PROGRESS

With which is Incorporated

THE SCIENTIFIC NEW ZEALANDER.

VOL. I.—No. 12. MONTHLY.] WELLINGTON, N.Z., OCTOBER 1, 1906. [PRICE: 6d Per Copy; 6/6 Per Annum posted, or in advance 5/-

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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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The Scientific New Zealander.

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

EDITORIAL COMMENT.

Our First Year.

WITH the current number PROGRESS completes its first year. From out the obscurity of a new and untried publication, possessing some twenty pages, this journal has, by a generally acknowledged merit, developed into an important contributory factor in the scientific and mechanical literature of New Zealand. Forty pages have comprised the issue for some months; yet, even with this extensive outgrowing, it has been found impossible to provide space for much that would have unquestionably proved of first interest to our readers Not only has New Zealand arisen to an appreciation of PROGRESS, but Australia, England and America have each recorded a measure of applause, consequently, it is reasonable for us to assume that this newspaper, as the organ and mouthpiece of invention, and chronicle of the engineering and allied professions throughout Australasia, has fully justified its introduction. During the past year the works of many noted writers have been printed for the first time in our columns, the articles having been of a designedly high standard in order to meet the critical propensities of those who require the best exposition of the colony's progress The importance of a country will always lie in its engineering achievements, the constructive advancement of its cities and towns, the studied application of chemistry and the expansion of electricity for local purposes. To these four generic heads, and to the encouragement of invention the columns of this journal are dedicated.

Main Trunk Railway.

WE have pleasure in presenting in this issue the first of two articles on the Main Trunk Railway of the North Island, written by our Special Commissioner. We believe that this is the first attempt to give the public of New Zealand a complete record of the great undertaking Our Special Commissioner, after having gleaned sufficient historical data, journeyed over the whole route in order to gather details and take photographs of the permanent-way construction. When the Line is finished it will unquestionably tend to cement the interests of Wellington and Auckland together in a manner hitherto rendered impossible True, there is a great deal of valuable country to be opened up on the Wellington side, but the benefits to be obtained by the two centres are set out as practically even, for the greater portion of the timber from the Waimarino district will continue to go to Auckland. This timber, which consists principally of red pine (*rimu*), black pine (*matai*) totara and (on the mountains) birch, has all along been sent chiefly to Auckland, and forms a valuable adjunct to the trade of the northern city It is not at all unlikely in view of the increased demand for timber which must necessarily follow the completion of the Main Trunk, that it will some day be found necessary to establish a forest preserve in the Waimarino. So vast, however are the forests at the present time that the estimated inroads for the next ten years cannot materially affect the crop. The possibilities of fast travelling from one part of the North Island to the other on this route appear to be very considerable, and the magnificent mountain country, hitherto accessible only by laborious coach journeys, will be traversed by the new route, allowing tourists to view the spectacle of smoking volcanoes and snow-capped ranges from comfortable railway carriages. It will be quite easy when the Main Trunk is completed for through passengers to leave Invercargill on Monday early, and arrive in Auckland at 8 a.m. on the following Wednesday morning; in other words, we shall have a forty-eight hour through passenger and mail service between the two extreme cities. The fares, also, will prove an inducement to travel by the new route, for they have been tabulated at very low figures, viz. —from Wellington to Auckland (426 miles) 40/- first class; 21/- second class. In the second instalment our Special Commissioner will give some new and interesting facts in connection with the great work The subject of our cover is a New Zealand built locomotive belonging to what is known in railway circles as the "W1" class.

Hollow-concrete Construction.

WITHIN the past five years a new building material, the hollow-concrete block, has come rapidly into use, and the industry has grown almost as surprisingly as the manufacture of Portland cement. Concrete building blocks were practically unknown in 1900, but it is probably safe to say that at present more than two thousand companies and individuals are engaged in their manufacture in the United States and the United Kingdom.

