the cement industry in New Zealand, combined with a ready appreciation of local advantages and sound methods of dealing with the same.

Starting business some years ago the Company had scarcely a twelvemonth to introduce their cement on a market then dominated by the imported Portland cement, ere a disastrous fire practically swept the works out of existence. These works, situated on an island in the Whangarei harbour, called Limestone island, built at the water's edge, were in a unique position for such an industry. The island consists of about 103 acres of solid limestone, the quality of which is unsurpassed for the production of Portland cement. This fire, although a great blow to the rising concern, was really a blessing in disguise, for starting as the Company had, by taking over a concern which for a few years previously had been run on a small scale with inadequate machinery, the fire necessitated the installation of a complete modern plant, which was carried out with great rapidity. The benefit of this became at once apparent, for the improved article turned out at once commenced to attract attention from engineers and others concerned in building work of all descriptions, with the result that their appreciation of the local article caused a steady but rising demand to set in, which, after four years, has become so great that, after being taxed to the utmost capacity, it was determined about twelve months ago to double the plant. In carrying this out advantage has been taken of the latest developments in cement machinery, and when the installation is complete—which will be by the beginning of January, 1907—the works will be the largest and most up-to-date in New Zealand. The increase and development of the Company will be more readily seen when it is mentioned that the output, 1000 tons per month, which has been found to be inadequate, will be increased to about 2500 tons This satisfactory position, apart from the high quality of the cement turned out—which has gradually broken down the prejudice against the article—has been obtained from the advantage of position, etc. Every part of the works has been planned to ensure a minimum of labour in production. The quarry is at the back of the mill, the stone is run in, treated, and sent out as finished Portland cement on to the wharf, at which steamers of 3000 tons have been berthed.

As showing the expansion of the Company, it has been found necessary to carry the wharf further out to accommodate vessels of 6000 tons. This is now being done in ferro-concrete by the Ferro-Concrete Company. The coal is obtained from the local mines and brought to the works by the Company's own lighters, and the time appears not very far distant when it will become necessary for the Company to run its own steamers.

The Portland cement manufactured by the Company is now well known as the "Crown" brand, and is in great demand for works of all descriptions. The Waihi Gold Mining Co. has, during the last three or four years, used upwards of 3000 tons, the Napier Harbour Board, about 2000 tons, while the Wellington Harbour Board have used immense quantities in the new sea wall. The Ferro-Concrete Company are using large quantities in their contracts with the Auckland Harbour Board, and also at Tonga, where they are putting up a ferro-concrete wharf In addition to these companies, the Makatote viaduct, the most important structure on the Main Trunk Railway is, we are informed, using up "Crown" brand solely for the concrete work—about 1000 tons being required for this purpose. The contracts for the Public Works Department for both Auckland and Wellington are held by the N Z. Portland Cement Company, and, in addition, the Company has just secured the contract for the supply of nearly 4000 tons for the Karori dam construction, Wellington. From this, which does not exhaust the contracts held, it will be seen that the extension of the works was taken in hand none too soon, and it speaks well for the management that, although working under great stress, the large demands are being met, while the dismantlement necessary to the enlargement is being carried on at the same time.

A great future is assured for this Company which, while being a credit to New Zealand, is most certainly a valuable asset to the town of Whangarei, which benefits greatly by the large amount of trade caused by having such a thriving industry in its midst.


NEW ZEALAND PORTLAND CEMENT CO.: VIEW SHOWING QUARRY BEING EXCAVATED TO MAKE ROOM FOR NEW BUILDINGS.

## America's Highest Viaduct.

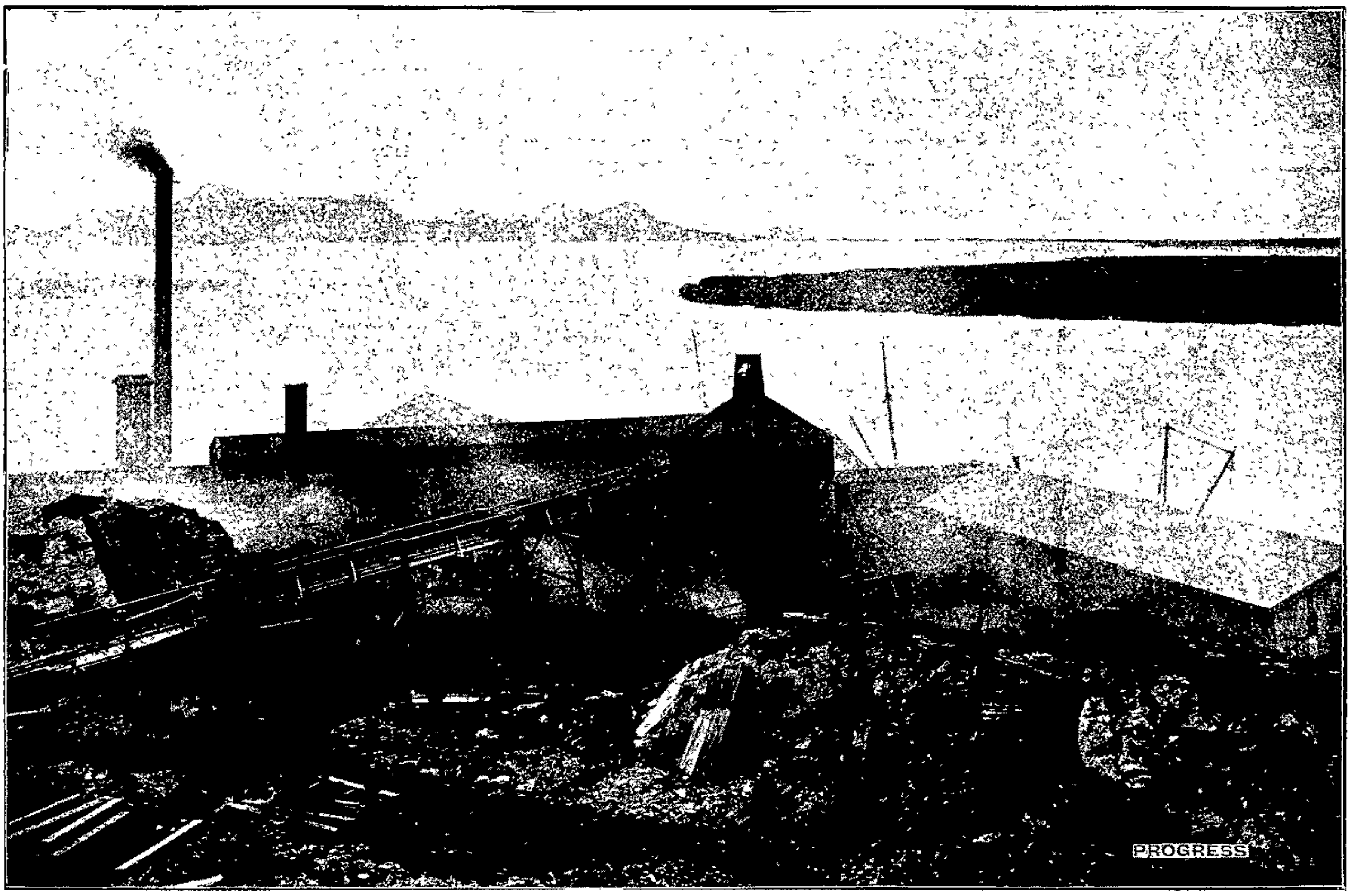
The Pecos viaduct is the highest in North America. If one dropped a stone from the centre of the bridge to the water beneath, it would fall 321 feet. The bridge crosses the Pecos river in Texas; and, besides being of great height, is 2,180 feet in length. So far as known, there are but two railroad viaducts in the world which are higher. One is the new bridge over the Zambesi river at Victoria Falls in South Africa, about 420 feet high, and the other the Loa viaduct in South America, which has a height of 336 feet.

## Coal Consumption.

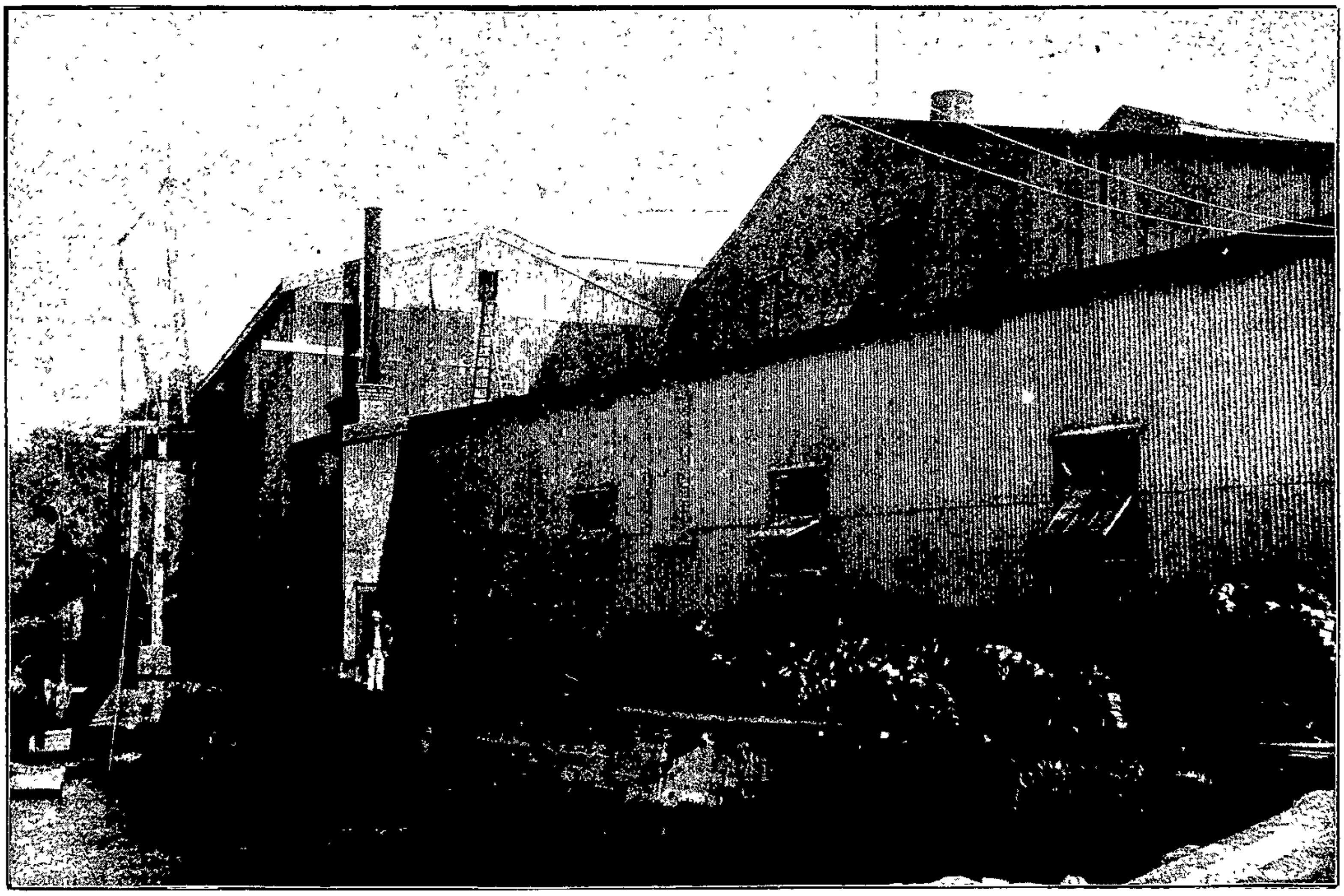
In the course of his address to the Glasgow University Engineering Society the president (Mr. G. T. Beilby) stated that there are, in Great Britain, steam engines and boilers with a yearly output of at least 5,000,000 h.p. The coal consumed by these is not less than 5 lbs. per 1 h.p. hour. By the use of gas engine and steam turbine that coal consumption might be reduced to 1½ lb. per 1.h.p. hour. The saving in coal, therefore, would be equal to about 28,000,000 tons, value at £9,800,000. The cost of making this change need not exceed £50,000,000, or, if the power is to be delivered in the form of electrical energy, £60,000,000.

The assertion that the rare earth metals of the incandescent gas mantle emit sparks on being scratched with a file has been investigated by Baron von Welsbach. He finds that the sparks are produced only when the rare metals are alloyed with 30 per cent. of iron, and he proposes to apply this property of the alloy to the automatic lighting of gas. As the gas is turned on, a file gently rubs the alloy, producing a brilliant shower of sparks, which immediately ignites the gas.

According to the report of the Inspector of Explosives, a workman was fined £2 last year for having pockets in his clothing when working in a danger building.




NEW ZEALAND PORTLAND CEMENT CO.: VIEW OF BACK OF WORKS, SHOWING PORTION OF QUARRY.



NEW ZEALAND PORTLAND CEMENT CO.: SOUTHERN SIDE OF MILL.


NEW ZEALAND PORTLAND CEMENT CO.: VIEW SHOWING ADDITIONS TO MILL AND NEW PLANT IN COURSE OF CONSTRUCTION


NEW ZEALAND PORTLAND CEMENT CO.: VIEW OF THE WORKS, SHOWING THE STEAMER HAUPIRI AT THE WHARF.

# The .... ...Motor.

## MOTOR NOTES.

By "Accumulator."

The only motor cars which were exhibited at the Glasgow Exhibition in 1901 were a 12 h.p. Dennis and an 8 h.p. Argyll.

* * * * * *

The Automobile Company of N.Z., Ltd., have received advices that owing to the phenomenal demand for the new Ford "N" 4-cylinder 15–18 h.p. runabout, the manufacturers have been compelled to raise the list price of this car fifty per cent.

* * * * * *

Petrol in France is obtained as easily as "café noir." In villages and the smaller towns it is stocked by grocers, at once indicated by tins and signs by the roadside.

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Many New Zealand motorists think nothing of carrying provender at the rear end of the chassis, where the exhaust plays on the hamper to an extent sufficient to poison the whole party.

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The first Dennis car of any importance to arrive in the colony will be housed in the Exhibition early in December This car, I understand, is already sold for £1,000

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The Automobile Co. of New Zealand Ltd, are landing one 6-cylinder Ford "K" car, which is the first car of its kind to arrive in the colony; also two of the 4-cylinder 15–18 h p. Ford runabout cars.

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In carrying spare tubes in a waterproof bag, see that the large thimble cap to the valve is not screwed on so that the pin in the dust cap projects beyond it, otherwise it will perforate the tube sooner or later.

* * * * * *

Messrs. Holmes & Allen, Wellington inform me that they have been appointed sole New Zealand agents for the well-known Mitchell motor cars. The same firm have also sole control in the colony for the Fairbanks marine and stationary oil engines.

* * * * * *

A novel type of motor boat has been designed in France for the International Cup races. The hull is an absolutely flat bottom, 8 feet wide amidships; and the propeller shaft will be altogether exterior to the hull, having its extremities encased in bearings supported by brackets projecting from the keel.

* * * * * *

It is said that a French automobilist, on paying his first visit to England the other day, when running into London was considerably perplexed at the meaning of a street board reading "Cars stop here." He is said to have stopped, until a passer-by, noticing the situation, informed him that the notice applied to trams only.

What is it goes where the big car won't?
The small car!
What is it goes when the big car don't?
The small car!
What is it costs but a sixth to run,
What is it gives you just as much fun,
And gets where you want ere the day is done?
Why the small car! The small car!

* * * * * *

Here are three good fundamental rules for getting the best work, with the least consumption, out of your engine:

1. Drive with ignition advanced to the utmost, short of getting engine knock.
2. Admit as much air to the carburetter as possible short of getting misfires. This, of course, only obtains with carburetters in which the air supply is controllable.
3. Never let the engine run hot or be in want of the proper supply of lubricating oil.

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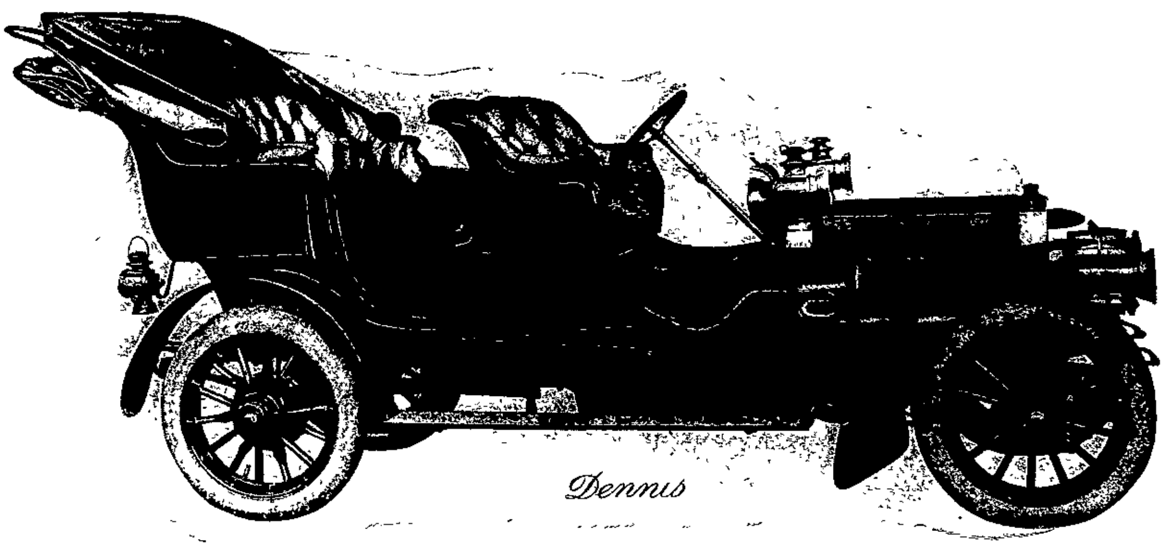
A man lying in the road near Market Rasen, England, one dark night was run over by a motor car. The owner, Mr. William Chapman, acting




20-H.P. DENNIS CAR THAT CARRIED OFF THE HONOURS IN THE RECENT BRITISH 4,000 MILES NON-STOP RUN.

the part of the good Samaritan, attended to the man, informed the police, and in company with a police officer fetched a doctor. The medical man afterwards made a claim of one guinea against the motorist for attending the injured man. The claim, however, was resisted, and the case came before the Market Rasen County Court recently for decision. His Honour, Judge Barker, gave judgment for the motorist, holding that what he had done was an act of kindness.

* * * * * *

Should a tank or other vessel which has contained petrol require repairs calling for a soldering iron, great care should be taken to clear such tank of any petrol fumes which may remain therein, otherwise there is the possibility of an explosion occurring. Petrol fumes being heavier than air, will remain in any vessel for a considerable time, even though it has an opening to the air. There are several ways of clearing away such fumes, of which turning the tank with its opening to the lowest point and leaving it so for several hours, is the easiest. Another method is to subject the tank to indirect heat in a similar position to that mentioned; this is, perhaps, the quickest method, though not always convenient. In any case, it is always advisable to keep it, if a blow lamp is used, as far away from the tank as possible.

* * * * * *

Some sensible advice was given by the West Kent (Engl.) coroner recently, when after a jury had returned a verdict of "accidental death" on a woman killed by a runaway horse and van startled by a motor wagon, he said that in this instance had the van been left in charge of a boy the accident would probably not have happened, and he stated that in his opinion horse vehicles should not be allowed to stand unattended on busy thoroughfares.

* * * * * *

It will come as a surprise to many to know that a limited quantity of motor spirit is made in the British Isles from British material. The spirit is not distilled from imported oil, but I understand it is made from shale. Shale is a slaty clay often occurring in the coal measures, and from it paraffin has been extracted in Scotland, and it appears that it is also possible to distil a spirit from the oil thus obtained.

* * * * * *

The Scott Motor and Cycle Co.'s exhibit at the Exhibition is one of the attractions of the Machinery Hall. There are on view: one 12–14 h.p. Argyll; two 10–12 h p. 2-cylinder Argylls, one of which is a doctor's two-seater phæton with wind screen, and the other a double phæton with side entrance; one 18–20 4-cylinder Scott car, a fine London-made machine, absolutely silent, having an exceptionally flexible running on the high speed, and fitted with a special form of radiator; one 8 h.p. single-cylinder Reo; and two 7 h.p. Alcyon cars of French make, each having a single-cylinder engine, and fitted with three speeds forward and a reverse. These latter handy little machines are furnished with hoods, and are to be sold at a very low figure.

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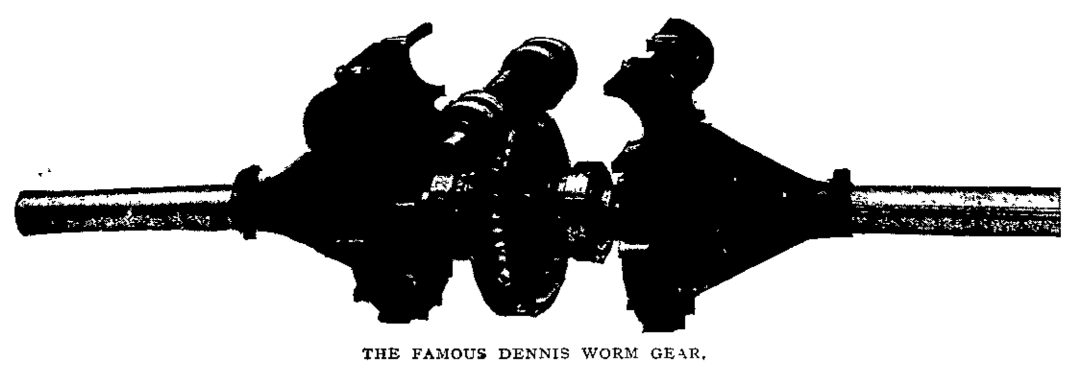
The enormous demand that exists for motor 'buses and wagons is shown by a letter received, by the last English mail, from Mr. Norman Heath, whose firm is the New Zealand and Australian representative of Messrs. Sydney Straker & Squire, Ltd., of London and Bristol

Messrs. Straker & Squire increased their works to three times their former size, so as to enable their entering into the manufacture of delivery vans and motor cars, nevertheless, they found it almost impossible to cope with the rush of orders for motor 'buses and wagons, and have, as a consequence, been paying for some time past over £1000 per month in penalties.