The cause of the remarkable development in the United States is chiefly to be found in the rapidly failing supply of lumber, together with the widespread public interest in all applications of Portland cement. The advance of more than 50 per cent. in the price of lumber during the past few years has been a serious hardship and obstacle to the increasing multitude of people who aspire to having homes of their own, and it is but natural that builders should look about for some efficient substitute for wood, and should look with favour on a material which offers advantages of durability, safety, comfort and beauty which are unknown in frame construction.

There is good reason to believe that an efficient substitute for wood has been found in the hollow-concrete block, and that we are still only on the threshold of the development of this building material. Opposition to its use on the part of the consumer is not to be feared; the obstacles to be overcome lie chiefly in the danger of careless or ignorant work by block-makers and builders, and in the need of study and invention to adopt the material to the economical production of convenient and beautiful structures. There is every reason why concrete should become the chief building material of the future. For large and costly buildings it is likely that solid concrete, plain or reinforced, will have the preference. For smaller structures, especially factories and dwellings, hollow blocks are certainly cheaper more suitable, and require much less technical skill in erection, The possibilities of this type of construction seem to be unlimited; and all that is needed to secure an immense expansion of the concrete-block industry is to improve the design of machines and product so as to make block construction simple, practical and beautiful To accomplish this, ingenuity, invention and good taste will be required, and there is little doubt that these qualities, so characteristic of the English people, will in abundant measure be brought to bear upon the problem.

Inventions.

The Ellis Motor.

An important invention of the day in steam engineering is the Ellis motor, which may be truly described as a mechanical wonder, puzzling alike to savant and layman, until its internal mechanism is seen and explained. It is an engine with a piston drive, and may almost be called a rotary engine. The casing revolves with the internal cylinder carrying the pistons, and in the same direction, and it is chiefly to this peculiarity it owes its novelty. At first sight the working of the motor seems paradoxical, it being such a distinct departure from the beaten track of engineering; and it is not surprising that one of the high officials in the American Patent Office, on seeing the drawings, reported that it was "inoperative," until convinced of its feasibility by working model. The accompanying illustration shows a working model of the motor, and its inventor; but a true appreciation of its merits can only obtain from the model itself actually at work and opened up for inspection. A well-known engineer of Wellington, fresh from the Home colleges, with up-to-date experience of modern steam engines, declares that in his opinion it is the simplest compound engine ever made.