* * * * * *

A correspondent writes:—"A two-cylinder car began to miss while running, so I stopped to find the cause. This was quickly located in a run-down accumulator, and, another being coupled up, that fault was remedied. Happening to cut out each cylinder separately to test the firing, I found that one cylinder would not run nearly as fast as the other. After trimming up the platinum points of the trembler which fired the defaulting cylinder, and adjusting the trembler so as to give the best possible spark, I still found that there was no improvement. Searching further for the cause, it was discovered that one of the wires of the core in the coil was



THE FAMOUS DENNIS WORM GEAR.

sticking up above the rest about 1-16in. When this had been filed down level, the trembler was again adjusted, and both cylinders then ran uniformly when tested separately. I have never before had a similar experience, but it must be obvious that with one of the wires of the core standing up higher than was intended, it would be impossible to correctly adjust that trembler."

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The manner in which the tar method of dealing with the dust nuisance is being taken up in Glamorganshire is most satisfactory, and is well worth the consideration of local bodies in New Zealand. The Bridgend District Council is the latest authority to put tar on its roads. Soon all the urban areas in England and Wales will treat the main macadamised thoroughfares in their areas in this manner.


DENNIS MOTOR OMNIBUS. AFTER TWO YEARS' HARD RUNNING IN LONDON THE DENNIS WORM GEAR IN THIS 'BUS WAS REMOVED FOR INSPECTION AND NO TRACE OF WEAR OR FRACTURE COULD BE DISCOVERED.

At present there seems to be a wide difference in the cost of the tarring in various places. The Cowbridge Town Council and the County Council both employ a method, the cost of which is considerably higher than that used at Porthcawl, where it is found to be cheaper to have the roads tarred than to leave them untreated. Not only do they wear better (the tarring need be done only once a year), but the cost of sweeping and watering is saved, and, above all, there is practically no dust.

* * * * * *

Always carry a piece of bread somewhere on your car—rye bread for choice. Well, rye bread is difficult of acquisition in this country, so a good wheaten compound must suffice. The bread is not to be stored against a prolonged *panne*, and consequent famine in the depths of the wilds, but because under certain circumstances the staff of life can be of much avail in directions other than that of alimentation. A slight leak in a radiator can be most efficiently, although temporarily, staunched by means of paste made from bread well kneaded with the fingers Saunier tells how one day, for lack of better material, he caulked a leak in a cylinder water-jacket with this same bread. The paste must be well kneaded, then spread over the leaky part, and worked in with some tool which will do duty as a spatula, just in the same way painters work up their colours on a palette.

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The Turner-Miesse steamers are now all being fitted with a new burner regulator which enables the driver to regulate the heat of the generator to any desired extent when the car is standing, or when the full power of the burner is not required. There is no pilot light, no tendency to blow out, the whole arrangement being contained in the main burner itself. This can be instantaneously turned fully up, or lowered to give an extremely small flame; thus, a start can be made at any moment, no matter how long the car has been standing, with the small flame going. There is an entire absence of the roaring usually produced by these burners when turned low down or when full on It is of interest to note that the idea of this burner was suggested by an amateur owner and regular driver of one of the standard 10 h.p. Turner-Miesse cars The burner has been fully tested for some time and has proved very satisfactory.

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The special feature of the Dennis car is the worm gear, illustrated on another page, and which is a perfectly silent drive and said to be more efficient than any other system adopted. The efficiency is equally displayed whether the worm pinion is driving the worm wheel, or the worm wheel is driving the pinion. There is not the slightest tendency towards irreversibility. The worm pinion is contained in a specially constructed differential gear box, and runs on each end on most efficient journal and thrust pinions, The worm wheel encircles the differential gear, which is of the parallel pinion type with 6 pinions and 2 star pinions. The rear-axle casing is extended to take the bearings of the road wheels, so that they have an independent bearing on each to support the weight of the car and passengers, and the live axle has to transmit the drive only.

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The new Dennis motor omnibus, imported by the Automobile Co of New Zealand Ltd., to the order of a Blenheim gentleman, had a trial run through Wellington recently. Laden with 18 people, it did all that was required of it without any untoward incident The running was nearly silent, practically vibrationless, and the demonstration is reported to have convinced the experts present of the car's practicability for the service it is intended to accommodate. The engine is four-cylinder, giving 24 h p. at 900 revolutions, and 28 h p. when accelerated. The weight of the omnibus is 3 tons, and its landed cost £1250. It is calculated that its New Zealand cost of carrying a full complement of passengers will be under 9d. per mile, depreciation, repairs, and all other expenses being reckoned in The English cost is under 6d. for 34 passengers per mile.

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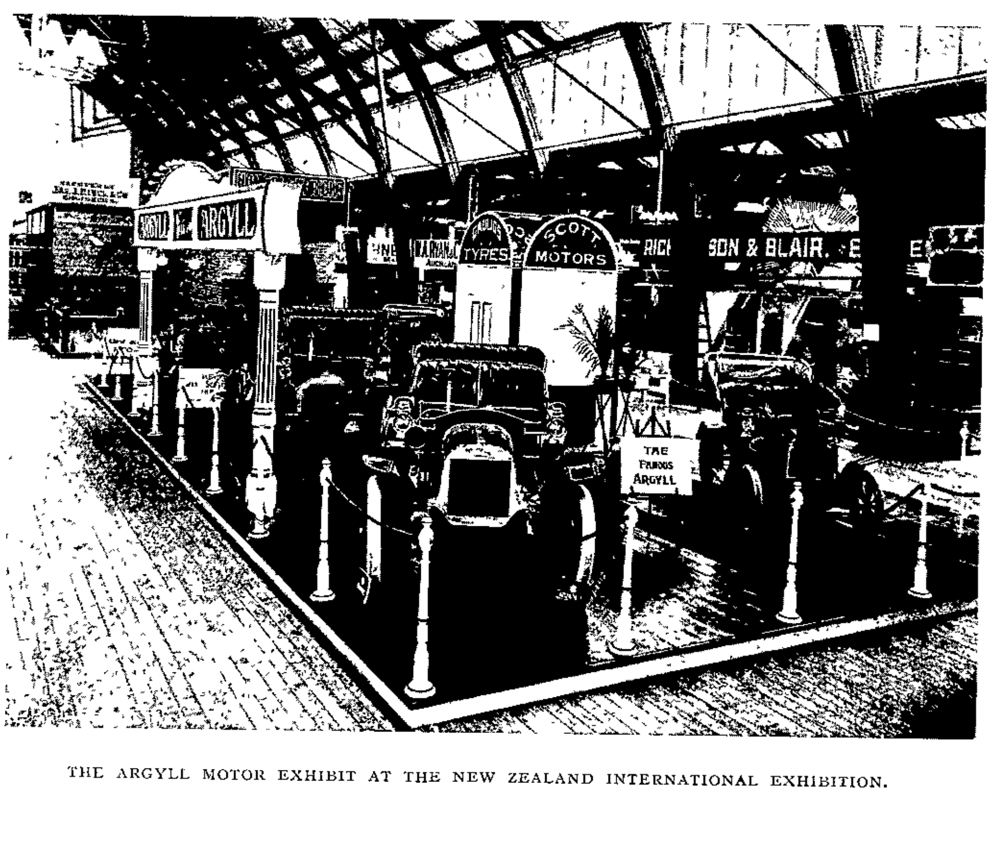
The Scott Motor and Cycle Co have been appointed sole New Zealand agents for the celebrated Renault cars.

## The Motor in the Colonies.

Owing to the legalisation of motive power on our roads in the United Kingdom, says *Motor Traction*, enormous strides have been made in the design and manufacture of the small high-speed internal combustion engine in order to meet requirements, and more recently the Heavy Motor Car Order has afforded wider scope to the makers of the steam lorry, who previously, in the earlier days of the motor movement, had to carry on their work penalised under a heavy handicap. Only as recently as two or three days ago it was not uncommon to hear men say that they intended buying a car, but would wait until the perfect motor arrived. Nearly all the men whom the writer has heard uttering such sentiments are now motor owners, so it may be assumed that the general belief is that the motor car is settling down into a standard form, and may now be regarded as fairly reliable. We would be the last to preach the doctrine of finality in anything, least of all in matters mechanical, but the experience of the past has shown that, when any master-system reaches such a point as to permit of reliable working with proper care, a stage is reached at which radical alterations cease, further improvements only lying in matters of detail, and that this stage lasts for some considerable period, until the system is superseded by another radically different. The locomotive is a case in point. Now, this is the stage which, in our opinion, has been reached by the internal combustion " motor " using such fuels as petrol or paraffin, although we are free to admit that there is room for improvement in the details dealing with the latter fuel. In fact, the industrial motor began at a stage quite different from the starting point of the private car. In its earlier days the motor car had to be painfully evolved by a process of natural selection, or, to be more correct, by the survival of the fittest, but the internal combustion motor for industrial purposes began life with the benefit of eight or nine years' experience obtained from the makers of the private car. The engine of the steam wagon, too, is the outcome of some sixty years' general experience, while the modern driving mechanism and structural parts have only been produced as the result of years of incessant work and experiment.

It is the consideration of such facts that brings one to realise that the time has now come for the industrial motor to extend its scope to the colonies, where he enormous possibilities for its use in all directions. The United Kingdom, like other countries, sends out a proportion of trash among her exports, but the percentage of that undesirable commodity is less in her case than in that of any other country. One point we would emphasise with all due respect to our colonial brothers. The foreigner is said to be taking our trade by supplying what the customer wants and asks for, while the Britisher loses the contract by trying to supply what seems to him fittest for his customer's needs, not what the latter wants. There is, however, something to be said for the British point of view, for it is no uncommon thing in our experience to come across makers who, against their better judgment, have supplied without question goods




THE ARGYLL MOTOR EXHIBIT AT THE NEW ZEALAND INTERNATIONAL EXHIBITION.

exactly as ordered, and have suffered by loss of trade in consequence of so doing. Again, it is no uncommon thing for orders from over seas to come to hand in which it is really extremely difficult to make out what the sender really does want We adduce these facts not with any intention of finding fault, but to show that there is a reverse to the shield. If only our colonial friends would follow the example of one or two well-known and successful firms that we could mention, by only dealing with well-known firms of integrity and by sending them an account of their requirements as regards the work to be done and the conditions under which it has to be effected, relying on them to execute the order to the best of their judgment, we would hear fewer complaints of orders unsatisfactorily fulfilled.

## The British Motor Trade at a Glance.

Below we give particulars relating to the number and value of imports and exports of motor cars and parts thereof for the first month of the years 1904-5-6. The increase for January of the present year is very great, both in imports and exports. The demand shows no diminution, but emphatically the reverse.

Eight times the value of parts of cars are imported as compared with exports, whilst the re-exports of the foreign parts are only about one-fourteenth of the imports thereof. Still, whatever way we look at it, the prospects of rapid expansion of business are most encouraging, and show that the industry is well on its feet, and that British motor manufacturers are slowly gaining ground

Tabulated British Trading Results of the Motor Cars and Parts thereof for January of the last three years.

| | Imports. | | | British and Irish Exports. | | | Foreign and Colonial Re-Exports. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Month ended 1st January. | | | Month ended 1st January | | | Month ended 1st January | | |
| | 1904 | 1905 | 1906 | 1904 | 1905 | 1906 | 1904 | 1905 | 1906 |
| Cars— | | | | | | | | | |
| Number ........ | 335 | 362 | 458 | 55 | 77 | 146 | 35 | 50 | 68 |
| Value ......... | £102,866 | £149,578 | £175,270 | £25,166 | £25,590 | £48,759 | £9,223 | £19,006 | £26,999 |
| Parts— | | | | | | | | | |
| Value .......... | £17,906 | £36,608 | £136,720 | £3,470 | £7,480 | £16,334 | £1,011 | £2,733 | £9,582 |

## The Turner-Miesse Generator.

The generator of the Turner-Miesse steam car, which is of the flash type, is built of a number of layers of solid drawn steel tubes, each tube being bent into a special shape. There are sixteen layers in all, laid horizontally one above the other, and each layer being at right angles to the other and each four layers connected together by outside unions. The water enters the bottom layer first and finds its way up through 8 layers, and from the 8th layer it passes to the 13th layer, and up until it reaches the 16th layer. From the 16th layer it drops to the 9th, and passes up to the 12th layer, leaving same as very highly superheated steam and passing to engine. The lowest tubes may thus be considered to act as a feed-water heater, and are therefore not liable to become burnt under ordinary working conditions. The top layers receive less heat from the burner, and may be called the steam raising coils. The intermediate coils may in the same way be looked upon as the superheater portion of the boiler The tubes vary in thickness, although the external diameter throughout is ¾", those at the bottom have an internal diameter of about 5/16", and the superheated coils of about 7/16". In the 10 h p generator the total length of tube is about 200 feet, and in the 16 h p car, roundly 300 feet The generator is enclosed in a special casing, built up with an inner and outer sheet of steel, held together by channel steel frames top and bottom the space between the metal sheets being filled up with asbestos. The long rectangular holes in it are made to form the bottom of a horizontal flue, a second bent plate being fixed above it This flue runs out through the bonnet in front, and is connected with a vertical flue passing down between the generator casing and dashboard, the burnt gases passing out through it beneath the car.

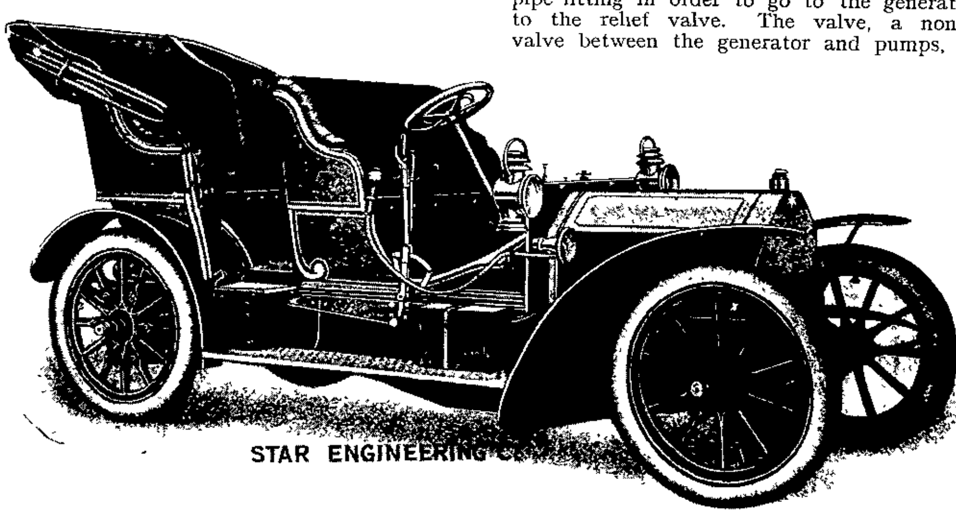
The generator, which is tested to a pressure of 1,200 lbs. per square inch, is fired by a special form of burner which uses ordinary paraffin as fuel. The latter is carried in the air-tight tank, the feed pipe from it is led to a shut-off cock on the left-hand side of the car. A pressure of about 70 to 75 lbs per square inch is maintained in the tank by a mechanically driven air pump, worked directly off the crank shaft of the engine. The delivery pipe from the pump is led to a three-way cock, which is connected with a gauge showing the pressure in the fuel tank, and with a relief valve on the dashboard. The three-way cock has a nozzle to which can be attached an ordinary tyre pump for obtaining the necessary pressure initially. The fuel finds its way into two vaporiser coils which lie above the burner, and then to the burner nozzle.

The quantity of gas which is fed to the burner is regulated by the amount of air pressure on top of paraffin in paraffin tank. No regulator for the air is provided, the air and gas pass along the pipe into a chamber from which a large number of parallel horizontal tubes project beneath the boiler. The tubes are perforated with rows of fine holes, drilled at an angle, which form the burner jets. The oil enters one end of the vaporiser which rests directly on two of the main burner tubes, passes through the various spirals and emerges at the other end as vigour The burner is placed in line with hole in the casing, through which the flame of the pilot light is introduced The vaporised oil passes through the pipe to the burner jet. The vaporiser has an internal bore of 5/16" and an external diameter of 9/16". An inspection hole in the generator casing allows the operator to see when the coil is sufficiently heated by the pilot light to permit the paraffin cock to be opened

The tubes are perforated, the two external tubes having but one row of holes in them and tubes two rows The mixture of gas and air issues out of these holes at an angle of 45 degrees, and the flames from each adjacent tube strike one another and cause the heat generated to be equally diffused The burner is held in position by two butterfly nuts at the front of casing, and the central tube of burner which is somewhat longer than the other, is slid through the hole in back of casing and fastened with a wedge-shaped cotter and split pin The mixture supply tube lies outside the burner

All the tubes are, of course, closed at their rear ends. The 10 h p burner has seven tubes and the 16 h.p. nine. Even the smaller burner has over a thousand small holes in its tubes The hole through the nozzle is extremely small, being about 1/16" in diameter. The burner can be easily taken out when necessary, the pipe connection to the nozzle and the cotter behind the generator casing, together with the two butterfly nuts alone require removing, when the burner can at once be dropped. The vaporising coil of the burner is initially heated up by a pilot lamp and subsequently kept hot by the burner itself. The vaporiser coil requires to be thoroughly heated by the pilot light before attempting to start the burner with its ordinary fuel. The operation of heating up takes something over five minutes to perform, but should not be hastened unduly, as the burner is liable to smoke, if the coil is not suffiently hot. The burner appears to work well and quietly, and to give a very high degree of heat.

The water is forced into one end of the generator either by a hand pump, when starting, or by a mechanically driven pump when the car is running; in the latter case the quantity of water delivered depends upon the speed of the car, but the actual amount which finds its way into the generator is regulated by hand, any surplus being allowed to find its way back to the supply tank. The hand regulator consists of a by-pass, and it primarily enables the driver to regulate the steam pressure. From the water tank the water is led to the feed pumps, its passage to the pump cylinders being regulated by a shut-off cock. A small dome is placed on the top of the tank on the right hand side, and an overflow which passes down through the water and out at the bottom of the tank, terminates at its upper end inside this dome. One of the delivery pipes from the pumps is led to a by-pass valve, which is also connected back again to the suction side of the pump. The by-pass is controlled by a small lever working over a toothed quadrant attached to the steering column under the steering wheel, and the quantity of water delivered to the boiler can thus be regulated The delivery pipe from the pumps to the boiler has an additional non-return valve between it and the pumps. It passes direct to the bottom coil of the generator, and has one branch pipe which leads through a relief valve, which forms a part of the quadrant on the steering pillar. The relief valve is normally kept closed, but in the event of the pressure rising abnormally at any time, it can be opened by the driver, when the water or steam in the delivery pipe will be allowed to pass to the condenser. The feed water pumps are fixed on the right-hand side of the car and are formed in one casting. One of them is operated by the hand lever, and the other by the eccentric on the countershaft. An air pump is fixed to the left of the engine, and is driven by a crank pin on the crank shaft. The other end of the shaft carries a hand brake controlled by a foot pedal; the latter also operates the steam throttle valve, its action being to first cut off the steam supply to the engine, and on further depression to apply the brake. The two water pumps have separate suction and delivery valves. The water passes from the pumps to the hand controlled by-pass, and through an additional delivery valve and pipe fitting in order to go to the generator and to the relief valve. The valve, a non-return valve between the generator and pumps, is thus provided which prevents the steam pressure forcing water or steam back through the by-pass and the condenser to the water tank.




14-18 H P 4-cylinder Stuart Car Side Entrance and Hood

An interesting trial is being conducted under the auspices of the Automobile Club, London, of an invention designed to obviate the use of the differential gear, which, if it fulfils the claims of the inventor, is destined to play a not unimportant part in the development of the motor car. Briefly, Mr Hedgeland, instead of using the ordinary differential, has a solid axle upon which he mounts the wheels on clutches These differ from the ordinary clutch in that as soon as the drive is exerted either forward or backward a coarse-cut thread immediately comes into operation and locks the wheel on to the axle, thus taking the strain from the clutch. The effect of this is that on turning corners one wheel is allowed to revolve freely and the other wheel simply does the driving. The action in this respect is not identical with that of a differential gear, nor, theoretically, can it be contended that it is so good when driving a car round corners. Many claims are made to the effect that the driving is more steady and that the chances of side-slip are minimised. These claims will doubtless be dealt with by the Technical Committee of the Automobile Club at the conclusion of the trial.