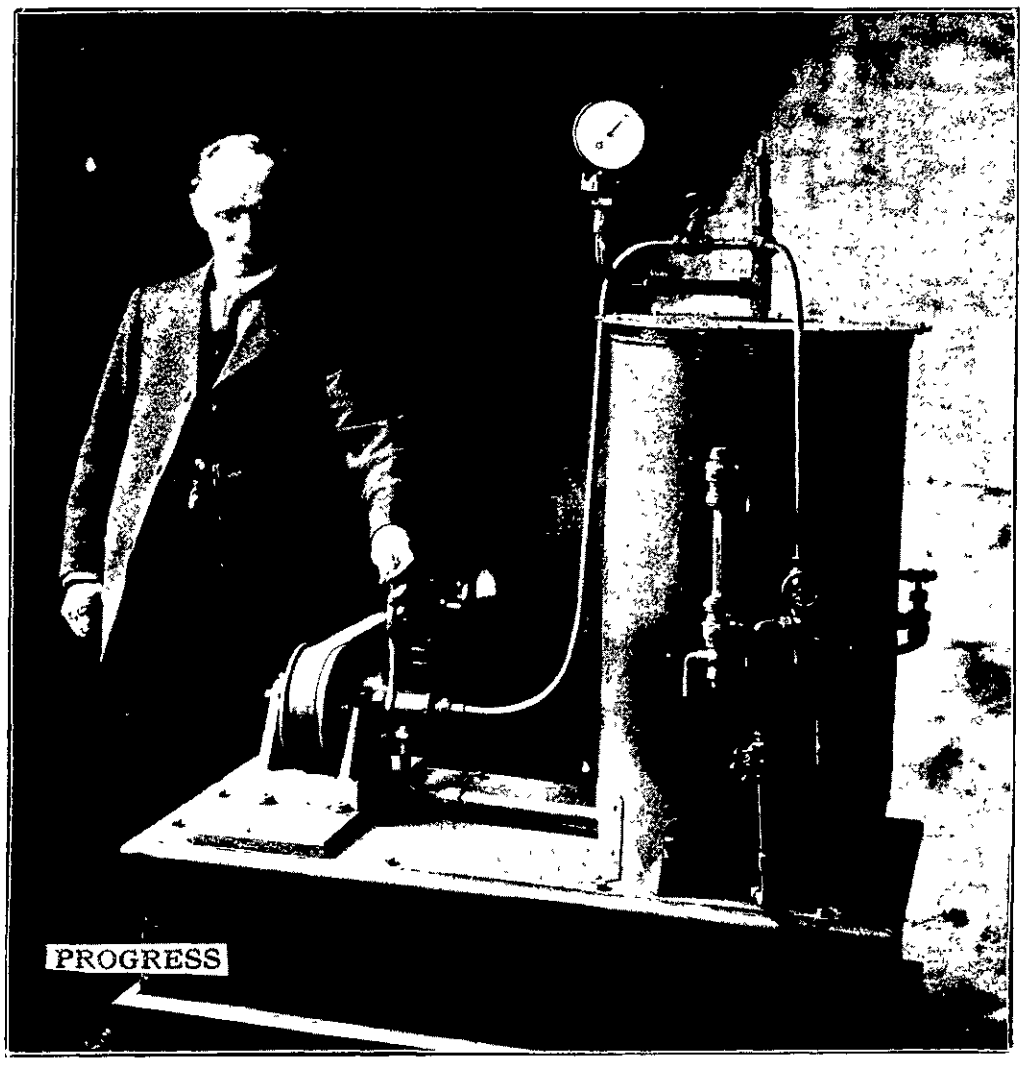
It is interesting to hear from the inventor how he conceived and brought the motor to its present stage. He tells us that the nucleus of the invention really lay in an experimental model of a rotary inclined plane, but whereas he once tried to propel his model up the incline, he now uses the principle of the incline to utilise the steam power. It is, therefore, easy to see that the reason why a wheel runs down an inclined plane is that the point of contact of the rim of the wheel with the track is behind a vertical line passing through its centre of gravity, and its tendency or power to run down the incline is in proportion to the rate of the gradient; moreover, if the incline is reversed, the wheel must revolve in the opposite direction. Given, then, an endless incline the wheel will continue its motion indefinitely; and given an incline which can be reversed, the motion will be in the opposite direction. In the Ellis motor the outer case, or cylinder, containing the inner one carrying the pistons, forms an endless incline—the pressure of the steam acting as gravity would act in the ordinary way—the reversing lever of the engine being so arranged as to reverse the incline when it is desired to reverse the engine.

The invention being so unique, and giving so much promise of success, makes it likely to prolong the use of steam motors in competition with rivals. One important fact in connection with the motor is its instant reversibility, and as there are few working parts it does not require highly skilled attendance. It uses the steam expansively, has a low piston speed per revolution of the motor, and for most purposes does not require intermediate speed gear.

The small model illustrated herewith was tried and tested for brake horse power a short time since at Messrs. Andrews & Manthel's engineering works, and the influential and professional gentlemen present congratulated Mr. Peter Ellis, the inventor, on the production of a piece of mechanism which promises to invade almost the whole sphere of steam engineering. Only comparatively small models have been experimented with but the results are so gratifying that it is intended to produce large units as soon as possible, and visitors to the N.Z. Exhibition at Christchurch will probably have an opportunity of witnessing the performance and tests of the engine.

Crosbie's Flax Stripper.