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Word comes from Melbourne anent the new automatic puncture sealing compound, "Miraculum," which, when injected through the valve into the inner tube of a pneumatic tyre, renders it quite impervious to puncture. A test recently made by Mr. Carty Salmon, M.H.R. gave those present a complete demonstration of its value. An inner tube of a motor tyre had been treated with the preparation as far back as last March, when, after various tests, it had been allowed to lie about the room unused. A few days ago this tube was placed in a cover, and used in a trip to Mornington, with all its many punctures unrepaired, and went through the journey without attention. This tube, which was used in Mr. A. E. Langford's car, was then detached from the cover, but not before the tyre was pierced through and through, much to the amazement of those present. An inspection of the tube showed very many punctures, through which the compound, a semi-liquid, milk-white substance, slowly oozed. The tube was then replaced, and, after a thick 4" nail had been hammered into the tyre and withdrawn, the chauffeur was ordered to take the car round the streets. On his return the tyre was found to be perfectly hard and firm. This test, however, proved more than that the preparation would seal punctures. It showed that the substance did not lose its efficacy, and that it had no deleterious effect on rubber, which, perhaps, is the most important point of all. On the contrary, it is asserted that it acts as a preservative, and it is, to all appearances, similar to rubber in its native state.

## Lead Pencils.

Lead pencils have no lead in them. The heart of a pencil is graphite, sometimes called plumbago. Such pencils have been in use over three centuries, but began to become popular about a hundred years ago. Henry D. Thoreau, of Concord, a literary man of recognised ability, made pencils, but he lacked enterprise. The firm of Faber, Nuremberg, Germany, was the first to establish a great pencil factory. Several firms flourished in England, the great Barrowdale mine furnishing a superior quality of graphite.

## West Australian Timber.

A recent report from the Premier of Western Australia to the Agent-General gives striking evidence of the immense forest wealth of that colony. The total wooded area of the colony is estimated at 98,000,000 acres, and the extent of merchantable timber has been reckoned to be, approximately, as follows: jarrah mainly (with blackbutt and red gum interspersed), 8,000,000 acres; karri, 1,200,000 acres, tuart, 200,000 acres; wandoo (white gum) and allied timbers, 7,000,000 acres; gum yate, sandalwood, and jamwood, 4,000,000 acres; total 20,400,000 acres. This represents a forest area of merchantable timber four times greater than the whole area of Wales. The total value of timber exported from Western Australia for ten years ended 1904 was £4,800,000.

## Concrete Wharf.

An important coal wharf is being built for Messrs Cory and Co. on the River Medway, at Rochester. It was designed by Mr. H. Shoosmith, M.Inst. C.E., in Hennebique ferro-concrete. The wharf has a river frontage of 340 ft., connected with the shore by two return ends 180 ft. and 100 ft. long respectively. It is founded upon 200 ferro-concrete piles, connected longitudinally and transversely by ferro-concrete girders, horizontal and diagonal bracing, and a continuous decking of the same material covered by tar macadam laid upon a foundation of Thames ballast. This wharf is one of the largest structures of its kind hitherto built, although, so far as design is concerned, it does not differ essentially from the various ferro-concrete wharves and jetties upon the same system which are to be found along the Thames and at many places on the South Coast.

## THE VALUE OF MECHANICAL DRAFT.

Low grade fuels can be burned only by steady and intense draft. Thus, it is difficult with a chimney to obtain sufficient blast to burn the smallest size of anthracite coal, which require a strong and concentrated draft. The lower efficiency of poorer grades of fuel may readily be offset by the decrease in their cost, provided the fuel is burned under proper conditions; and these conditions can scarcely fail to be supplied by mechanical draft. It has been stated that a simple change in grate bars is all that is required to adapt a boiler to burn practically clear yard screenings by means of forced or induced draft. In general, better results may be expected with automatic stokers when they are used with mechanical draft, on account of the positive and, perchance, automatically controlled air supply.

With the chimney damper wide open, an increase in draft and resulting additional output of the plant can be secured only by adding to the chimney's height. The admission of a little more steam to the cylinder of the fan engines solves the problem with mechanical draft. A further advantage lies in the fan's independence of outside weather and temperature conditions. Additional economy in fan-engine operation may be secured by utilising the exhaust steam for heating purposes.

Mechanical draft finds a special field of usefulness in connection with power plants which are operated wholly by water-falls during part of the year, and which are reinforced by steam engines in the dry seasons. In most cases it is much cheaper to install a fan system for the allowable purpose of forcing the boiler output for a comparatively short time than it is to invest in additional boilers. As a substitute for the chimney in case of accident, artificial draft may be quickly and easily applied.

In solving the draft problem it is wise to provide every possible precaution to obtain continuous service. This is far more important than an increase in operating efficiency. A flexible arrangement is a combination of chimney and mechanical draft, each of which will serve as a supplement and relay in case of trouble or even in regular operation. Probably the greatest simplicity is secured by driving fans for mechanical draft by steam engines. It would seem that the possible greater economy of an electric motor drive would be somewhat offset by the increased complication of the regulating and controlling mechanism. Published information in regard to motor-drive draft fans, their economy, and cost of operation in comparison with the single-fan engines largely in use to-day would be welcome to designers.

Enough has been said to indicate the importance of thoroughly going over the draft question before deciding off-hand to use either the chimney or its rival. If more space has been given in these comments to the advantages of mechanical draft over chimneys, it is only because the good points of the artificial method are as yet unrecognised in many places. Experience is not wanting with either method, and there would seem to be no excuse for not analysing both sides of the draft problem in deciding which combination to use.

## A NEW CAST IRON.

IT is reported in the *Times Engineering Supplement* that a member of the well-known firm of William Sellers & Co., of Philadelphia, sent recently to the Journal of the Franklin Institute an account of some experiments made by him concerning the effect of adding a small percentage of high-grade ferro-silicon to molten cast iron after tapping from the cupola into the ladle. The results were so encouraging as to lead to an extension of the experiments, and the facts as determined by a large number of these are reported in the *Iron Age*. In test bars of foundry iron treated in the ladle with small quantities of ferro-silicon containing 50 per cent. silicon there was found an average gain of about 15 per cent. in strength, accompanied by a somewhat larger average gain in ductility or bending quality, accompanied by a marked increase in softness. "The silicon in untreated samples ranged from 1.7 to 2.25 per cent., and in the treated specimens from 2 to 2.75 per cent. The addition of even so little as 1 lb. of the alloy in powdered form in a ladle containing 200 lbs. of foundry iron produced a remarkable effect not only as a softener, but invariably increased the strength and resilience of the metal, this occurring with an addition of a little less than 0.25 per cent. of silicon to the iron. By adding four times this amount of the alloy to a very hard iron mixture in a ladle, which ran quite white when cast in thin section, and was therefore entirely unsuitable for small castings requiring to be machined, it was found that a soft grey metal of good strength and ductility was produced, having a low shrinkage and being suitable for casting pulleys and other light work." It is expected that on a lowering of the present price of the powdered alloy, which is shortly anticipated, the method will become of value in general foundry work.


THE STRATFORD-EGMONT RAILWAY.

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New buildings erected in Wellington during 1905-6 numbered 814, valued at £574,000, against 614, valued at £350,000, during the preceding year.

# Inventions.

## Neville's Patent Electrical Signalling Apparatus.

By W. G. Manners, C.E., Kalgoorlie, W.A.

The advance of deep mining and the increased tonnage in mines has created the necessity for a more perfect and comprehensive system of signalling.

The mental strain in counting the numerous knocks and the liability to error in existing systems, the absence of a reply and interlevel signalling, thus causing considerable delays and inconvenience in mining, all contributed to the urgent demand for some system that would obviate these faults and supply the necessary requirements

Mr. F. H. R. Neville, at one time electrician on the Lake View Consols, Limited, Kalgoorlie, but now in Wellington, New Zealand, invented and patented what is known as Neville's Electrical Signalling Apparatus, and which is claimed to supply all that can be desired in the way of speed, economy and general utility.

All knocks are abolished and the signal is communicated by symbols. That is to say, by making a contact in the mine the platman instantaneously places the required signal before the driver. The driver can then immediately reply, showing the signal in all plats simultaneously, so that the platman knows the driver has received the signal correctly, and it can be known in all parts of the mine where the cage is being employed. At the same time any person in the mine can communicate with every plat without connecting with the driver's signal, and thus call the platman's attention to any requirement in any other level, such as an accident, etc., in which his services are immediately required

It must be understood that the platman is the only man permitted to signal the driver, and the driver only replies to the platman; any one in the mine may communicate with the platman.

Several exhibitions of this invention have been given at the chambers of the Mine Managers' Association, Kalgoorlie, at which members of that association engine drivers and platman were present, and many useful hints and suggestions were made which were taken advantage of, and improvements made in the apparatus. Its adoption has increased the usefulness of the system.

The apparatus as at present constructed is as follows:—

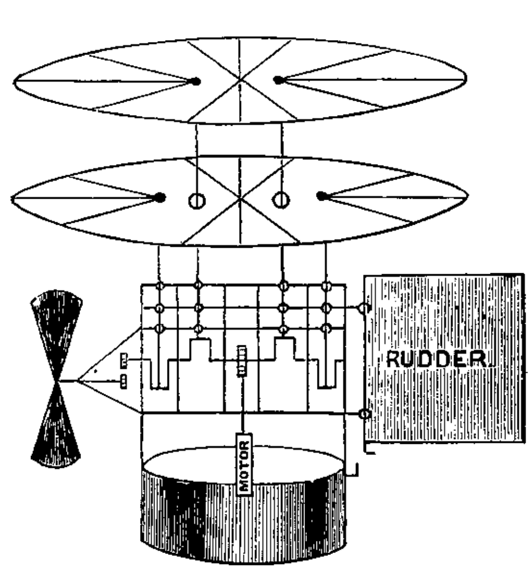
In the engine room and at each level in the mine is placed an indicator and a plug board connected by wires, i.e., a wire for each separate signal, and a feeder wire. These wires are properly protected from injury by being encased in a gas pipe filled with bitumen, or some similar material.

The indicator consists of a light tight box divided into a number of compartments and covered with a translucent front, and inside each compartment is an incandescent lamp. The required signal is cut out of an opaque sheet, such as tin or cardboard, and placed behind the translucent surface, each symbol being coincident with one of the compartments, so that when any lamp is in contact, the figure, letter or word is plainly visible. Each signal is in circuit with a bell which strikes once, thus attracting the attention of the driver. A large continuous bell is also placed in circuit with the stop signal which calls immediate attention while the cage is in motion and the driver watching his level gauge.

A very clever system of wiring is introduced by means of which one plug inserted in the plug board will give any required signal. The Government code is used, with the exception that "and" is used instead of the pause. For instance, "1 pause 1" means No. 1 or 100 ft. level, 1 pause 2, No 2 level, and so on; whereas, in Neville's system 1 and 1 and 2, etc, are shown on the indicator. By the use of one plug the operator can show any signal required, and the driver, by the use of one plug, can reply to that signal. Thus 1 and 1, 1 and 2, 2 and 1, or any level signal, can be given and replied to. A separate plug board is required at each level, connected by a feeder wire to the driver's plug board, and to each level indicator box, but not to the driver's indicator; by this means any one can signal from level to level and receive a reply by the same agency. The drivers plug board may be constructed with spring contacts or switches so that he may simply have to press the switch to reply to the signal received. There is no confusion occasioned by this system, as the driver receiving only the platman's instructions is saved the mental strain of counting, and so replies to this signal by a single contact, then receives the signal "hoist" or "lower," as the case may be, and it is all done in a moment.

In the old system the knocks would be for 1500 feet level - - - ——— - - - - - then a pause, and for hoist -. In place of this 3 and 5 would flash on the driver's indicators. He would press No. 13 switch and 3 and 5 would flash in the plats; then the figure 1 would flash on the driver's indicator, all in less time than would take to give the first two knocks in the old system. Again, in case of an accident the platman and underground manager have to be found, which sometimes takes an hour or more under the present system in a big mine, while with this the signal is immediately communicated to all levels, the platman gets it wherever he may be, and signals the driver, the cage being immediately at his command. The underground manager has the news in a few minutes, can obtain the platman and the cage, and be on the spot in the shortest possible time.

It is estimated that by this system in a busy mine, such as the Golden Mine, as much time as two hours per shift could be saved, while accidents due to mistaken signals would be minimised, if not entirely abolished.




## Novelty in Flying Machines.

The last word has not been said about flying machines, and plenty of inventors are endeavouring to say it. Among them is Mr S di Lauro, of 3 Bedfordbury, Charing Cross His airship is devised to rise immediately and vertically without travelling forward. He achieves this by providing horizontal planes of considerable width at the top of a perfectly round machine. These planes have a series of openings fitted with valves. The air passes through these as the machine rises, but it cannot return through them These planes move up and down (through the action of cranks), but always in opposite directions to each other, and the lifting power depends on the width of the planes and the rapidity of their movements. Any number of pairs of these planes may be employed. The inventor's idea is that the planes will not only serve to raise or drag up the machine in the manner roughly sketched, but when lowering it they will act after the fashion of a parachute.

## The Holmes-Allen Trolley Head.

Successful Tour of the Inventors in Australia.

In the course of a conversation with a Progress representative Mr. Garnet B. Holmes stated that negotiations are now proceeding for the purchase of the patent rights of the trolley head in the Commonwealth, and Mr. Allen has been in West Australia for some weeks superintending trials in several of the cities. The latest advice is that the tramway authorities of Kalgoorlie, Coolgardie, Perth and Fremantle are all watching with much interest a very extensive trial now under way in Perth, and should it prove successful, it is certain that this new type of trolley head will become universally adopted in that part of Australia. Trial heads have also been supplied to the Brisbane Tramway Company, and negotiations, it is hoped, will be completed very shortly. The heads are now running permanently on the Ballarat and Bendigo tramways, while the Essendon line will very shortly adopt them throughout.

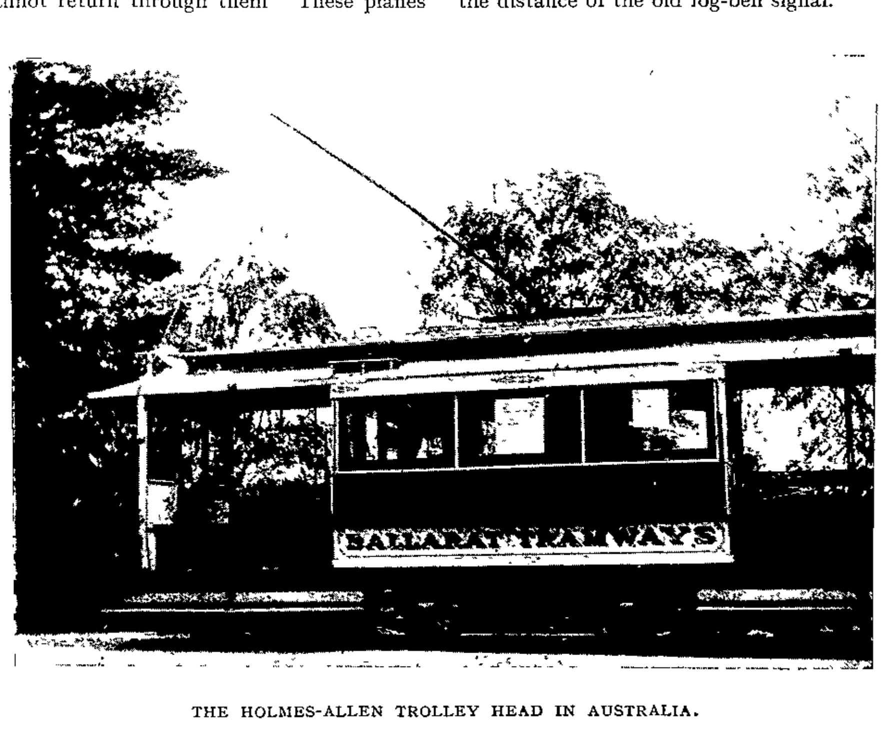
While in Australia the inventors discovered that, on sytems where the fixed trolley head had been running, they could with ease apply their swivelling and cushioning action in a much simpler manner. This had to be done with their complete swivelling trolley head, and they had to set to work and make fresh designs strictly in conformity with a request from the New South Wales Government, with a view to adoption on their system.

## The Ultramicroscope.

One of the latest scientific inventions, which is due to Professors Sledenlopf and Zsigmondy, of Vienna, is the ultramicroscope, an instrument which will enable scientists to examine even the minutest particles which are beyond the range of the most powerful ordinary microscopes. It is said that, with the aid of the new instrument, the five million globules contained in a cubic centimetre of human blood can be examined as if they were spread on a surface of eighteen square feet. It is even possible with the new instrument to see particles measuring the hundred-millionth of an inch in diameter.

## A New Fog Signal.

A new fog signal is installed at the Needles Light house, which takes the form of reed trumpets worked by compressed air, and can be started instantaneously when fog descends. The blast of five seconds' duration every fifteen seconds can be heard at treble the distance of the old fog-bell signal.




THE HOLMES-ALLEN TROLLEY HEAD IN AUSTRALIA.

# The New Zealand International Exhibition

1906—1907

## PAST EXHIBITIONS OF NEW ZEALAND.

In 1865 New Zealand made her first attempt at an international exhibition—Dunedin being the favoured locality. For so young a colony the event was considered highly creditable, there being 29,831 admissions during the 102 days it was open. We have to pass over fifteen years before we come to the next exhibition, the Industrial Exhibition in Christchurch in 1880. This was visited by 23,000 people, the profit from it amounting to £400. Two years later was held the Joubert-Twopeny Exhibition in the South Park, Christchurch, which was a private enterprise, organised by Messrs. Joubert and Twopeny. It was a much larger affair than the two previous exhibitions, and exhibits were sent from all over the world. The area under cover was 114,200 square feet, while that of our present International Exhibition is 500,000 square feet. The affair was a great success, 226,000 people paying for admission during the six months of its career. This was followed by the Industrial Exhibition at Wellington in 1885, which, though successful, resulted in a deficit of nearly £10,000. In 1887 another Industrial Exhibition was held at Christchurch, but it was not so successful financially as the first one, there being a small loss. Seven years later a third was held in the same place, and resulted in a profit of £2000.

The New Zealand and South Seas Exhibition, held in Dunedin in 1889, was much the largest affair the colony had seen. The exhibition was due to the energy of a number of Dunedin citizens, a company being formed with a capital of £10,000 to carry it through. The public subscribed readily, so readily that the directors speedily took steps to increase the capital to £15,000. The Government gave £10,000 and helped the affair in other ways. The building was erected in Crawford street, and covered about 9½ acres, the area of the whole exhibition being 13 acres. During the five months the exhibition was open it was visited by 625,000 people, or 18,000 in excess of the population of the colony then. The cost was £54,670, and there was a profit of £579. In 1898 a very successful Industrial and Mining Exhibition was opened in Auckland, which resulted in a profit of £2000, which was devoted to building a Chamber of Commerce. In 1900 another Industrial Exhibition was held in Christchurch. The exhibition which was held in the new Canterbury Hall buildings has been described as the best display of local manufactures ever held in the colony.

## THE EXHIBITION OF TO-DAY.

All past efforts, however, have been eclipsed by the magnificent international event of 1906, the 14½ acres of buildings being all too small for the merchandise and machinery which have been assembled from all parts to silently testify to the progress of New Zealand and the nations.

The floor space is about 500,000 square feet, of which about five-twelfths is taken up by corridors and avenues. The value of the exhibits, independently of the pictures, exceeds half a million sterling, and the pictures are valued at a quarter of a million.

The Premier, Sir Joseph Ward, in the course of his speech at the opening ceremony, said :—" When the last exhibition was held in Dunedin, the exports from this country amounted to £9,400,000. Last year they were £15,500,000. The imports at that time were £6,200,000 ; last year they were £12,800.000. The depositors in banks and savings banks have to-day £30,316,954 of their own money in this New Zealand of ours. The financial position of the Exhibition, briefly, is that already the colony has paid £73,000, and it may be reassuring to those of my brother members in Parliament when I tell them that I am informed upon the authority of the Chairman of the Executive Commissioners that the £64,000 which we voted during the session will not nearly all be required, so that there is every prospect of this great undertaking turning out more favourably than was originally anticipated."

## THE VISITORS.

The opening day was a notable event in the history of New Zealand. Over 37,000 visitors passed through the gates, and amongst this vast assemblage were the distinguished representatives of the over-sea countries exhibiting, together with the members of the Legislative Council and the House of Representatives, and the judges of the Supreme Court. So great has the attraction of the Exhibition proved that for the first week-ending upwards of 150,000 visitors passed through the turnstiles.

## THE EXHIBITS.

The merit of the exhibits is of a high order, and their range far exceeds in comprehensiveness that which ruled at any former exhibition in New Zealand. The seven-and-a-half miles of avenues are flanked with the products of our colonies and of foreign nations. Every care has been taken by the Exhibition authorities to provide ample lighting and good ventilation, and this, coupled with the general desire on the part of firms to show their exhibits to the best possible advantage, helps materially to make a tour of the Exhibition an educational, as well as a pleasurable, one.

The Machinery Hall, which forms the northern annex of the main building, contains, in addition to working and stationary machinery, numbers of exhibits connected with building construction and the allied trades. Here, also, the lighting and ventilation are perfect, and the visitor is enabled to examine the exhibits with a maximum amount of comfort. Conspicuous in this section are the many gas-producer plants, nearly all of which are working ; while the exhibit of the Railway Department includes two locomotives and four or five carriages, not to mention signal boxes, motor tricycles and railway apparatus generally. The motor cars, it might be said, take first place as regards pleasing and effective show. All kinds of machinery made in the colony are to be seen, and the representation in this respect serves to demonstrate the resources of New Zealand as a manufacturing country. It is no exaggeration to say that the Machinery Hall is an exhibition in itself.

The Agricultural Department have a quarter of an acre under cultivation outside the main building, and here nitrogen inoculation and other experiments are being carried on. The Department's exhibit in the main building is very embracive, as it shows in some form every subject treated in the interests of the New Zealand farmer.