The flax industry is one of great importance to New Zealand at the present time when flax fibre bulks so largely in our exports, and, consequently, anything tending to improve the quality of the article and lessen the cost of production is of interest not only to those engaged in the industry, but to the public as a whole. It might be stated that stripping is the first process flax goes through after it is cut, the object attained being the removal of all surplus vegetable matter, and leaving the blade of flax in strips of fibre. A feature in the construction of Crosbie's stripper is that the revolving beating roller, which is acted upon by special worm gearing, works on springs which not only prevent vibration but also the bruising of the fibre, which is at present frequent owing to rigidity so common in the ordinary forms of strippers. These springs allow of the flax being fed by half-blade or several blades at one time with equal facility and satisfactoriness of results, and ensure the production of a fibre which, when washed, bleached and scutched, is of a soft and silky texture. The guide chute which is attached to the front part of the chairs prevents the fibre from spreading over the edge of the drum and wrapping round the drum spindle when feeding heavily, and is easily removed for adjustment or cleaning purposes. The springs, of which there are six, are all interchangeable and easily accessible for adjustment. The drum is of the angular beater type, cast of a special mixture of cast iron, hard, tough, and close, turned true and balanced so as to work at highest speeds without vibration The supervision required after the machine has been set to a proper working grade is reduced to a minimum, and the quality of the work maintained for a lengthened period. Compared with the work done by ordinary strippers, the output of Crosbie's stripper is more, the quality first class, the quantity of green flax required for a ton of fibre considerably less, the quantity of tow per ton of fibre greatly reduced, the attention required to keep the machine in proper order is very much reduced, and all the bearings and working parts, being strong, will do a large amount of work before requiring attention or renewal. In the case of some other strippers in use in New Zealand flaxmills, only one blade of flax can be fed in at a time, and when it is stated that in Crosbie's machine as many as three and four blades are fed in at once, and perfectly treated, it will readily be seen how great an acquisition to the industry the improvement is. Mr. Crosbie is connected with the foundry of Messrs. A & T. Burt, Dunedin, who make all the strippers turned out under the inventor's name



THE ELLIS MOTOR.

The Holmes-Allen Automatic Trolley Head.

Messrs. Holmes & Allen are meeting with a considerable amount of encouragement in Australia with their patent automatic trolley head. Several important interviews have recently been arranged at which the merits of the Holmes–Allen device have been demonstrated to principals. Mr. Brain, chief engineer, and Mr. J. Kneeshaw, general manager, of the Sydney tramways have been much impressed with the invention, while Mr. Fehon, one of the railway commissioners, has invited the young inventors to carry out a trial on the Sydney trams. In order to give effect to this invitation Messrs. Holmes & Allen have been busy preparing special plans, and also heads suitable for attachment to the Sydney trolley poles, which are constructed on entirely different lines to those in use in Wellington. We learn, also, that trials of the invention are proceeding in many other directions and that the inventors have been asked to visit the United States (which country has recently granted a patent for the head), and several States in the Commonwealth. Brisbane, Melbourne, Ballarat, Kalgoorlie, Perth and other places are to be exploited in turn.

RECENT LEGAL DECISION.

Patent. Prior Publication. The Wilfley Ore Concentrator Syndicate, Limited, sued N. Guthridge, Limited, for infringement of their patent for the Wilfley Table for concentrating ores. One of the defences was that the patent had been anticipated by the prior publication in Melbourne of a New York journal containing a description of the invention. Mr. Justice Hood held that the description so published was unintelligible. Held on appeal by the High Court of Australia that that the principle to be applied was whether the description was sufficient to convey to men of science and employers of labour information which would enable them, without the exercise of inventive ingenuity, to understand the invention and to give a workman specific directions for the making of the machine, and that subject to evidence as to the state of common knowledge among persons familiar with the subject matter at the time of the publication and as to the meaning of technical terms or words of art, the interpretation of the document is a question of law for the Court; further, that the description quite intelligibly described the construction of a table which anybody of ordinary intelligence and sufficient mechanical ability could make, and that therefore there had been prior publication. *N. Guthridge, Limited v The Wilfley Ore Concentrator Syndicate, Limited.* 3 *Commonwealth L.R.* 583

Chemistry and the World's Food.

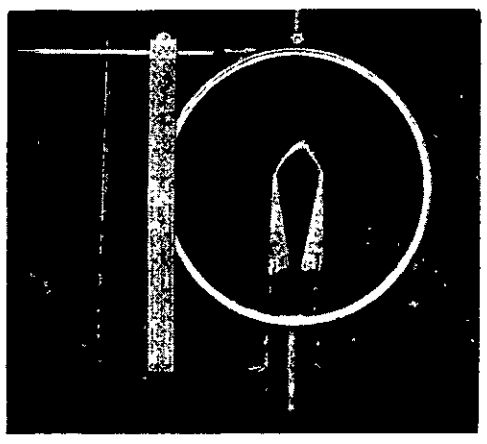
By Robert Kennedy Duncan.

Synopsis.

In the previous article on this important subject Professor Duncan enlarged upon the various forms of fixed nitrogen which we have with us, and which we are continuously using up, and must continuously restore. The author showed how we consume fixed nitrogen in the form of animal food or of certain plant products, such as wheaten bread; but, as pointed out, plants and animals themselves depend upon the soil for every trace of the nitrogen they contain, and the soil is so inadequately charged with this nitrogen that we and the lower animals filch what it contains much faster than it can be restored by natural processes. Meanwhile, the land grows sick and barren and refuses to grow our crops; consequently, we have to cure the land and mix with it manure or fertiliser. The natural manure of the world is, however, a "mere drop in the bucket of our wants;" and Professor Duncan goes on to say that in Professor Adolph Frank's wonderful discovery "we see the unwilling nitrogen, fixed by the genius of man into the active and useful form, working not only in the thousands of nitrogenous substances used in our civilisation, but in the soil, in the plant, and causatively in the actions and thoughts and feelings of men, until, freed of its energy, it sinks back into the Nirvana of the empty air."

SECOND PAPER.

Now, resting on every seven acres of earth there are 237,000 tons of nitrogen, sufficient, if we could burn it, to replace the 1,500,000 tons of saltpetre consumed last year. That we could burn this amount we know, but how to burn it in the cheapest way has still to be discovered. The whole question of its economic burning bristles with difficulties. Not only is the ignition point above the temperature of its flame, but the temperature of the union of the nitrogen and oxygen of the air is perilously close to the temperature of its dissociation, and there results an awkward equilibrium point at which the nitrogen oxides are decomposed as fast as they are formed under the action of the arc. The prize of burning the air is certain riches, but how to proceed is the present question. Is it wise to employ arcs depending upon great electric intensity and small volume, or great volume and small intensity? What kind of electrodes should be used—carbon or platinum, or what? Should the air be compressed,



FLAME OF BURNING NITROGEN. THE IGNITION POINT IS ABOVE THE TEMPERATURE OF THE FLAME

should oxygen be added to it, or should it be dealt with as it is; and, moreover, how shall we be rid of the equilibrium point?

Among the race of chemists and chemical engineers, many men have been busy in the attempt to solve this momentous problem. There is the Atmospheric Products Company at Niagara Falls, where, through their earnest and intelligent efforts to solve this problem, Messrs. Bradley and Lovejoy have won high praise and cordial recognition from all the other workers in this field of investigation. The fact of this recognition is significant; it means that there is room enough for all. These gentlemen believe in sparks of high intensity, and they seem to have perfected their method to the limit of its powers.

The operation is carried out in a sparking chamber which consists of a large cylindrical metal box lined in the interior with vertical rows of contact points, each one of which is in connection with the positive pole of a dynamo generating a direct current of 8,000 volts. Now, inside the chamber rotates a central shaft provided with a similar set of negative contacts in the form of long rods, and all connected, of course, with the negative pole of the dynamo. But this cylinder is rotating at the rate of 500 revolutions a minute, and as each negative contact comes up to a positive, it strikes an arc which is drawn out and extinguished as the negative contact moves past and away from the positive.

In the illustration we see the cylinder at work at the instant of revolution, and since there are many revolutions and many contacts, there are no less than 400,000 arcs a minute. It is like the inner cylinder of a music-box ringing out sparks instead of sounds. But air is drawn through these multitudinous sparks, and each spark as it forms burns a small per cent. of the incoming air into oxide of nitrogen. The result is that some two per cent. of the outgoing air is converted into oxides, which are caught in absorbing towers of water with the formation of nitric acid, or of soda with the formation of saltpetre or sodium nitrite.