The Education Department presents a very representative display of work from the various technical colleges and schools of art in the different centres. These displays are very tastefully arranged in different compartments, and comprise illustrations and models in connection with all the leading trades. Some very fine engineering and plumbing work is shown, and some excellent models of various parts of vehicles. Many of the designs for tiles and linoleums exhibit careful thought and study, and considerable technical ability. Particularly fine collections have been sent in by the Canterbury College School of Art and the Wellington Technical School. The Canterbury College School of Art exhibit is shown to better advantage than the Wellington exhibit, being better lighted and arranged. The beaten copper work reflects great credit both on students and instructors. A large portion of the work which would ordinarily come under this section is included in the section devoted to Home Industries, which is in the same gallery as the exhibit of the Education Department.

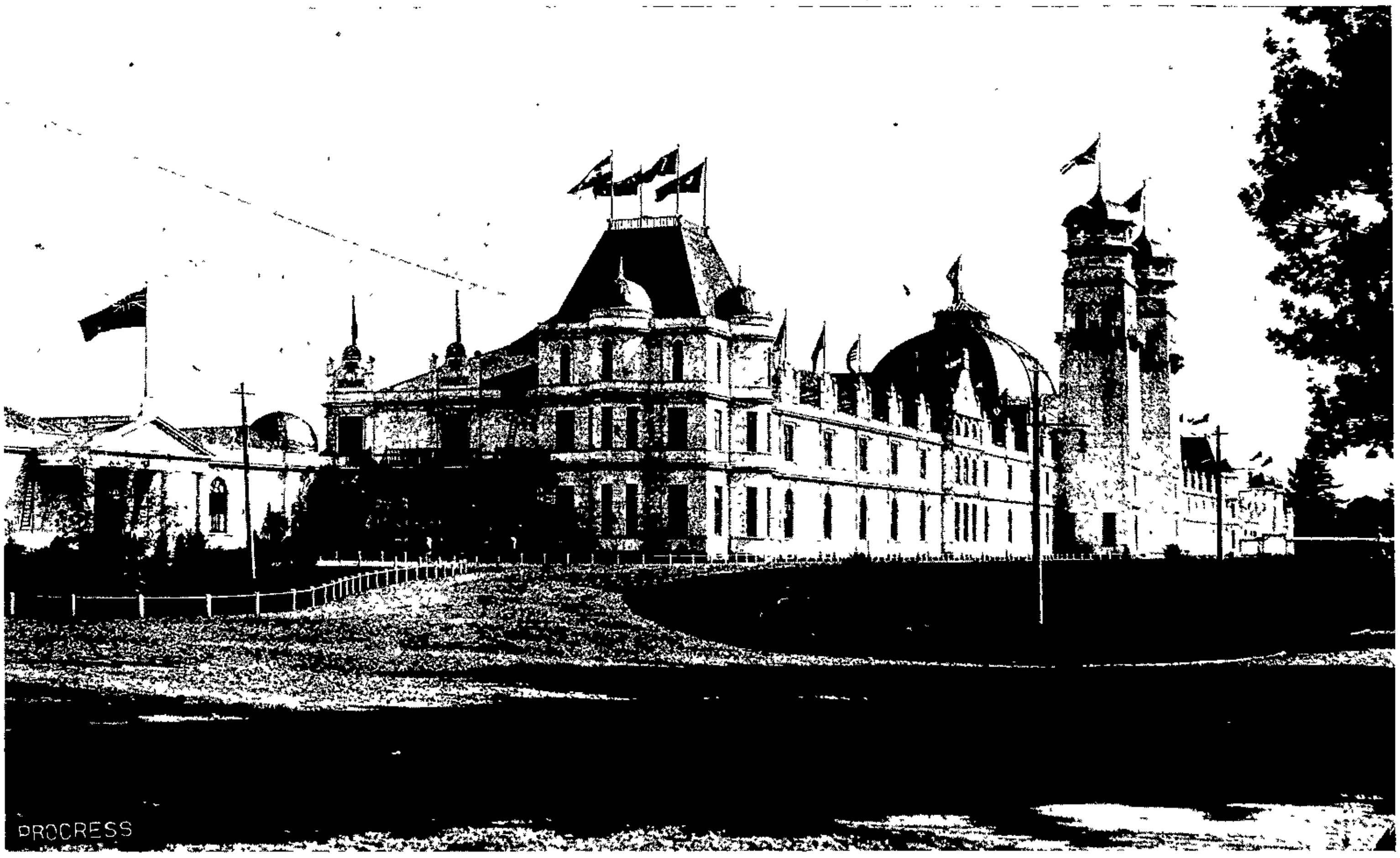
It is a good sign where healthy emulation is existent between the Government and private concerns in helping on the New Zealand International Exhibition to success, and the complete fruition of the most optimistic hopes, as the natural outcome of such emulation, is inevitable, for the people will come to New Zealand from afar, and they will not be disappointed, for the reason that the Exhibition is the largest, most complete and most interesting ever held under the Southern Cross.

## THE GREAT EXHIBITION OF 1851.

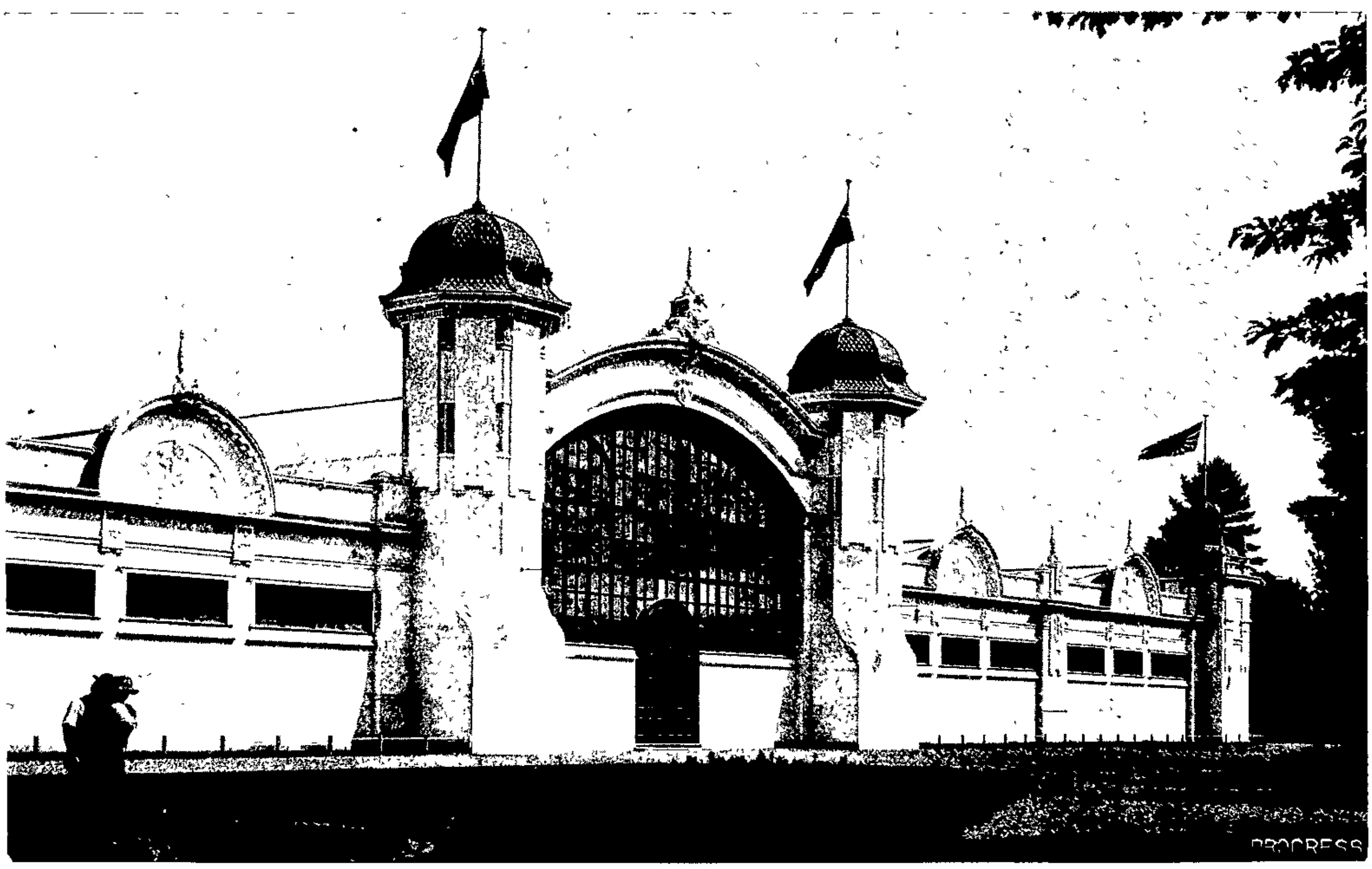
The illustrations of the first British international exhibition, which we print in this issue, tend to show the rapid strides which England had made amongst the nations half a century ago. This magnificent event, which has since become familiarly known as the "Great Exhibition," was really the outcome of a proposition made to the London Society of Arts by Prince Albert, who sketched the outline for a great exhibition of all nations, and proposed that such exhibition should be held in London in 1851.

In July, 1849, the prince, in the name of the society, applied to the government for the appointment of a Royal Commission to organise and manage such an exhibition. As a result of the agitation then set on foot, the Commission was appointed early in 1850, with the prince at its head ; and the exhibi-

# THE NEW ZEALAND INTERNATIONAL EXHIBITION.



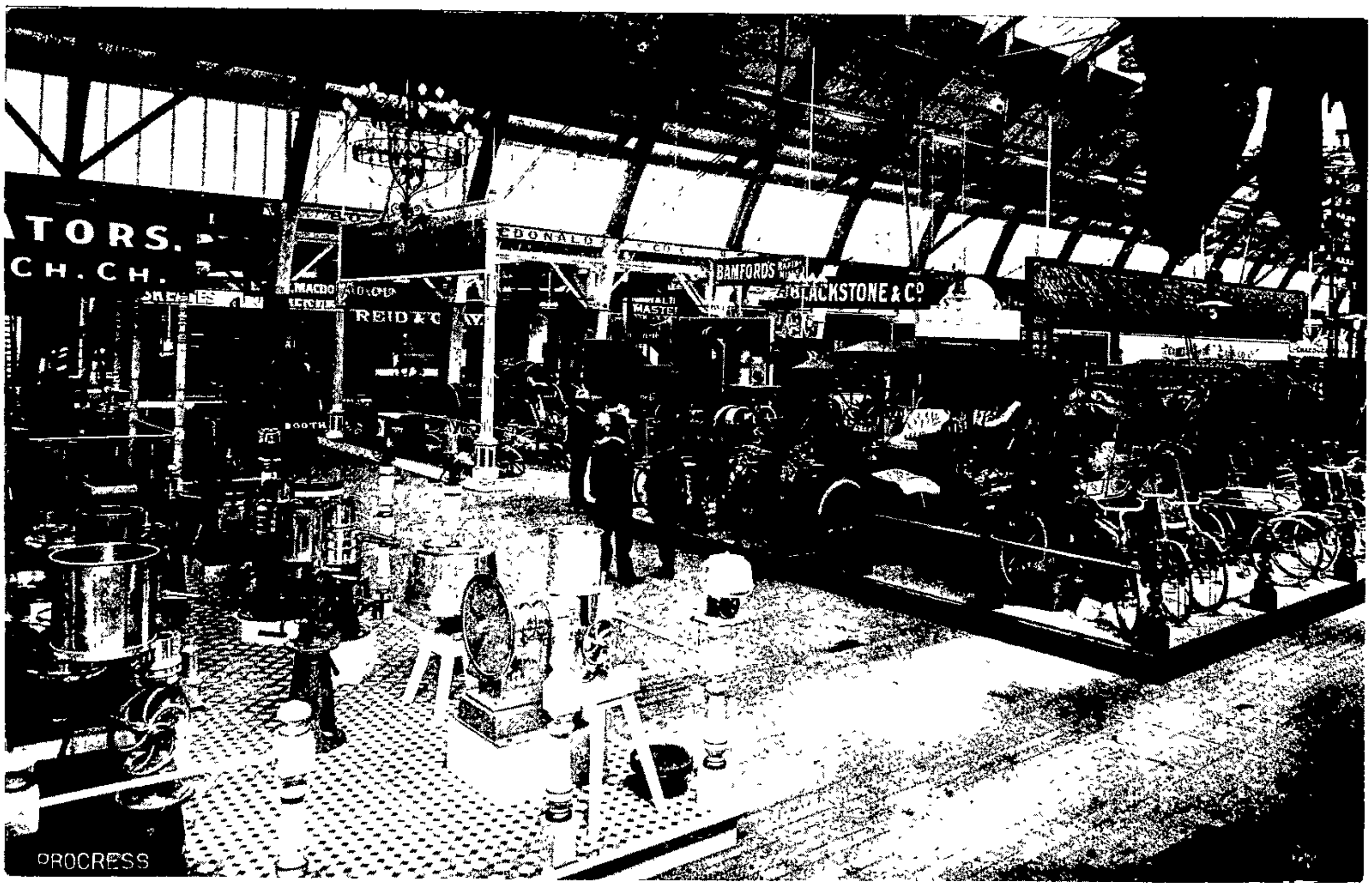

THE MAIN BUILDING FROM THE SOUTH. THIS HUGE STRUCTURE HAS A FRONTAGE OF A QUARTER-MILE.




THE MACHINERY HALL.

# THE NEW ZEALAND INTERNATIONAL EXHIBITION.


A GLIMPSE AT THE NORTH WING, MAIN BUILDING.




PART OF THE INTERIOR OF THE MACHINERY HALL.

tion was opened by the Queen, in Hyde Park, on May 1st, 1851. It was held in a vast structure of iron and glass planned by Sir Joseph Paxton, and called the Crystal Palace, which, as everyone knows, is now located at Sydenham. The building was 1851 feet long, by 408 wide, with an additional width of 48 feet for half the length; the highest portion was a centre transept 108 feet high; the area covered was 19 acres, equal to seven times that of St. Paul's. The exhibitors numbered nearly 16,000, about equally divided between British and foreign contributors. The cost of the structure was £170,000 (for use and waste, not for absolute ownership), which, in addition to the other expenses down to the close of the exhibition, made a total outlay of £292,795. The entire number of visitors was 6,039,195, averaging 41,938 per day. The total receipts from admission and other sources amounted to £505,107, leaving a surplus of £200,000.

## THEORY AND PRACTICE.

By Peter Ellis Wellington

How often the remark is heard "Yes, it sounds all right in theory, but it does not work out in practice", in such cases which is at fault? Certainly not practice, for as Sir Humphry Davy declared "one fact is worth a thousand theories" Now, there are "theories and—theories," as the French say, and if theory and practice fail to agree it is mainly because the theory is incorrect, and not that theory and practice are incompatible Theory and practice always agree when theory is sound; therefore, "practical" engineers should not despise theory because it sometimes fails to "show the reason why." It may seem peculiar, but sound theory is founded on fact, and it is a happy combination when practice and theory go hand-in-hand, and an engineer with a well-balanced mind commanding this combination is likely to be more successful than either the theorist or the practical engineer. Depend upon it, that when theory does not fit in with practice, it is not that theory, as theory, is of less value than practice, but because it has fallen short of its true value in that particular instance, or has been propounded on a false basis, since every fact must have its true theory somewhere, whether discovered and elaborated, or not. Probably the reasons why so few successful inventors spring from our colleges and so many come from practical men is that the practical man is in possession of ascertained facts based on his experience, which cannot be gainsaid; and whether these facts can be successfully theorised on or not, they are facts; and the practical man knows that if he bases his ideas on these solid facts he is on safe ground—hence the great value of actual experiment. Actual experiment may introduce important elements which theory may have overlooked or wrongly calculated; on the other hand, the inventor without theory, especially if his experience of facts is limited—and no man can experience all the facts in the engineering world—will have a hard row to hoe to bring his ideas to fruition. There is not the slightest doubt but that some theories are absolutely sound and consistent with solid facts, but since all progress is the result of evolution, theories must evolve, and some of the theories to-day must disappear and give place to others, as surely as the sun shines and that day follows night. Why are scientists so anxious to get to the North Pole? Why not be satisfied with their theory? Simply because they are in the habit, and properly so, of proving their theories by absolute fact, based on experiment or actual experience. Who would have divined the existence of electrical energy—now such a handmaid of our civilisation—apart from the experience, accidental or otherwise, of the effect of electricity on our senses? This is a self-evident fact, without a suspicion of theory. Theory has its place, but if we pin our faith wholly to it our progress will be slow and the practical experimentalist will distance us in the race of improvements, although he may wade through a maze of intricacies.



## THE IMMENSITY OF SPACE.

The first thing to realise about the stars is the immensity of the distances which separate them from one another. If we attempt to express such distances as those of the stars in ordinary units of measurement, we have to deal in numbers which are quite beyond any power of mental realisation. In order to get over this difficulty astronomers have introduced a new unit for the measurement of stellar distances. This is known as the light-year, or the distance which light, travelling at 186,000 miles per second, would traverse in a year. One very curious consequence follows from this way of measuring stellar distances. When we look at the star-strewn sky we are fathoming the depths, not merely of space, but of time. We do not see any star as it was when the light which affects our retina set out upon its journey. And, as almost all visible stars are set at very various distances from the earth, we see them all at different periods. If we look at the constellation of Orion, we see the bright star Bertelguex at the head of the constellation as it was 126 years ago, whilst Rigel at the foot is visible by light which must have started at least three centuries before it reaches us. Sirius, however, which "bickers" into red and emerald to the south-east of Orion, we see by light which only started eight or nine years ago. It is plausibly suggested that some of the faintest stars visible in our largest telescopes may be as much as 30,000 light-years away The new star which recently displayed itself in Perseus was shown by an ingenious train of reasoning to be 300 light-years distant, so that in 1902 we were able to watch the progress of a stellar conflagration which really occurred about the time of the Spanish Armada An ingenious French astronomer has based on this fact the pleasant phantasy in which he imagines that a disembodied spirit, able to move with the speed of thought, and endowed with supernatural powers of vision, may at will behold any incident which had ever taken place on the earth under an open sky by transporting itself through space to the point which the light waves emitted by that incident have reached in their endless journey. Such a being, placed at the distance of Canopus, might now be watching the massacre of St. Bartholomew, and by travelling thence in a straight line towards the earth it would be able to pass in panoramic view the whole subsequent course of the world's history. Of course, there would be considerable gaps, due to clouds, to the rotation of the earth, and to the fact that a great part of the earth's history has been conducted indoors But the general idea is perfectly sound The old superstition of the Recording Angel might be replaced by this modern discovery of light-waves which travel for ever out into boundless space with their story of human actions and sufferings.

The Hamburg-American liner "Kaiserin Auguste Victoria" has just made a record in giving notice of her whereabouts over 700 miles. Being due at Plymouth early on a Friday morning she was in communication with her port on Wednesday at mid-day The French liner "La Provence" lately was in communication with Poldhu and Cape Cod at the same time, being 1800 miles distant from England and 1700 from America.

## Britain's Seaborne Trade.

REMARKABLE RECORD OF COMMERCIAL POWER.

A remarkable statement of Britain's seaborne trade is contained in a Blue-book on "the Navigation and Shipping of the United Kingdom for the Year 1905" just issued.

The total number of vessels of all nationalities which entered at ports in the United Kingdom during the year was 66,840, with a tonnage of 35,623,974. The total of trade, entries and clearances amounted to 112,040,734 tons, as against 104,773,168 tons in 1903.

London naturally occupies first place with 10,814,115 tons entered Liverpool comes next with 7,806,844 tons, and Cardiff next with 4,337,720 tons. In 1903 Dover only entered 951,662 tons, whereas last year the total rose to 2,928,741.

The total number and tonnage of vessels belonging to the United Kingdom, which were actually in trade or in fishing, were 14,521 vessels and 10,397,761 tons. The number of persons employed numbered 263,686, as against 257,937 in 1903, and 259,489 in 1904 The numbers of British, foreigners, and lascars employed in these three years were as follows —

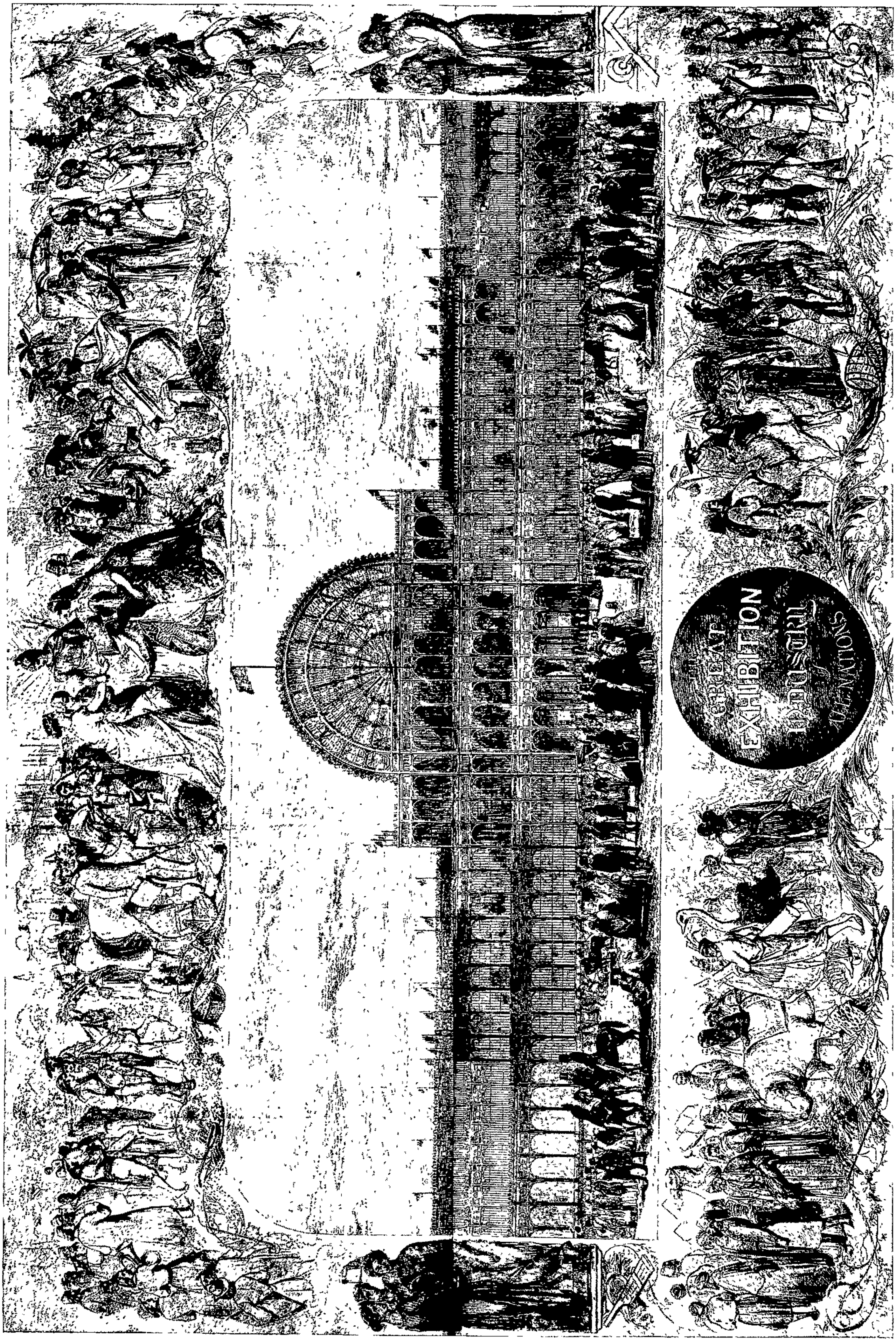
| | British | Foreigners | Lascars. |
|---|---|---|---|
| 1903 .. | 176,520 .. | 40,396 .. | 41,021 |
| 1904 .. | 176,975 .. | 39,832 .. | 42,682 |
| 1905 .. | 180,492 .. | 39,711 .. | 43,483 |

The total tonnage of vessels built (exclusive of vessels either for the Royal Navy or for foreigners) was 851,433 tons last year, compared with 629,069 in 1903 The tonnage of vessels built for foreigners was last year 197,015—234 vessels.

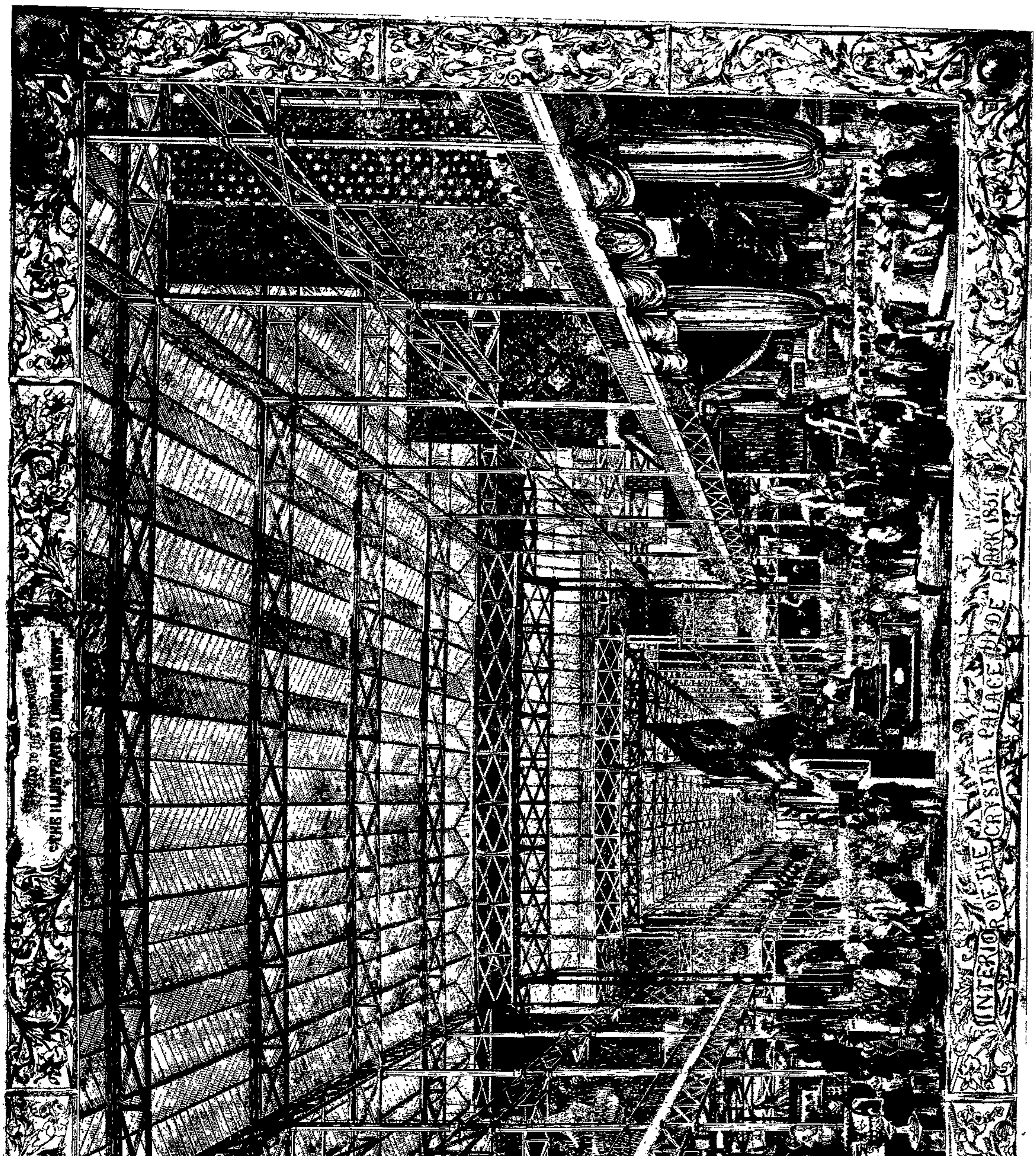

"PROGRESS" OFFICE AT THE NEW ZEALAND INTERNATIONAL EXHIBITION

## Large Hydro-Electric Power Plant.

One of the largest artificial storage reservoir hydro-electric power plants in the world is under construction on the river Sihl, in the Canton of Schwytz, Switzerland. A dam 90 ft high and 350 ft, long will impound the water in a lake with a surface area of two square miles The capacity of the reservoir will be 25,360,000,000 gallons. The generating plant will be upon the shore of Lake Zurich, and will be operated under a head of 1 575 ft It is estimated that a continuous supply for 20,000 h p. will be afforded, or for 45,000 h p, if operated only ten hours per day.




THE FIRST BRITISH EXHIBITION HELD AT THE CRYSTAL PALACE IN LONDON IN 1851.




THE INTERIOR OF THE FIRST BRITISH EXHIBITION, 1851.

# ..Legal..

CONTRIBUTED BY H. F. VON HAAST, M.A., LL.B.

## RECENT DECISIONS.

PATENT. COMBINATION. INFRINGEMENT. — A. and T. Burt, Ltd. are the assignees in Dunedin of the patent for a sky-light known as "Wade's Improved Iron Sky-light Frame." This patent, about which there has probably been more litigation than about any other in New Zealand, is for a combination metal sky-light frame, in which the glass is used without putty, and in which by means of a cap for preventing the water getting in and by means of wires as described in the specification for allowing water which might get in to get out again, the sky-light is rendered practically water-tight. There is no provision for carrying off water caused by condensation on the inner side of the glass. Messrs. J. and F. Christie, of Dunedin, manufactured and sold a metal sky-light frame, which was made water-tight by securing the glass with putty, in which the capping was on the top end and the two sides only to protect the putty from the sun, and which had channelling for carrying off water formed by condensation on the inside of the sky-light. Messrs A. and T. Burt, Ltd sued Messrs. J. and F Christie for infringement of Wade's patent. HELD by Cooper, J. that Wade's patent was a combination for improvements to bring about in an improved, simpler, and cheaper manner a result known before, that it fell within the doctrine of Curtis v. Platt viz, that where a combination only is claimed for improvements to bring about a given result well known before, the patentee must be held to the particular combination which he described, the doctrine of mechanical equivalents does not apply and there is, therefore, no infringement unless the particular combination be taken. HELD further that Christie & Co. had not taken Wade's combination, and that they were entitled to succeed on the authority of Curtis v. Platt, but that, even if the case did not fall within the rule established in Curtis v. Platt, there had been no infringement, as they had not by mechanical equivalents or otherwise taken the pith and marrow of Wade's patent. Their sky-light was a different sky-light, constructed on a different principle, and the object aimed at by them, viz., a water-tight sky-light, was obtained by the means (the use of putty) which it was the main object of Wade's invention to avoid. *A. and T. Burt, Ltd., v. J. and F. Christie. IX Gazette L.R.* 61.

SALE. AUTHORITY TO SELL. PRINCIPAL AND AGENT. OFFER AND ACCEPTANCE. Mr. John Taylor, after some correspondence with Ewing, King & Barry, a firm of estate agents, who wanted him to sell the Royal hotel, wrote on 21st October offering to sell the property for £6,100, stating :"I only give you this offer for 8 days." On 23rd October Mr. Baker, the prospective buyer, refused this offer and made a counter offer to buy for £6,000, which Mr. Taylor refused on 25th October. On 26th October Mr. Baker and Ewing, King & Barry, purporting to act as Taylor's agents, entered into an agreement for the sale of the Royal hotel by Taylor to Baker for £6,100. Mr. Taylor, having declined to sell, was sued by Mr. Baker for specific performance of the agreement. HELD that in order that a vendor of real estate may be bound by a contract entered into on his behalf by an agent who has been employed in and about the sale, it must be established that the agent was not merely employed to negotiate a sale, but that he had definite instructions to sell, that Messrs. Ewing, King & Barry had no authority to conclude a contract of sale, and that the sole extent of their agency, if any, was to make a definite offer to a definite person and that, on the rejection of this offer, their authority came to an end. The suit was therefore dismissed *Baker v. Taylor. VI N S W. State Reports* 500.

ACT OF BANKRUPTCY. SECURED CREDITOR TENDERED REPAYMENT.—The Union of London and Smith's Bank, Ltd made an advance on certain securities to Ponsford, Baker & Co members of the Stock Exchange, who subsequently were declared defaulters. The official assignee of the Stock Exchange thereupon proceeded to collect the firm's assets tendered the Bank the amount due on the securities and requested it to hand them over The Bank refused to do so on the ground that as the official assignee was assignee of all the firm's property, an act of bankruptcy had been committed within three months, of which the Bank had notice, and that therefore the Bank would not be protected. The official assignee and the firm sued the Bank. HELD by the Court of Appeal that a man who has committed an act of bankruptcy is not entitled to deal with his estate, has no right to gather it in if it is not already in hand, or to make payments to his creditors out of that which he has actually at his command, and can give no good discharge to a debtor who pays him with notice of the act of bankruptcy; that if such a payment by a debtor be made under an order of a Court the debtor obtains thereby a valid discharge, but the Court ought to direct the money to be kept in court until it is seen whether the plaintiff is entitled to it or the representative in bankruptcy of his estate. HELD, therefore, that the proper course was to direct the Bank to deliver up the securities to the official assignee upon payment by him of the amount due he undertaking to hold them until it was ascertained whether bankruptcy would supervene within the three months, otherwise the action would stand over until the period of three months had expired. The Bank was allowed its costs of the action and interest until actual repayment *Ponsford, Baker & Co. v. Union of London and Smith's Bank, Ltd.* 22 *Times L R.* 812.

LIBEL. LIABILITY OF PRINCIPAL FOR MALICE OF AGENT. TRADE UNION'S REPORT The Australasian Institute of Marine Engineers, a trade union, published in its report of its 7th conference, a resolution passed at the conference, containing allegations against Mr Hay, a former member of the Institute, which were untrue and defamatory. In an action for libel brought by Mr. Hay against the Institute, evidence was given that the secretary of the Institute, who handed the report to the members, knew that the allegations were untrue. The jury awarded Mr Hay £1,500 damages The occasion of the publication of the report was privileged, that is, an action for libel for anything contained in the report would not lie unless malice were proved on the part of the Institute or some person for whose action they were responsible This verdict was set aside on the ground that there was no evidence of express malice on the part of the Institute HELD (on appeal) by the High Court of Australia, that the knowledge of the secretary that the allegations were untrue could not be imputed to the Institute as that knowledge had not been communicated to the secretary for the purpose of being transmitted to his master the Institute, and further, that even if the secretary's knowledge could be imputed to the Institute, yet as it was not shown that the governing body did not believe that it was their duty to publish the report to the members, there was no evidence of malice and the Institute was not deprived of its protection of privilege. *Hay v. The Australasian Institute of Marine Engineers. 3 Commonwealth L.R.* 1002.

INSURANCE. RISK VERBALLY REFUSED BY ANOTHER OFFICE. MISSTATEMENT Mr. Critchley insured his furniture and effects for £200 with The Atlas Insurance co They were destroyed by fire He sued the Company for the amount insured for. To the question in the proposal form "Has the risk been offered to or refused by any other office ?" Critchley answered "No" Before effecting the insurance with the Atlas Company, Critchley had asked Mr. Callender, agent for the Yorkshire Fire Insurance Company, to take a line on his furniture for £100. Callender submitted the risk to the Yorkshire Company, it was declined by the manager, and Callender informed Critchley that the Company would not accept the insurance, as they already had enough on the building. HELD by Cooper, J. that the answer to the question in the proposal was a material misstatement, which avoided the insurance, and that the proposal or refusal need not be in writing. *Critchley v. The Atlas Insurance Company. IX Gazette L R* 7

BILL OF SALE. NON-REGISTRATION OF DEBENTURE OF FOREIGN COMPANY.—Section 2 of "The Chattels Transfer Act, 1889" exempts from the operation of the act "debentures and interest coupons issued by any company or other corporate body, and secured upon the capital stock or chattels of such company or other corporate body" HELD that a similar section in the Bills of Sale Act, in which the words "incorporated company" were used, applied only to local companies, and consequently that a debenture of a foreign corporation required registration. *The Transport, Trading and Agency Co. of W A , Ltd v Smith. VIII Western Australian L R* 33

FIRE INSURANCE AVOIDANCE IF UNTRUE STATEMENT MADE FALSE STATEMENT IN PROPOSAL FILLED IN BY AGENT. Mr Berechree insured buildings with The Phœnix Assurance Company, Ltd , through their local agent who gave a cover for fourteen days only, subject to the managers approval and sent the proposal on to the Company According to the policy an untrue statement in the proposal was to avoid the policy, and fraud or falsehood in the claim for loss under the policy was to work a forfeiture of all benefit thereunder. In the proposal which was filled up by the agent and in the notice of claim after the fire, Berechree's interest in the premises was falsely described to a material extent, such description having been inserted by the agent in the proposal after it had been signed by Berechree. In an action by Berechree against the Company the jury found that the false description in the claim was not wilfully and intentionally untrue, and that the local agent in falsifying the proposal was acting as the Company's agent. HELD by the High Court of Australia that the agent could not be considered as the Company's agent in filling in the answers in the proposal, that if the proposal as transmitted was affirmed by Berechree, the policy was vitiated by the falsity of one of the answers , if it was denied there was never any completed contract between the parties, and the plaintiff could at most recover back the premium in an action not founded on the policy. *The Phœnix Assurance Company v. Berechree. 3 Commonwealth L.R.* 946.

COMPANY. WINDING-UP CONTRIBUTORY COMPROMISE.—An arrangement was made between M'Lean Bros. and Rigg, Ltd , the executors of Silas Harding, a shareholder, and the administrator of his widow, to whom the Company was indebted, that Mrs. Harding's claims against the Company should be released in consideration of the Company handing over certain properties, releasing the estate of Silas Harding from all liability in respect of the uncalled liability on his shares in the Company, and registering a transfer of the shares from Harding's executors to one. Metzler. The transfer of the shares was sent to the Company, but never registered, although the agreement was acted on by both parties. The Company passed a resolution to wind up and appointing a liquidator, at a meeting at which there was not a quorum The liquidator made a call and sued in the name of the Company the executors of Silas Harding for £7,500, the amount of the call on his shares in the Company. HELD that the above arrangement was within the powers of the directors and of the Company, was for valuable consideration, and amounted in equity to a release HELD further that a section of the Companies Act validating the acts of directors, managers and liquidators *de facto*, "notwithstanding any defect that may be afterwards discovered in their appointments or qualifications," did not cover this case, where there had been no appointment at all, and therefore did not validate the call made by the liquidator Judgment was therefore given for defendant *M'Lean Bros and Rigg, Ltd , v. Grice. X Victorian L.R.* 610.

BANKER. FORGERY NEGLIGENCE OF CUSTOMER. ESTOPPEL.—The three directors of The Lewes Sanitary Steam Laundry Company (Limited) appointed the son of the chairman secretary of the Company. The chairman, but neither of the other directors, knew that his son had four years before forged his signature to a document, but since that time the son had lived an honest life. The directors allowed the secretary to have the custody of the Company's cheque book and bank pass-book, and did not require him to produce the cheque book for inspection at the directors' meetings The signatures of one director and the secretary were required to the Company's cheques. The secretary forged the signature of a director to a number of cheques purporting to be drawn on behalf of the Company, and obtained payment thereof from the Company's bankers. He not only escaped detection for long by his subtlety in forging the bank manager's signature and obtaining a duplicate pass-book, which he produced from time to time to the directors and from which he omitted all matters connected with the forged cheques, but actually won from the auditor an encomium on the excellence of his book-keeping When the forgeries were at last discovered the Bank claimed that the Company was estopped from asserting the invalidity of the forged cheques, by the directors' negligence (*a*) in appointing as secretary one whom the chairman knew to have committed forgery in the past, and (*b*) in giving him possession of the cheque book and not requiring its production for inspection and in not discovering the entries of the forged cheques in the bank pass-book The Company sued the Bank to recover the amount of the forged cheques HELD by Kennedy, J. that there is a duty on the part of a customer of a bank to be careful not to facilitate any fraud which when it has been perpetrated is seen to have, in fact, flowed in natural and uninterrupted sequence from the negligent act But in order to relieve the banker from the consequence of paying money on a forged cheque it is not enough for the banker to show that the conduct of his customer enabled him to pay money upon the forged cheque. It is not enough to show that the customer gave occasion for his so forging—that different conduct would have prevented the fraud and the payment by the banker. The carelessness of the customer, unconnected with the act itself, cannot be put forward by the banker as justifying his own default HELD further that the facts did not justify the defence of estoppel by negligence. Judgment for the Company. *Lewes Sanitary Steam Laundry Company (Limited) v. Barclay & Company (Limited)* 22 *Times. L R* 737.

# HYDRO-ELECTRIC DEVELOPMENT.

By Fredk. Black, A.M. Inst. E.E

*(Engineer, Waihi Water-Power Scheme)*

## PART II.

One of the most wide-spread views concerning hydro-electric power supply is that it must of necessity be cheap to the consumer, " because the water costs nothing." If a steam or gas-producer power station is installed to supply electricity, there is the monthly coal bill. How can any engineer justify the recommendation of a fuel-using plant if a water power is anywhere within transmission distance? The hold that this fallacy has upon many intelligent people is little short of marvellous. It is a product of the popularisation of an intricate and difficult engineering subject, which forcibly appeals to the imagination of the public mind by reason of the great results sought. It has always been an admirable thing for the progress of electrical engineering that the general public should have taken a keen interest in each notable step of its development—from telegraphy to lighting, from lighting to city-power supply and traction. Now public attention is directed to the electrification of great railway systems, and the transmission of power over wide areas of country. This interest has had a stimulating effect, both mentally and materially, thus giving to engineers higher imaginative power and the means with which to carry out big undertakings But whenever the public's ideas force the pace of development, disaster is certain to result This occurred in England in the early days of electric lighting, when the public demanded great undertakings all over the country, notwithstanding that the best technical opinion was adverse. The movement was years ahead of the times and of the state of electrical knowledge, and it ended in great failure, with much loss of capital, and a set-back to electrical development. The more alluring the possibilities, the greater is the risk of this experience being repeated, and I am satisfied, from personal discussion with numbers of business men in all parts of the colony, that there is a danger of hydro-electric development being seriously injured by the efforts of public opinion to employ it indiscriminately. Water does cost something It costs the whole of the capital charges upon the hydraulic works that harness it and make it available, it costs also the capital charges upon that proportion of the entire installation from turbines to selling end of transmission line—not infrequently 15 or 20 per cent. of the whole—that does nothing but supply the energy dissipated in the unavoidable transmission loss. These capital charges, if the transmission is a long one, or the harnessing of the water difficult and costly, or for both reasons together, may be so heavy that the energy, when it reaches the market, has cost three or four times the money that it could have been obtained for, if generated locally from coal.