From data based upon the actual running of this plant, nitric acid may thus be produced from air and water at a cost of about one penny a pound, and since the market price is about twopence halfpenny, it ought to be a profitable operation. But this is for nitric acid, and large as is the market for this substance, it is not limitless, as is the case with saltpetre. Whether the acid may be combined with soda to form artificial nitrate, at a rate capable of competing with the natural product, is still a matter of doubt; it depends on the price of soda.

Away off on the coast of Norway, where they have cheap water-power and cheap labour, other men are still engaged in the practical elucidation of this same problem. Professor Kr. Birkeland and Dr. S. Eyde, of Christiania, have developed a process by which the air is conveyed into a series of ovens. Each one of these ovens contains two metal electrodes, between which plays a high-pressure flaming electrical arc. The arc is moved rapidly hither and thither by a powerful magnet, in such a way that the maximum amount of oxidation is obtained. In accordance with data submitted by the company, about 2000 pounds of nitric acid may thus be synthesised with an energy expenditure of only one kilowatt-year.

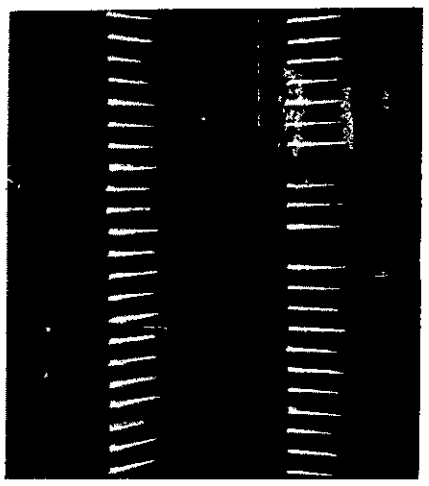
At the present price of nitric acid this means a most respectable profit, and it is not surprising, therefore, to learn that they already employ 2000 horse power for burning the air.

E. Rossi, of Italy, proceeds in still another way. He obtains improved results by oxidising the air under heavy pressure. The oxidation is brought about by an incandescent substance similar to the filament of a Nernst lamp, and the equilibrium point is avoided by absorbing the burnt nitrogen oxides with concentrated sulphuric acid flowing constantly through the interaction chamber. Among the Germans the great firm of Siemens and Halske has been intermittently busy ever since 1884, when old Werner Siemens sent a letter to his assistant directing him to experiment on the fixation of nitrogen. Dr. George Erlwein, who has present charge of this investigation, does not hold with the experiments just described. Instead of a multitude of intense little sparks of high-potential flaming arcs, he employs an arc formed by an enormous current at low voltage. He points out, and very truly, that increasing the size of these other plants will not increase their efficiency, while, in his own case, he finds that the greater the size of the arc he can form (the greater the unit in his factory), the greater is the per cent. of the nitrogen burnt. He has also provided against the easy decomposition of the burnt nitrogen into free nitrogen, by mixing the carbon of his huge electrodes with powdered fluor-spar, thus decreasing the temperature of the arc.

At present this firm is resting on what they have so far accomplished, and for a most significant reason. They have no more doubt than other people that they can profitably make nitric acid out of air and water, and at a rate concurrent with the present market price, but they are not satisfied with the market thus afforded, immense though it is. They demand the exploitation of the whole saltpetre industry as well, and nothing else will satisfy them. They deny that at present the electric nitre can compete with the natural product; hence they prefer to wait until a little further advance in pure science brings it within their grasp.

Calcium is one of the few elements that have the power to unite directly with nitrogen. It is a silver-coloured metal, which with comparative ease burns nitrogen, to form a nitride, and this nitride, on being thrown into water, yields ammonia and lime. Hence, if we could obtain calcium cheap enough, we could obtain ammonia cheap enough, and this would solve the problem of nitrogenous manure. Ten years ago this would have been visionary nonsense; to-day, were there no other means at our disposal, this is the very scheme we should quickly take measures to cheapen and adopt. Two years ago calcium was worth three pounds a thimbleful; to-day it is worth about five shillings a pound, and its price might be greatly reduced.