Some months ago it was seriously suggested that the Huka Falls in the centre of the North Island should be harnessed and made to supply electricity to Auckland and Wellington. In an investigation that I was instructed to make of the proposal, the results of which have been published, I found that under the most favourable conditions—too favourable, in fact, to be obtained for several years to come—it would be impossible to deliver energy in Wellington in bulk for less than 6d. per horse-power hour. When retailed to the consumer the cost could not be much less than 8d. At the present moment the power user in the capital city, making his own energy from coal, often in a wretchedly uneconomical steam plant, does so for a total cost of rarely more than 3d., and if in a producer-gas plant, for 1d.! Why should Huka power be so costly? Because of the enormous cost of the water; in other words, because capital charges would have to be paid every year on the cost of harnessing works, generating plant for supplying the energy expended in overcoming transmission line resistance, the transmission line itself, and a large amount of transforming plant—all of which sources of expense would be non-existent in the case of a steam or gas-producer installation The figures are worth a little consideration

| | Capital Cost for 10,000 h p |
|---|---|
| Hydraulic works | £100,000 |
| Generating plant supplying transmission losses | 25 000 |
| Transmission line | 150,000 |
| Transformers | 35,000 |
| | £310,000 |
| Capital charges at 5 % per annum | £15,500 |

To this annual cost must be added depreciation and maintenance, items which together would certainly not be less than 8 per cent., that is, £24,800. Now we have the cost of the Huka water, viz., £40,300 per annum Forty thousand pounds would buy a big lot of coal. After going to all this expense the hydro-electric energy would be landed in a city where coal of good quality is sold for 20s per ton, and where even an obsolete form of steam driven electric station offers energy to all and sundry at less than 3d. delivered.

Quite recently the chief engineer of the Public Works Department, Mr. P. S. Hay, M.I.C.E., has condemned the Huka Falls proposition, not, however, on the grounds of the excessive annual cost, but because of lack of sufficient water to furnish energy to all the chief markets of the North Island. It is significant of his sentiments that whereas he states that " Waikaremoana is the only scheme which could be considered in connection with any proposal to serve all the North Island from one power station," he does not recommend the Government to develop that power in lieu of the abandoned Huka. Everything I have said about Huka applies with equal or even greater force to Waikaremoana, which, according to Mr. Hay's valuable and interesting report on the colony's water powers, is much the better power of the two. In a word, the position of both Huka and Waikaremoana, far remote from markets, is fatal to their value.

I have dealt with the case of the Huka Falls at this length because it is (or was) a specific proposition, and because also it forms a most effective illustration showing how enormous may be the cost of water to the owners of a hydro-electric transmission plant. The truth that this analysis drives home is that every hydro-electric scheme should be the subject of detailed investigation to ascertain the probable cost of the power it is to furnish by the time the consumer is reached, and that while such a scheme as the Huka one may be possibly the worst example of hydro-electric aberration in New Zealand, other propositions of lesser degree may be just as unsound commercially, because utterly incapable of meeting and overcoming competition from power derived from coal

The capital cost of hydro-electric development cannot be stated in figures of general application Obviously, hydraulic works will vary enormously according to the physical surroundings. About the only constant feature they possess is great magnitude and if anyone doubts this let him turn to Mr Hay's report, already referred to, or look up the articles describing undertakings constructed during the last few years that have appeared in the technical press. A point generally overlooked is that hydraulic works are not a liquid form of asset. They cannot be transplanted if the undertaking of which they form part—usually the most expensive part—is not a financial success. Here is another important reason for exhaustively examining the prospects of every scheme The cost of turbines or, in the case of high falls, Pelton wheels, varies to a considerable degree, depending upon the volume of water to be dealt with in securing a given horse power. The greater the fall, the more substantial and massive must be the conduit line bringing the water from the intake to the penstock. In the majority of cases, the hydraulic works must be constructed, from the first, to the full size necessary for utilising the ultimate amount of power that will be required, as it is often impossible to only partially harness a river, and always much more costly to construct conduits or tunnels one after the other, as needed, than to make one of full size at the start of operations. The cost of dynamos and transformers per kilowatt is less variable than the other items, while that of the transmission line per mile is full of uncertainty until the route is surveyed and a contract made for the purchase of the copper. Here, however, is the summary of an estimate recently worked out for an undertaking to supply light and power to a city, it being clearly understood that the hydraulic-works cost is peculiar to this scheme and is absolutely no criterion for any other The power house is situated 17 miles from the city boundary the installation has to be capable of delivering 3000 h.p. to the low tension city mains, and the transmission line crosses open settled country, free from flood and landslide risks The amount of fall is 35 feet.

| | |
|---|---|
| Hydraulic works | £46,000 |
| Turbines and dynamos (3600 h p capacity at turbine shafts) | 16,000 |
| Step-up transformers and switchgear (3450 h p capacity) | 6,000 |
| Transmission line (1 circuit of 3 wires, each 3/10" dia.) | 10,500 |
| Step down transformers and switchgear (3000 h.p. capacity) | 5,500 |
| | 84,000 |
| Buildings, engineering costs, and sundries | 7,000 |
| Total | £91,000 |

The two notable features in this are the low cost of the hydraulic works, due to natural suitability of the river, and the high cost of the transmission line, due to abnormal price of copper.

In calculating what will be the cost of energy delivered to the consumer, it is necessary to first estimate the likely demand and its average daily character. For an industrial market of the best kind, the demand will be comparatively steady for 10 to 12 hours daily in the summer months, and for 12 to 15 hours daily in winter, it being reasonable to assume that the great bulk of domestic and public lighting will be secured. A market of poor industrial character will rarely, if ever, justify a hydro-electric scheme, no matter how good the prospects of lighting may be, unless the hydraulic works can be of an extremely inexpensive character, and the transmission line a short one. A market comprised almost entirely of electric railway supply is happily not common, for it is about the worst and most expensive of any to handle, except in cases where a frequent service of cars is run, and in this event it should—as already explained—soon become a mixed market. The actual duration and extent of demand can usually only be forecasted by a detailed investigation, including a thorough canvass of the district or districts affected; and when this is done the personal equation still comes in, for experience, and what I can only term a trained intuition must be brought to bear upon the mathematical result. Having arrived at a conclusion, it is then comparatively a simple matter to divide the maximum supply capacity over a certain number of turbines and generators, and to fix the capacity of spare plant, it being of course necessary to include in the demand on the generators that amount of energy which is expended at time of full load in overcoming the resistance of the transmission line. The three great factors in determining the cost to the consumer are. First, ratio of normal load to maximum load in extent and duration, second, capital charges on the total cost of installation, and third, length of transmission line. The importance of the first and second factors I have endeavoured to explain; the third one is bound up with the other two as regards carrying capacity and cost, but calls for additional treatment on the score of absorption of energy. With any given size of line and given input of energy the greater the distance that energy is transmitted, the greater will be the transmission loss, and therefore the smaller the output. The loss is a loss of pressure (volts), not of quantity, just as water forced through a long length of pipe emerges with some loss of pressure (lbs. per sq. in.), but still the same quantity or number of gallons. No matter how great the pressure of input, some fraction must be absorbed in the line by forcing over it the quantity originally put in and ultimately taken out. It is commonly spoken of as " transmission loss," but it is only a loss in the sense that it is expended in doing necessary work. Within the practicable variations of pressure it increases with the distance of transmission, proportionately increasing the cost of energy output, until a commercial limit is reached when that energy becomes too dear to compete with coal. It is this factor, which in conjunction with capital charges, kills more hydro-electric schemes at their first investigation than any other.

A still further factor in determining the cost of supply is operating costs—wages, salaries, sundry materials, maintenance (including cost of patrolling line), and repairs. As a general rule, however, the influence of this item is small compared with the others mentioned, unlike the steam or gas power installation, where it is always a very material item. This being so, a detailed discussion of it may be omitted for the present, as being of more purely technical interest.

The question of what constitutes a good enough market to justify a hydro-electric installation is not easily answered, yet it is the alpha and omega of the whole subject. Occasionally, as in the recent Horahora proposition of the Waihi Gold Mining Company, the market is a definitely assured one, and thus the commercial practicability of the scheme can soon be determined. But the average scheme is for a general public supply, the extent of which has to be estimated. All the qualities that make for shrewd business management with an up-to-date resourceful policy will have to be employed yet these will fail if the market is incapable of being made sufficiently large and progressive enough to give a return on the capital invested. Industrial towns are nearly always essential, but if they possess supplies of cheap coal they will not constitute a market, unless the hydro-electric plant can be economically installed within close reach. In New Zealand every town which runs a freezing works or can lay claim to having in its neighbourhood a dozen or two flax mills or a few saw mills, and happens to be within a hundred miles of a water power, considers that it is entitled to the benefits of hydro-electric supply. The colony is not yet thickly populated enough to enable these small centres to exist in clusters. Unless, therefore, they


R. BUCHANAN AND SONS' IRON FOUNDRY, ST. ASAPH STREET, CHRISTCHURCH.

lie upon or very near the route of a transmission line supplying one of the larger cities, they do not form adequate markets. In parts of Switzerland, where there is a waterfall of some size or other in nearly everyone's back yard, demands of this character may often be met, but until towns in this colony acquire the habit of forming themselves on the lower slopes of alps, it would be preposterous to attempt it here. The nearest approach to this that we have at present is the case of certain mining towns, and as the power requirements of these are usually considerable, they at least offer a promising field for close examination. The hard fact has got to be faced that, with occasional exceptions, the only possible markets of any value for hydro-electric energy are the cities, and some sections of the railways, while, most unfortunately, the majority of the practicable water powers are many leagues from anywhere—and good coal is only 15s. to 25s. a ton in the heart of the market. To disregard this stubborn truth and expect power users to buy energy simply because it is hydro-electric energy, is foolish. Any glamour the water power may have will not last five seconds, if it turns a factory's monthly coal power bill from a sovereign into an electricity bill of a guinea, for the same output of wares. I do not hesitate to say that the only alternative to this, in many of the hydro-electric schemes now proposed, involving long transmission distances, is to sell the energy below cost price—very much below in most cases. If undertakings are to be run without becoming a direct burden on the general body of tax-payers (assuming there to be state ownership), long distance transmissions are inadmissable in New Zealand. A 200-mile proposition might just as well be a 200,000 mile one—to the moon. There would be about as much supply done from the one as from the other.

Finally, a word may be said as to the possibility of taking Mahomet to the mountain, when it costs too much to take the mountain to him. Can the market be taken to the water power? I see no possibility of doing so, but by the ordinary development of the country in population and industries. If the raw materials of manufacture can be obtained cheaply near the water power, and the cost of transport of the finished articles to their market is not excessive, the market may eventually go to the water power. It is a moral certainty that the manufacturing interests of the existing cities cannot be transplanted from the sea-board to far inland sites all in a hurry; I, for one, do not think they will ever be transplanted, though it is reasonable to suppose that in course of years, as the country becomes more and more developed, and coal perhaps becomes a little more expensive, and city expenses heavier, that industrial development will gravitate inland. When that day arrives, the Huka Falls and Waikaremoana may come into their glory—but it is not yet.

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While some people were dining at a Winchester (Eng.) hotel a salmon was put on the table and it was found to possess two distinct backbones joined at the tail.

## Manufacture of Malleable Iron.

Malleable iron is now principally made from charcoal pig iron, to which is added a percentage of scrap and sprue, culled work, gates, runners, and shrinkers resulting from previous casting operations being suitable. When coke pig iron can be found, which has been made out of a good quality of coke, it is also used.

There are two principal kinds of furnaces used, the cupola and the open hearth. The cupola is the cheapest and really the best of the lighter patterns, when a uniformly superior metal is not required. The open-hearth furnaces are much better for heavy work, and a much superior uniformity can be obtained by them. There are in the United States, says a writer in the *American Machinist*, only ten foundries which use the open-hearth furnaces. To run them economically they must be run continuously, and have a skilled workman to run the mixer well. By means of the open-hearth furnace the iron is not only melted, but refined. The usual limits of these furnaces are from 15 to 20 tons at a heat. They will run 300 heats without repairing, and 1,000 heats before rebuilding. Still the cupola iron does the majority of the business, though it is considered inferior and requires 200° F. more to anneal than the open-hearth iron.

There are two kinds of fuel in general use for the furnace: a hard, close-grained coal requiring a straight forced draught with an air pressure of about 4 to 5 ozs., or a Siemens-Martin furnace using fuel oil. Since sulphur is undesirable and is always contained, to some extent, in the hard coal, and not in the oil, it gives the oil an advantage. It is easier to regulate the oil burners, but the expense is slightly greater. The regulation is, too, a great advantage, for if the heat is run too high in the furnace it will burn the iron, especially if it is low in silicon. This does not show in the casting, but gives it a high tensile strength without elongation. This is due to the interior arrangement of the molecules.

After the castings have been chipped and sorted they are packed in iron annealing pots holding about 800 lbs. of iron. The are packed into these pots together with a packing of clean, heavy forge scales. Great care must be taken in the packing in order to avoid distortion during annealing, and the pots must be packed full. A sprinkling of powdered quicklime, sal-ammoniac, muriatic acid or any oxidising agent is then put on to the packing to assist in the annealing, and also in dumping the pots afterwards. The fuel used in annealing is in most cases coal. However, many of the modern foundries use oil or gas burners. These latter are generally considered better, not so much on account of expense, but because they are cleaner and permit better regulation. Good iron can easily be spoiled in the annealing ovens unless the greatest heat is brought out at just the right time. This is very hard to do with coal ovens, and requires a great deal of experience. An experienced man can tell whether the heat is right or not by the colour of the inside of the oven. The time necessary for annealing varies with the mixture of the iron more than with the size of the castings, and is from three to ten days, including the time necessary to cool the pots. In the first thirty-six hours the oven is brought up to the maximum heat of about 1,250° or, better, 1,350° F. At this temperature it is kept for two days, when it is allowed to cool slowly until it reaches a black heat, at which time the pots are taken from the oven. In the space above the pots in the oven the temperature runs some 200° above the values given. After annealing, the castings are sometimes dipped into asphaltum diluted with benzine, to give them a better finish. The cost of annealing is 1/- per lb. in a 30-lb. oven with two oil burners. Using coal as a fuel the cost is somewhat less.

After the castings have been annealed they are unpacked, collected, and taken either to the tumblers or the sand blast. The tumblers are the cheapest method of cleaning, but the sand blast has come into use, as it is much quicker. When cleaned, the castings are ready for shipment, and may be drop-forged or even welded when the iron has been made for that purpose.

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A tram car equipped with roller bearings has been running in Hanover without special attention for six months. The bearings have shown no perceptible wear, and tests indicate an economy in power of 23 per cent., while the actual saving includes the usual cost of oiling and attendance.


INTERIOR OF R. BUCHANAN AND SONS' IRON FOUNDRY, CHRISTCHURCH.

## WHEN LIFE OR DEATH HANGS ON A BLOOD STAIN.

HOW SCIENCE SOMETIMES SERVES THE ENDS OF JUSTICE.

BY WILLIAM FRANKLIN WATSON,
*Expert in Microscopy, Furman University, Greenville, U.S.A.*

IN cases of murder, stains supposed to be blood are sometimes found on the clothing or belongings of suspected persons. In doubtful cases of this kind, the fate of the defendant usually depends, not so much on judge, jury, or eloquent lawyers, as on the observations of a man who, quietly seated in his laboratory, is compelling with his microscope the invisible to become visible.

When the prisoner claims that certain dark red stains on his clothing were caused by spatters of red paint, the judge and jury and the lawyers cannot prove or deny the statement. They may say: "It looks like blood." But what do value resemblances amount to, since, in so many of the affairs of life "things are not what they seem?"

A human life hangs in the balance. It must neither be sacrificed by vague suspicions, nor saved if the suspect is guilty. The man with a microscope and a laboratory is the only person who can settle the question, and he can settle it beyond the shadow of a doubt. He dissolves a particle of the stain in a drop of liquid, then spreads a minute fraction of this drop on a little slip of glass three inches long and an inch wide. Next he examines it with the microscope. If he sees a great host of little red discs, such as appear highly magnified, he knows that the stain was made by blood.

But suppose the stain is old and has been exposed to the weather for weeks or months. It has become greatly changed. It can be dissolved only with difficulty; and the little blood discs, if present, may be shrivelled, distorted, and broken up, until it is impossible to determine whether they are real blood discs or particles of something else. When the blood has reached this state, it is impossible to use any chemical which will restore the discs to their original condition. Consequently, it is frequently impossible to identify old blood by means of its discs. In such cases the investigator takes a particle of the stain on a glass slip, and dissolves it in strong acetic acid, adds a minute portion of common salt, and heats it with extreme care. Great skill is here required in order to heat just sufficiently and not too much. The glass slip is then examined with the microscope; and if a great number of stick-like, X-shaped (and occasionally stellate) crystals appear, the stain is known to be blood. These are called "Teichmann's crystals" (from the discoverer). They are regarded by experts as yielding evidence which is absolutely conclusive. They can be produced by no known substance except blood.

Another important method for the detection of blood is that of spectrum analysis, which depends on its optical characters and requires more complicated apparatus than the other processes.

The fourth test which may be applied to blood is strictly chemical. A small portion of the suspected substance is put on clean, white paper, and is moistened with tincture of guaiacum. A drop of hydrogen peroxide is next added, when, if the substance tested is blood, the paper will turn to a beautiful blue colour. A particle of blood which is scarcely visible to the naked eye may be detected in this way.

The human blood discs are very small. It would take 3,200 of them placed side by side in a row, to measure one inch in length Though very minute, they are so numerous that a volume of blood not larger than the head of a pin is believed to contain five millions of them. In fact, they are present in the blood in such vast numbers that some scientists have made the astonishing statement that if all the blood discs which are in one person were arranged side by side in a continuous line, that line would be long enough to reach four times around the earth

Without discussing the differences between blood from the veins and that from the arteries, and the differences in colour as affected by the different substances on which it falls and dries it may be noted that in general, when blood stains are fresh, their colour is scarlet and they dissolve readily in water. As the stains get older they become darker, first changing to reddish brown and later to dark brown. They also become less and less soluble in water Finally they become entirely insoluble in water, and chemicals must be used for their solution. From these facts it will be seen that the analyst can, under favourable conditions, determine the age of blood stains. He cannot be exact in his conclusions, it is true, but he can say whether the stain is a few days old, a few weeks old, or a year old.

By the examination of a blood-spattered surface, one does not need to be a Sherlock Holmes to determine pretty accurately the direction of fall of the drops and the distance from which they came.

An important question arises After determining that the stain is blood, can the investigator decide whether it is human blood or the blood of a beast? In deciding this question, he must rely entirely on the microscope. All chemical tests give exactly the same results, whether the blood is that of a man, a bird, or a reptile. Many suggestions for differentiation along this line have been made, which, however, would not stand the test of practical experiment in the laboratory, many fine theories have been advanced, only to be overthrown. So it must be acknowledged that up to the present time it has been found impossible by any other process or instrument to distinguish human blood stains from those of other animals. But under favourable conditions, when the blood is fresh, the microscope will give results which are satisfactory and reliable. The blood discs of birds and reptiles are oval and nucleated, while human blood discs are circular and have no nucleus. The blood of pigeons and frogs may be taken as types of blood of birds and reptiles. Therefore, if a man who is arrested for murder claims that certain stains on his clothing were caused by killing a chicken, a reptile, or a fish, the microscopist can easily determine the truth or falsity of the statement.

The camel and llama have oval blood discs like those of birds and reptiles; but all other higher animals classed as mammals have circular blood-discs closely resembling those of human blood. In fact, the resemblance is so close that the only way of determining the difference is by measuring the discs. For this purpose, exceedingly delicate instruments are used in connection with the microscope. The blood of sheep, goats, horses, and cattle has discs which are considerably smaller than those of human blood. But monkeys, dogs, rabbits, and guinea pigs have blood discs so nearly like those of man that it appears doubtful if it is possible for any scientist to decide positively between them.

It has also been found impossible to distinguish the blood of a man from that of a woman or child, or the blood of any one person from that of another under any ordinary circumstances. Notwithstanding the limitations mentioned, the specialist has in very many cases, rendered eminent service in the identification and conviction of criminals.

## Britain's Growing Trade.

TINNED MEAT IMPORTS DROP MORE FRUIT EATERS.

The Board of Trade returns issued show further enormous increases in Britain's oversea trade. As compared with the same month last year, imports were greater in value by £3,867,836 and exports by £5,621,911.

The imports for the whole of last year showed an increase of £14,240,774; for the seven months of this year the increase is £31,299,367. Exports last year increased £29,312,427, but this year they have already increased £30,509,206. The following table gives the values of trade —

| | July 1906. | July, 1905. | Increase. |
|---|---|---|---|
| Imports— | | | |
| | £48,609,674 .. | £44,741,838 .. | £3,867,836 |
| Exports— | | | |
| | £33 442,962 .. | £27,821,051 .. | £5,621,911 |
| | Seven months. 1906. | Seven months 1905 | Increase. |
| Imports— | | | |
| | £349,146,766 .. | £317,847,399 .. | £31,299,367 |
| Exports— | | | |
| | £214,036,478 .. | £183,527,272 .. | £30,509,206 |

The imports of tinned meat show a decrease during July of 2,687 cwt representing a value of £18,975.

Britons are daily becoming more fruitarian apparently In July they took £29 088 of apples, as against £24 589 at the same time last year; £236 265 worth of bananas, compared with £185,941; £63,569 worth of cherries, as against £61,340; £116 735 worth of raw currants, as against £76,663; £10,549 worth of raw gooseberries, as against £3 712; and £48 946, worth of raw pears as against £22,813. Strawberry imports were four times as great—£12 672, as against £2,975 in 1905.

## CHIMNEY v. MECHANICAL DRAFT.

A chimney with natural draft will have a draft dependent upon its height, the power of which will not vary, except upon the rise or fall of the internal temperature. It has, therefore, no sucking power, in fact, the term suction in this connection is a fallacy. The chimney acts because the external air is heavier than the internal, and thus presses into the chimney by the only available opening, viz., that at the bottom, the furnace front. The pressure or intensity of the draft fixes the amount of fuel it is possible to burn on a given area of grate. It therefore becomes necessary, when it is desired to increase the steaming capacity of a boiler by increasing its coal consumption, to increase the intensity of the draft, and the only way in chimney draft is to increase the temperature of the gases passing up it, or increase the height of the chimney. The first method, of course, means a large amount of waste, and is a very uneconomical arrangement; the second is expensive and unusual. A chimney stack 150 ft. high will burn from 15 lb. to 20 lb. of coal per sq. ft. of grate area per hour under normal conditions, but in wet or foggy weather it will be very much less than this, as the wet air is lighter than the dry, and thus produces less pressure at the furnace (the weight of water vapour is about half that of air). A fair average of temperature in the furnace is 2,400° F., and that of the escaping gases at the chimney, without economisers, 600° F. This means that one-quarter of the total heat generated is sent up the chimney to waste. Thus, on a 2,000 h p. plant, almost 500 h.p. is going up the chimney per hour, and the coal bill necessary to sustain this will come to a big figure in the year.

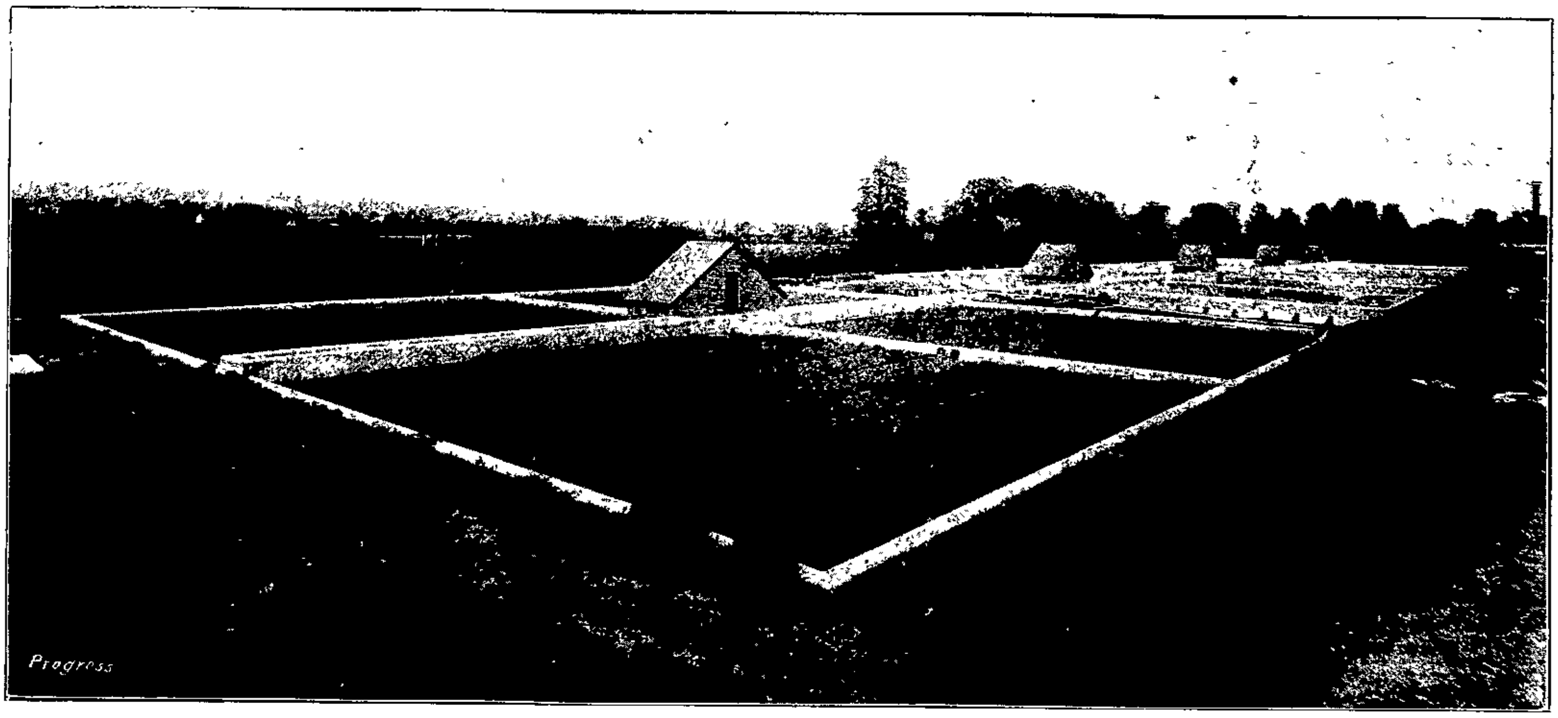
It is not the author's contention, but it has become a well ascertained fact, that it is cheaper and better in every way to provide the necessary supply of air for burning fuel in steam boilers by mechanical means, and to take as much heat out of the hot gases after they have ceased to be in contact with the boiler itself, before they are turned out into the atmosphere, than to do it in the older way by utilising a portion of the heat generated to create the necessary supply of air. This is the primary reason for using a mechanical means of moving the air. The heat previously necessary to create the draft by means of a chimney may now be employed usefully in other directions—*The Engineering Review* (*London*)

## Still Believes the Earth is Flat.

The hopelessness of convincing every living being of the truth of any proposition, remarks *Building & Contracting News* is again illustrated by what one, Aurin F. Hill, of Boston, says about an item that appeared in a recent issue of the *Springfield* (Mass.) *Republican*, to the effect that Springfield is 65.8 feet above sea level. Mr. Hill says regarding this "Springfield is about 100 miles from Boston. Is this grade at Springfield correct? If the earth were a globe 8,000 miles in diameter, Springfield ought to be about 6,666 above or below Boston. Is it? Can our engineers survey a level and straight line—a horizontal line—from Boston to Springfield? I think they can. I think they did it; and by their works prove that this earth is a plane and stands fast. They prove by their works that water is level—straight on its surface. Consider the curvature on a globe 8,000 miles in diameter at the centre circle; also at what we call 42 degrees north latitude, going east or west. We are on a plane that stands fast."

It will be news to engineers that a level line is a straight line, and if by considering the curvature of the earth, Springfield is found to be something over 6,000 ft. above Boston, then in the same way we should find that Boston was about 6,000 feet above Springfield, which discovery we imagine would be somewhat confusing. The dictum to the effect that "this earth is a plane and stands fast," when uttered by a man who exhibits so much and such comprehensive ignorance of the elementary principles of levelling, does not amount to very much.

In the past six months the use of the steam turbine has increased from 65,000 h p. to more than 2,000,000 h p on land, and from 25,000 h p to 800,000 h p at sea On land the chief applications of the turbine were in large electrical generating stations The chief items of saving resulting from the use of turbines as compared with reciprocating engines were reductions of 25 to 40 per cent. in the total capital cost of steam, from 10 to 30 per cent in the cost of fuel from $\frac{1}{4}$ to $\frac{1}{8}$ in the consumption of oil, and from 25 to 30 per cent in the engine-room staff.




SEPTIC TANK FOR 20,000 PEOPLE INSTALLED AT SCONE, N.B.

## MARINE FISHES.

By EDGAR R. WAITE
(Curator, Christchurch Museum).

OF the animals composing the fauna of any given area it is perhaps safe to say that the birds are known first and known best. They are conspicuous, their haunts are more or less accessible, and they are readily procured. A knowledge of the mammals and reptiles is obtained later, but in a comparatively short time nearly all are known. These animals, for the most part, live on the land, breathe the same air as we do, and are thus brought into close contact with ourselves.

In regard to fishes matters are very different: we can only to a limited degree become personally acquainted with them. They are, without exception, inhabitants of water and a knowledge of the marine forms is acquired very slowly. Naturally the Littoral, or shore, fishes, those which live on the threshold of the land, are the earliest discovered, and, indeed, beyond these a knowledge of the fishes is scarcely extended by the community as a whole. In addition to the shore fishes two other divisions are usually recognised, namely, the Pelagic, or surface, forms, and the Bassalian, or deep sea, fishes.

The Shore, or stay-at-home, fishes exhibit the greatest peculiarity of form, colour and habit, and afford the best examples of geographical environment. This is what one would naturally expect, and it is parallelled in ourselves. People who do not travel develop peculiarities of speech and manner, and are recognisable as from certain districts and such evidences, once developed, are never wholly obliterated in the individual. One can, therefore, in a similar manner identify many shore fishes as coming from certain localities; they have adapted themselves during the course of many generations to their environment, and such specialisation has unfitted them for life under different conditions.

Not only may shore fishes be confined to certain geographical districts, but they may be extremely restricted even within those limits.

The Pelagic fishes are the ocean wanderers, whose geographical range is determined mainly by differences of temperature. If we find a species on, say, the western side of a land area only, it does not follow that the conditions on the eastern side are unsuited for it, but, rather, that the land extends, north and south, beyond the limits in which the species can exist.

Many degrees of tolerance of temperature, however, exist, so that whereas a certain genus, or even species, may occur in the open sea between certain land barriers either north or south of the equator, others are cosmopolitan.

As these Pelagic fishes do not encounter diverse conditions, the open ocean being similar, temperature apart, the world over, we find them formed on much the same type and without those extreme modifications so numerous in shore fishes; they are the typical forms and, generally speaking, approximate to the mackerel in shape.

There are, however, many notable exceptions. The sucker fish has assumed a lazy life, and has therefore lost the faculty of prolonged rapid motion. Instead of using its own fins it attaches itself to other fishes, notably sharks, and is carried about by them. Some small fishes shelter themselves beneath the bells of jelly fishes, and with these animals are wafted about by wind and wave.

The Bassalian, or deep sea, fishes are, like the Pelagic ones, of wide distribution. The term Bassalian is applied to those forms which live below the depths to which light can penetrate. They therefore dwell in absolute darkness and, not needing eyes, many of them have lost the faculty of sight. Others are provided with luminous organs, or lanterns, and in order to catch the faintest ray of light, have gone to the opposite extreme and developed eyes of great size.

The range of deep sea fishes is to be measured by vertical depth rather than geographical area. The pressure of the water increases so rapidly as the depths are attained that the particular zone to which a certain type may have accommodated itself is very limited vertically. Fishes hauled to the surface from the depths expand so greatly, owing to the withdrawal of outside pressure, that they are usually forced out of natural shape, their eyes, when present, generally protrude from their sockets, while their stomachs are driven out of the mouth.

While the Littoral and Pelagic fishes may be more or less generally known, the Bassalian fishes are obtained chiefly as the result of scientific research; and it is only in comparatively recent years that the presence of fish life at the greatest depths has been demonstrated.

Some day the deep waters off New Zealand will receive attention equal to that now bestowed upon the Mediterranean and the deep seas of Europe and America, and though one cannot hope to have such research undertaken in the near future, there is no reason why a small beginning should not be made at once, when investigations might be carried on to, say, the 200-fathom line. The results to be obtained would, without doubt, be great, and nothing tends to bring a country to the fore so much as active evidence of scientific enquiry and diligent research.

## Heaviest Passenger Engine.

What is said to be the heaviest passenger engine ever built has been delivered to the Lake Shore and Michigan Southern Railroad. It weighs 244,700 lbs., of which 170,000 lbs. are on the driving wheels. The engine and tender weigh 403,700 lbs., and the capacity for water is 7,800 gals., while that for coal is 15 tons. This powerful locomotive was designed as a step in the development of large passenger locomotives on the Lake Shore Road, which began about seven years ago, as a result of which this road has a series of successful designs. The Walschaerts gear has been generally adopted because of favourable experience in both freight and passenger service. The new locomotive is entirely free from untried devices or principles.

Think naught a trifle, though it small appear,
Small sands the mountain moments make the year,
And trifles, life.—*Edward Young.*

## Tying Down the Desert.

Over 150,000 acres of sand dunes in France, once blown about by the wind until they overwhelmed great stretches of fertile ground and even threatened to bury whole towns, are now covered with forests of pine, which produce turpentine, lumber, and charcoal.

A new apparatus for the determination of the mechanical equivalent of heat was recently described by Herr H. Rubens in a German paper. A brass tube, 60 centimetres long and $4\frac{1}{2}$ centimetres in diameter, closed at the end by insulating caps, through which project inwards the bulbs of two thermometers, is firmly fixed coaxially within a slightly larger highly polished and nickel-plated brass cylinder with closed ends, which can be turned into a vertical plane about a horizontal axis through its middle point. The inner tube contains a cylindrical mass lead, weighing over 4 kilos., of but slighty less diameter, and of nearly half its volume; the remainder of the tube being filled with machine oil. Observation windows are provided so that the behaviour of the lead weight can be noted. The tube is quickly turned from its vertical position to another, halt is made for the short period needed for the weight to fall to the bottom of the tube, and the procedure is repeated, the rate of about ten turns a minute being possible. With this instrument the author has found $J = 424.8$ as a mean of ten observations with an average variation of 1 per cent. from the mean.

## Progress for January.

*The January issue of* PROGRESS *will contain the following specially contributed articles :—*

**ASTRONOMY OF TO-DAY**
*By* SIR ROBERT STOUT, K.C.M.G.

**WIRELESS TELEGRAPHY**
*By* CAPT. LOUIS E. WALKER, *Representative of the Marconi Company.*

**THE CAUSES OF SPONTANEOUS COMBUSTION**
*By* PROFESSOR EASTERFIELD, *Victoria College, Wellington.*

**DEVELOPMENT OF THE MARINE STEAM TURBINE**
*By the* HON. C. A. PARSONS *and* R. J. WALKER.

**THE TRANSMUTATION OF METALS**
*By* PROFESSOR ROBT. A. MILLIKAN, PH.D.

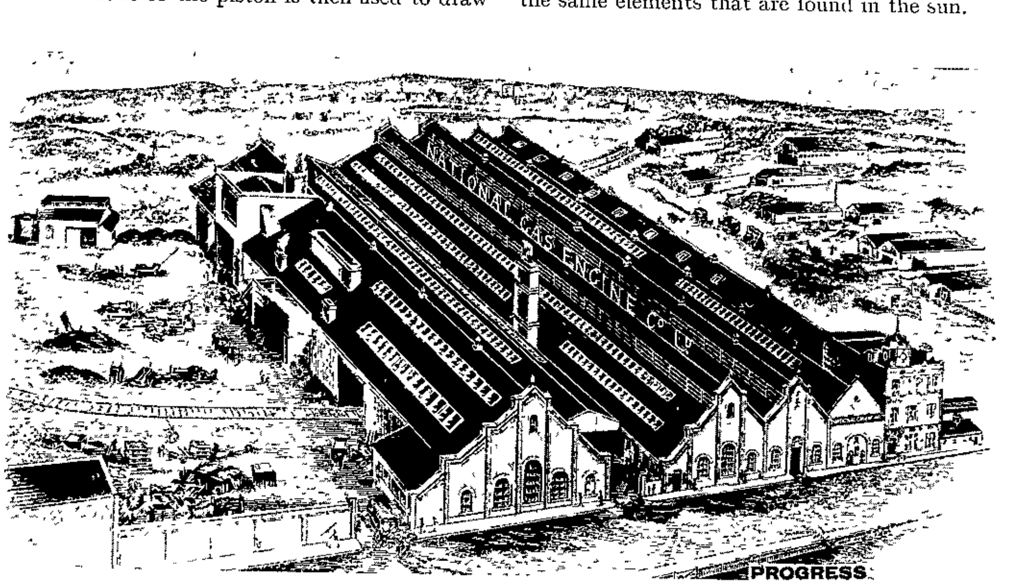
**THE FINGER-PRINT SYSTEM**
**For the Identification of Criminals.**
*By* WM G FITZGERALD, *Author of Travel and Exploration in Central Australia.*

## NATIONAL GAS ENGINES.

One of the most important engineering developments of recent years has undoubtedly been the introduction of suction producer-gas plant, which, owing to its increased economy in working, is creating what may be described as practically a revolution in gas-engine driving. Realising the future of the producer, the National Gas Engine Company have devoted considerable attention to its improvement, and their plant is at present amongst the best in the market. The great advantage of the suction producer over the older form lies in its very low first cost, the absence of a gas-holder, the ease of starting, and the long period of time during which the producer can run without any attention whatever. The cheap gas of the older pressure producer was not obtained without considerable attention to the plant; and consequently the power at which pressure plants began to be applied ranged much higher than those at which suction plants apply. It was rather unusual to associate pressure plants with any gas engine below 50 h.p.; whereas now engines of 30 h.p. and lower are often operated by suction gas. Where larger powers are required, suction plant presents many advantages over the pressure type; and the increase of power and dimensions is steadily proceeding. Suction plants are now made by the Company as low as 10 and as high as 300 h.p., and will soon be constructed to practically any power, in suitable units. The plant can be used in combination with a gas engine connected directly with it. The suction caused by the outstroke of the piston is then used to draw air through the fire in the gas generator, but the plant will work equally well if the air is supplied by a fan or blower. The gas is made by passing a mixture of superheated steam and air through incandescent fuel in the generator, the fire being made with small anthracite peas, or small clean coke. In special cases other fuel can be used. There is no external fire, and the gas is made as quickly as it can be consumed. An important feature of this plant is that it has been designed on the heat regenerative principle. All the air used for producing the gas is heated by waste heat from the body of the gas generator. The superheated steam required for making the gas is likewise produced by waste heat. The fuel which is to be converted into gas is also heated by waste heat before it reaches the combustion zone. Throughout the apparatus the loss of heat is therefore reduced to a minimum, and the efficiency is exceptionally high. When an engine works the suction plant, the engine itself governs the rate of gas production to suit its varying consumption. No surplus gas can then be made and as there is a partial vacuum in all parts of the plant, and in the piping while the engine is working, there cannot be any escape or waste of gas. The special feature of the "National" producer, which the Company claim gives it a marked advantage over suction producers, lies in the regulation of the water supply. This we learnt, is their own patent, and is applied only to the "National" engines. A large portion of the tools now running in the Wellington Works is driven by means of these producers. A 70 horse-power engine, driving the machinery in one of the large bays, is running under suction plant with gas produced at the rate of 2d. per 1,000 cubic feet. This is, of course, of a much lower quality than the ordinary town gas, but a careful computation has shown that with the suction plant, gas can be made for 7d. which will induce the same power as the town's gas at 2s. 4d. per 1,000 feet. It is estimated that when made the quantity of gas equivalent to 1,000 cubic feet of the ordinary town supply costs from 70 to 75 per cent. less than ordinary town gas at 2s 6d per 1,000 cubic feet, including fuel, labour, and repairs. The result is still more striking when the town gas is dearer. With any engine of good make, suitably adjusted to work with suction plant, the consumption of small anthracite is about 1 lb, and of suitable coke about $1\frac{1}{4}$ lb per b h.p. hour.

No visitor to the Wellington Works can fail to be struck with the extreme order and cleanliness which exist in every department, and the evident effort on the part of the management to provide every possible comfort and convenience for their employees. In the grounds outside the works a spacious dining hall has been built for the sole use of the workpeople. Each man is provided with a numbered can to hold his tea or coffee, and any victuals which he may wish cooked. This, on entering the works, he places on his numbered seat, and on the dinner bell sounding all he has to do is to go to his place, and there he finds whatever he has left, cooked, and ready for consumption. About 300 workmen have their meals here every day. Lavatories and all conveniences are provided; the hall is heated by gas, and there are also comfortable fires.—*Implement and Machinery Review.*

Professor Dewar states that the new chemistry has shown beyond question that we have on earth the same elements that are found in the sun.




WORKS OF THE NATIONAL GAS ENGINE CO., ASHTON-UNDER-LYNE, ENGLAND

## Electric Light v. Gas: A Struggle.

It cannot be disputed successfully, the *Times* points out, that the improvement of the incandescent gas mantle puts electric lighting, from the standpoint of economy at any rate, in a secondary position. The comparative cheapness and efficiency of gas, used in that form of lighting, was chiefly demonstrated by its employment in public thoroughfares where the electric arc lamp was displaced for its more inexpensive rival. It now seems that the electric light will again come uppermost, and as regards cost, will be less. We are within view of an incandescent electric lamp more economical than the incandescent gas mantle under the most favourable circumstances. The "long flame" electric arc lamp is to demolish gas competition in the future.

## A New Alloy.

According to the *Iron Age* two parts of aluminium and one part of zinc form an alloy to which the name of "Algene" has been given. The strength of this alloy is equal to good cast iron, and is superior to it so far as the elastic limit is concerned. It does not easily oxidise, and takes a fine polish. It melts at a low red-heat, and becomes very fluid, and it will then fill small places. While melting it great care must be exercised particularly when mixing the two metals. The alloy is not suited for articles which require the toughness possessed by bars, but there are many purposes for which it can be used with advantage. It has a tensile strength of about 22,000 lbs per sq. in., and its specific gravity is 3 3

## FORCE AND POWER.

If we may judge by the articles which from time to time appear in the motor columns of the non-technical press, it is evident that the prevailing ideas regarding the meaning of the terms force, energy and power, are by no means exact. It is more than likely that many motorists are sufficiently interested in these matters as applied to automobiles to justify a short discussion thereon, with a view to eliminating any uncertainties that may exist in their minds.

In one of these pseudo-technical articles it was stated that the prime object of the change-speed gear of a modern car is to render it more powerful on the hills at the expense of its velocity, and that more power is required to start the vehicle from rest than to maintain it in motion on its top gear. To further illustrate these remarks, the case of a locomotive starting from rest with a heavy train is referred to as analogous, since the locomotive is said to develop more power when starting than when maintaining a velocity of sixty miles an hour on the level.

It is, in the first place, incorrect that the locomotive develops its maximum power when starting up with a heavy load. From indicator diagrams taken from the cylinders of locomotives, it is found that the maximum indicated horse power is obtained when travelling at sixty or seventy miles an hour with a heavy train in the rear, notwithstanding the fact that the engine is greatly assisted by the kinetic energy of the whole train, which at high speeds is considerable.

The actual power developed at starting (even with maximum boiler pressure and cut-off in the cylinders at seventy-five per cent. of the stroke) is less than half that which is obtained when travelling at full speed, owing to the fact that the locomotive is not geared down, the same ratio between engine and wheels obtaining at all speeds. The fact to be noted is that the horizontal force or pull exerted by the engine on the train is about three times as great at the period of starting as when running at full speed.

Before going further, it would be well to define, in as few words as possible, the exact meaning of the terms force, power, etc. Force, considered dynamically, is usually defined as that which changes or tends to change the state of rest or motion of any body. It is measured in pounds weight by engineers. Work is done when a force moves through space in the direction in which it acts. Work done is therefore the product of two factors—force in pounds weight and distance in feet—and is measured in foot pounds.

Power is the rate at which work is done, and is measured by the amount of work an agent is capable of doing in unit time.

The horse power, being the unit of power, is the rate of working of 33,000 foot pounds in one minute. Thus, if 33 pounds are lifted through a vertical height of 1,000 feet in one minute, one horse power is developed.

Energy is the capacity of an agent for doing work in virtue of its mass and the square of its velocity. It is therefore measured in foot pounds, being the product of half the mass of the body and its velocity in feet per second squared. This form of energy is kinetic.

It is quite evident, therefore, that the terms force and power are quite distinct, and they should never be confused. Force is a single measurable quantity, whereas power is a rate, and always involves time. The measure of a force remains the same whether it does its work quickly or not.

It would clearly be impossible for the locomotive to develop its 1,000 h.p. during the first twenty yards of its journey, since its pistons are moving comparatively slowly though the pressure behind them is probably greater than at any other period. The tractive force or horizontal pull on the draw-bar of the engine is at its maximum because the total load on the pistons in steam pressure is at a maximum, but this force is not performing its work fast enough to register maximum power.

In the case of a modern express locomotive, this tractive force when starting will measure about ten, or even twelve, tons, which will fall to about three tons when a speed of sixty miles an hour on the level is obtained, owing to the cut-off in the cylinders taking place at twenty per cent. of the stroke.

Further, it should be mentioned that the total horse power that would be necessary to propel a train weighing 300 tons at sixty miles an hour on the level is something over 1,500. With modern express locomotives, it is rare for more than 1,000 h p to be available. The deficit is made up by the kinetic energy stored in the whole train, which, as before stated, is its capacity for overcoming resistance, or doing work by virtue of its mass and velocity.

# Applications for Patents.

THE following list of applications for Patents, filed in New Zealand during the month ending 15th November, has been specially prepared for PROGRESS.

21914—A. Morris, Green Island Waterproof dubbing.
21915—W. C. Southgate. Dunedin Tarring and sanding streets.
21916—H. Bostock and J. A. Peck, Sydney, N.S.W., Lock nut.
21917—P. Rabbidge, Sydney, N.S W. Electric generator.
21918—R. A. Bradbury, Christchurch Hat.
21919—Morgan & Co., Dannevirke. Galvanised iron roof.
21920—J. E. Crowle, Ballarat Victoria Lifting-jack.
21921—E. Old, Dingee, Victoria Clamping device.
21922—D. Robertson, Wellington Message or letter form.
21923—J. Taylor, Inglewood Harrow.
21924—J. T. Reece, Sunbury, Victoria. Frames for tents, etc.
21925—C. H. Thorby, Halcombe Screw-driving machines.
21926—T. E. Pettinger, Darlinghurst, N.S.W., and C. G. Merkley, Sydney, N.S.W. Differential hoisting-pulley.
21927—W. J. and E. S. Henry, Christchurch: Music-book holder or cover.
21928—P. Whelan, Orbost, Victoria Shovel, spade, etc.
21929—A. J. Reid, Sydney, N.S.W Railway, etc., brake.
21930—F. Blanckensee, G. McMullen, and F Mosey, Perth, W.A.: Gravity-fed arc lamp.
21931—A. H. Krause, Auckland Preservatives for plants.
21932—J. Stitt, D. B. Hood, and A. T. Blair Greymouth: Discharging railway trucks
21933—R. D. Adams, F. G. Semb, and L. C Knight, Christchurch: Magnetic toy
21934—F. C. Thompson and A. Fraser, Christ church: Lifting venetian blinds
21935—W. Tyree, Nelson. Spray.
21936—C. Burns, Sydney, N.S.W: Ship's propeller.
21937—W. G. Barger, Melbourne, Victoria Disc plough.
21938—A. Hare, Auckland: Operating gas valves, etc.
21939—R. O. Clark, Hobsonville Draught-increaser for fire grates.
21940—J. and A. Burfoot, Auckland: Pneumatic Wheel.
21941—W. M. Norrie, Auckland Potato peeler
21942—E. Seagar, Wellington Antimony-cruding furnace.
21943—W. Hinson, Sydney, N.S.W.: Liquid-sprayer.
21944—J. C. Vincent and J. Upritchard, Greytown Deepening and straightening rivers.
21945—C. M. Cruickshank, Timaru Night-soil pan.
21946—L. Rismuller, New York, U.S.A. Drying, grinding, and screening apparatus.
21947—T. H. Gillman, Hawera. Jointing timber.
21948—W. A. Strachan, Rakaia Turnip cutter.
21949—E. A. Barnes, Stawell, Victoria Perforating cheques, etc.
21950—W. Tyree, Nelson Building-block.
21951—H. Ashworth, Wadestown Destination indicator for trams, etc.
21952—G. H. Hunter, Wellington Butter box
21953—J. Pomeroy, Invercargill Paper file.
21954—E. M. Tomlinson, Petersfield, England Railway hand-signalling lantern
21955—W. Rundle and T E Lund, Johannesburg, S.A. Nut lock.
21956—The de Forest Wireless Telegraph Syndicate, Limited, London, England Signalling by electro-magnetic waves.
21957—J. H. Hickman and J. Whitelaw, Wellington: Show case
21958—J. H. Hickman and J. Whitelaw, Wellngton: Motor-car dust and wind shield.
21959—J. H. Hickman and J. Whitelaw, Wellington. Window or show-case bar
21960—A. D. Sloane, Wellington Toy and advertising device.
21961—B. Dudley, Waddington. Book cover.
21962—J. W. Marriott, Bairnsdale, Victoria. Burrow-fumigating apparatus.
21963—W. Curtis, Remuera Hurdle
21964—E. H. Kirkby, Sydney, N. S.W. Electric temperature alarm.
21965—W. Tattersall, Launceston Tas.; Hames
21966—J. E. Crowle, Ballarat, Victoria Stove, furnace, etc.
21967—S. V Rowe, Sydney, N S W Fly catcher.
21968—A J. Bond, Auckland Garden roller
21969—J. B Leydon, Gisborne Vehicle seat.
21970—F Arenas and J Ross, Christchurch Fire alarm or temperature indicator.
21971—A. Cattlin, Akaroa. Rolling-pin.
21972—F H Jackson, New Plymouth. Garden hoe.
21973—J. C. Pearson, Auckland Hair pin.
21974—R. C. Burke, Timaru. Fire-reel attachment to cycle.
21975—H. G. Kettle, Dunedin: Teat-cup of milking-machine.
21976—La Compagnie Francaise des Produits Fixator, Paris, France Stoppering bottles, etc.
21977—F. S. Y Ximenez, Chicago, U.S A. Raising sunken vessels
21978—A. Adair, Johannesburg, S.A Cyanide treatment of ores.
21979—H. Hill and J. Blain, Dunedin Mitre box and cramp.
21980—D. B. Hood and A. T Blair, Greymouth Induced draught.
21981—J. B. Hunter, Eparaima Harrow
21982—F. S. Greer, Wallandool, N S.W. Fume-delivering apparatus.
21983—T. H. Mapp, Surrey Hills, N.S.W. Hydraulic press
21984—W and A Ross, Foxton Twine-reeling machine.
21985—D. J. Kelly, Salt Lake City, U S A.: Slime filtering apparatus
21986—J F. Nicolaus Wellington Vehicle shaft props.
21987—C. W. Peach, Palmerstone N Hinge.
21988—J A. Belk, Feilding Window.
21989—G. H. Longdin, Christchurch Fastening lids of hampers, etc.
21990—A. J. M. Chapple, Cobar, N S.W. Pipe coupling.
21991—Rheinisch-Nassauische Bergwerks-Hutten-Actien-Gesellschatt, Germany Production of zinc from ores.
21992—C. E. Wright, Walsall, England Saddle tree.
21993—D E. Radclyffe, Staines, England Machinery to decorticate fibres
21994—C Miller, Nelson Producing optical illusions on post etc. cards
21995—J. A. McGeoch, Melbourne, Victoria Suction air power.
21996—J A McGeoch, Melbourne, Victoria Force air power.
21997—J. A McGeoch, Melbourne, Victoria. Transmitting and distributing air.
21998—T. Grace, C. A. Jaques & A J. Metcalfe, Sydney, N S W. Sheep shearing machine
21999—V. A de Perini, Rio de Janeiro, Brazil Production of textile fibre and paper pulp
22000—G Oliver and A J. Peasley Yarra. Valve, for flushing cistern.
22001—J Baird, Waikino, N Z Elevating sand liquid
22002—J. Baxter Window
22003—J Bambrick, Rotorua Tapping cock
22004—T. I Yourelle and J. Bellingham, Wellington. Utilising water pipes in building construction
22005—J. Stevenson, Christchurch Plough.
22006—C A Reinkowsky, Mathoura, N S W Bridle
22007—J Jamison, Dunedin Window-fastener and anti-rattler
22008—H. K. Wilkinson and F. W. Barton, Dunedin: Milk can.
22009—H J Ward, Melbourne, Victoria Illusion apparatus.
22010—W Sim Underwood, Invercargill Milking-machine
22011—A. H. and D J Byron, Wellington Steel-framing for buildings
22012—E W. Thurgar, Auckland Detaching tongue of buckle from strap
22013—J Macalister, Invercargill Disc scarifier for ridger
22014—A L Kemp, Karamea Construction of wharf
22015—A E Stonex and P. C White Auckland: Potato, etc., spraying machine
22016—W R Eade, Orawia Disc coulter
22017—W. Brown, Invercargill Earth scoop
22018—E Powick, Weka Weka Indicating and marking time in music
22019—C. Suggate and W E Cayley-Alexander, Auckland: Ore furnace.
22020—A Lyell, Wellington: Non-refillable bottle
22021—R R Gray, Pukeuri Weed eradicator
22022—R Cosslett, Bristol, Eng. Steam cooker.
22023—W. H. Trengrove, Wellington Tyre protector for motor car, etc
22024—G. T. Wilson, Stratford, and H. Downs Railway fish plate
22025—W. S. Harkness, Toorak, Victoria. Stamp affixer.
22026—T. Walsh, Eketahuna: Roundabout.
22027—J. G. McMillan, Toorak, Vic.: Cream cooler.
22028—G. Farquhar and R. North England: Hermetically sealing receptacles for food.
22029—W. Jamieson, Grays, England, and R. Burn, London, England. Hooping casks, barrels, etc.
22030—B. Baron, London, England: Pressing leaf tobacco.
22031—B Baron, London, England: Cutting cake or leaf tobacco.
22032—C. A Parsons, Newcastle-on-Tyne, Engl.: Turbine and rotary compressor.
22033—R. H. White, Wellington: Internal-combustion engine.
22034—A T. W. Allan, Thames: Gas burner.
22035—T B. Lockley, Goulburn, N.S.W.: Carpenter's vice.
22036—H. Spencer, New Plymouth: Destroying noxious weeds and plants.
22037—T. H. Hansen, Wellington: Pneumatic tyre and wheels therefor.
22038—F. McLaughlin, Wellington. Push-cart.
22039—W. Morrison, Waverley, N.S.W.: Rubber heel.
22040—B. Boehm, R. Entz, and A. J. Rost, Sydney, N S W.: Manufacturing wire netting.
22041—E. W. Thurlow, Northcote, Vic.. Golf ball.
22042—J. Budge, Sydney, N.S.W.: Cream cooler.
22043—D. H. Clarkson, Auckland, and P. C. Gould, Aratapu: Oil feeder.
22044—J. D. Leach, Dargaville. Table, etc., legs.
22045—C Colpus, Wellington: Picture-frame clamp.
22046—L. Roberts, Timaru. Pattern chart.
22047—L. Roberts, Timaru: Pattern chart.
22048—C. M. Stewart, Wellington: Dress chart.
22049—F. T Boys, Napier Fencing-standard.
22050—E H and E. V Featon, Gisborne: Burglar alarm.
22051—T. A. Dudley, Auckland: Incandescent gas lamp.
22052—Aktiebolaget Separator, Stockholm, Sweden: Feed device for centrifugal separator.
22053—Aktiebolaget Separator, Stockholm, Sweden: Centrifugal machines.
22054—N. R. Gordon, Melbourne, Victoria: Non-refillable bottle.

Full particulars and copies of the drawings and specifications in connection with the above applications, which have been completed and accepted, can be obtained from Baldwin & Rayward, Patent Attorneys, Wellington, Auckland, Christchurch, Dunedin etc

## Ireland's Longest Viaduct.

The new railway between Rosslare Harbour and Waterford, which was formally opened by the Lord-Lieutenant of Ireland on July 21, has the longest viaduct in Ireland, the new bridge across the River Barrow before its junction with the Suir being 2,131 feet between the faces of the abutments.

It consists of thirteen fixed spans, with a swing span over the river, giving a clear passage of eighty feet at each side of the centre dolphin. The swing span is worked by powerful oil engines on the central dolphin, and in fair weather it can be opened and closed in two minutes. In this opening span alone there are 230½ tons of steel.

## Legal—A Recent Decision.

CONTRACT. FRAUDULENT CONCEALMENT OF MATERIAL FACT.—Scott, Fell & Co. contracted with Mr. Lloyd to buy from him 5,000 tons of Abermain coal which had been then purchased by him from the Abermain Colliery Company, Ltd., and which he was to deliver to Scott, Fell & Co., as agreed upon. In an action by Scott, Fell & Co. against Lloyd for failure to deliver the coal, he alleged that before the contract Scott, Fell & Co. knew that the Abermain Coal Co. had agreements with certain persons not to supply coal for shipment to South Australia to any one but such persons, but concealed such knowledge from him and also the fact that Scott, Fell & Co intended to ship the coal to be purchased from him to South Australia, that Scott, Fell & Co. asked him to direct the Abermain Coal Co. to deliver to Scott, Fell & Co. the said coal for shipment to South Australia, and the Abermain Coal Co. refused to do so. HELD that Scott Fell & Co. were guilty of fraudulent concealment, and Mr. Lloyd was entitled to rescind the contract. *Scott, Fell & Co. v Lloyd VI N.S.W. State Reports* 447.

According to the returns just issued there was an increase of £16,000,000 in Canada's foreign trade during the last fiscal year, and of this increase £8,000,000 was with Great Britain.

## NEW ZEALAND TRADE RETURNS.

COMPARATIVE TABLE OF SOME PRINCIPAL IMPORTS.

| | 1905 | 1904 | 1903 | 1902 |
|---|---|---|---|---|
| Arms and ammunition | £54,512 | £55,374 | £57,246 | £57,672 |
| Copper and brass | 33,184 | 33,946 | 34,541 | 27,264 |
| Manufactures of same | 18,723 | 22,501 | 11,920 | 9,845 |
| Cordage, iron and steel | 26,474 | 20,940 | 25,939 | 25,640 |
| Cutlery | 38,595 | 37,797 | 27,160 | 29,993 |
| Hardware | 267,175 | 288,881 | 305,898 | 283,303 |
| Iron—Bar, bolt and rod | 129,166 | 127,524 | 119,672 | 118,032 |
| Galvanised sheet | 267,289 | 275,929 | 251,940 | 265,464 |
| Pipes | 100,881 | 119,154 | 117,434 | 113,363 |
| Sheet and plate | 40,765 | 58,922 | 59,972 | 50,369 |
| Pig | 26,443 | 43,699 | 34,735 | 29,462 |
| Wire and netting | 191,793 | 158,767 | 140,715 | 188,749 |
| Ironmongery, saddlers | 19,951 | 22,164 | 24,402 | 21,104 |
| Iron and steel, other forms of | 38,439 | 42,529 | 46,369 | 41,041 |
| Lead and leadware | 28,416 | 26,860 | 28,260 | 25,602 |
| Machinery and machines | 696,974 | 816,832 | 663,268 | 584,887 |
| Machines (sewing) | 36,008 | 53,055 | 51,095 | 37,005 |
| Nails and tacks | 48,013 | 44,923 | 43,416 | 48,149 |
| Silver plate and plated ware | 72,149 | 72,570 | 56,395 | 47,263 |
| Tinplates | 43,683 | 38,675 | 40,523 | 52,185 |
| Tools and implements | 165,560 | 165,901 | 149,752 | 142,073 |
| Zinc—Sheet and spelter | 20,342 | 17,771 | 15,680 | 15,346 |
| Other | 173,612 | 188,925 | 162,798 | 153,893 |
| Totals | £2,538,147 | £2,733 639 | £2,469,130 | £2,367,704 |

## Paper from Cotton Stalks.

The manufacture of paper from the fibre of the cotton stalk is one of the latest inventions and which is said to have passed the experimental stage. It is asserted that all grades of paper, from the best form of linen to the lowest grade, can be manufactured from cotton stalks. In addition to this, a variety of by-products, such as alcohol, nitrogen, material for gun cotton and smokeless powder can also be secured in paying quantities. Mills for the use of cotton stalks in that way may become general in the cotton-growing states of America. It is estimated that on an area of land producing a bale of cotton at least one ton of stalks can be gathered. Upon this basis, from 10,000,000 to 12,000,000 tons of raw material could be secured for the production of paper, which would increase the value of the cotton crop of the Southern States nearly £2,000,000. According to a letter in the *Manufacturer's Record*, of Baltimore, a company has been organised under the laws of Maine, with a capital stock of £3,000,000, preferred and common, for the purpose of manufacturing pulp and paper from cotton stalks. Mr. Harvie Jordan, president of the Southern Cotton Association, has been elected president.

## A New Method of Insulating Copper Wire.

A cheap and effective method of insulating conductors for use in house wiring and other purposes is described by the *Electrotechniker*. The surface of the copper is first treated by passing it through a solution of proto-sulphide of potassium, and so exposing it to the action of sulphuretted hydrogen vapour. When the copper has attained a bluish-black tinge, it is exposed to the air until it becomes quite black, and finally it is well washed in water. When dry, it is only necessary to coat the wire with a suitable varnish made of good linseed oil; to do this the wire is drawn through a bath of the melted varnish, and dried. The resulting covering is perfectly continuous and impervious to moisture, and its flexibility, though not so great as that of gutta-percha, is ample for ordinary purposes

## Locomotive Running.

The *Natal Government Railway Magazine* contains in its September number an article on the subject of the disadvantages which accrue from single shifting as against pooling of engines, from a locomotive engineer's point of view. This question is one that has frequently been discussed of late in Natal, and therefore the conclusions arrived at are of interest. They are . that the working of engines on the single-shift principle is a decided advantage, as, independent of the fact that it creates a more contented and harmonious working staff, the consumption of fuel and lubricants is reduced to the lowest possible limits , it also reflects to a very great extent on the upkeep of the engines, both as regards running and general repairs, the saving to be derived from these items being worthy of consideration.

## Large Paper-making Machine.

Some idea of the dimensions of the largest paper-making machine ever constructed in the United Kingdom may be had from the fact that it fills a shed 185 ft. long. It has great width, due to the fact that the Swedish Paper Mill Company, for whom it was built, intends to use it for the production of two 75-in. sheets of paper, a total width of 150 ins., or 12½ ft. The paper is to be run through the machine at the high speed of 500 ft. per minute, which calls for very heavy and accurate driving gear and large rolls. To provide paper of a superior finish a stack of calender rolls is fitted, weighing 70 tons, the lowest one alone accounting for nearly 15 tons. The entire machine weighs 550 tons, and is driven by a 200-h p. steam engine.

De Beers Diamond Corporation has offered £2,500 towards the fund for the establishment of a college in South Africa for the higher education of natives.

## World's Coaling Record.

A world s record for rapid coaling has just been established by the crew of the King Edward VII., the flagship of Vice-Admiral Sir W. H. May, commanding the Atlantic Fleet.

The crew shipped 1,660 tons at an average of 283 tons per hour, and in one hour reached the extraordinary high intake of 350 tons.

Mr. Francis Clark, late engineer of the Christchurch Meat Co., has commenced business in Christchurch as a consulting and contracting engineer.

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FOR ☞ Quality,
☞ Finish and
☞ Price,
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**COMMERCIAL CHAMBERS, 3 Hunter St., WELLINGTON.**
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## ENGINES, MACHINERY, APPLIANCES,

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