It is a very common metal, because every bed of limestone contains nearly forty per cent. of it; in the past it was very rare because of the difficulties of its extraction. To-day, calcium is made by



INTERIOR OF CYLINDRICAL SPARKING CHAMBER FOR THE ECONOMICAL BURNING OF NITROGEN. CYLINDER ROTATING AT THE RATE OF 500 R.P M.

the ton, by decomposing the melted chloride of calcium by a current of electricity. The metal attaches itself to the cathode, and by slowly lifting the cathode a long "cabbage stalk" of the metal is produced. Fortunately we do not need to worry over the still cheaper production of calcium, for, working in one of its compounds, this same metal has solved our problem in another way and with such success that it has temporarily thrown into secondary importance all the other processes we have so far considered.

Everybody has heard of calcium carbide, and of the bright illuminating gas, acetylene, which it evolves when thrown into the water. The story of the carbide discovery, its manufacture, the fond hopes of the investing public that they could displace by acetylene the ordinary illuminating gas which the manufacturers could afford to sell for nothing, their disappointment, the revivification of the industry, and the latest phase of its usefulness, is a story of high romance and high finance. We are concerned here only with its latest phase.

It occurred to Professor Adolph Frank, of Charlottenburg, that the easy manufacture of carbides pointed out a way to the commercial fixation of nitrogen. In order thoroughly to test his schemes, he took refuge under the broad ægis of the restless, experimenting, progressing firm of Siemens and Halske, whose means and resources were adequate to every human purpose. At first he had in mind only the manufacture of cyanides, by passing atmospheric nitrogen over the heated carbide of barium and converting the cyanide of barium obtained subsequently into the most valuable of the nitrogen compounds, the cyanides of sodium and potassium. He was entirely successful in this operation; but, in order to still further improve it, he resolved to make a stubborn attempt to utilise the analogous carbide of calcium instead of barium, for it happens that it is not only cheaper, but much more efficient, weight for weight.

His attempt resulted in a complete surprise. He found, as a matter of fact, that atmospheric nitrogen reacted with red hot calcium carbide in accordance with a little equation, which, with apologies to the lay reader, we shall insert:

$$CaC_2 + 2N = CaCN_2 + C.$$

The result of the reaction is the complete conversion of the carbide into carbon, and into a substance which, while its name sounds something like the calcium cyanide expected, is wholly different from it—calcium cyanamide.

Next he discovered that this calcium cyanamide, on being heated with high-pressure steam, passed easily into limestone and ammonia, and finally he found that, on merely spreading out the material in the moist air, it slowly evolved this same substance, ammonia. This led him to the natural

conclusion that the substance might be used as a fertiliser, and to determine the question he sent large quantities to Herr Geheimrat, Professor Wagner, of Darmstadt, to Dr. Gerlach, of Posen, and subsequently to numerous agricultural stations scattered over the country.

The result of this experimentation has established beyond all question the fact that, under certain conditions, calcium cyanamide is a better fertiliser than the sulphate of ammonia from the gasworks, and practically equal to the saltpetre from the mines, weight for weight of the nitrogen that it contains For the growth of wheat it gives its best results when buried four or five inches below the surface of the soil some eight to fourteen days before the seed is sown. The exact mechanism of its action has still to be determined. It is not unlikely that the calcium cyanamide in the soil breaks down into cyanamide itself which in turn decomposes into ammonia, which oxidises into nitric acid, and that the nitric acid so formed unites with the lime constituent of the compound to form calcium nitrate.

Under the name of "Kalkstickstoff," calcium cyanamide is now in the markets of the world. The little experimenting Cyanid-Gesellschaft, which consisted of Siemens and Halske, the Deutsche Bank, and Professor Frank, has turned over the manufacture of Kalkstickstoff to a large company formed for the purpose, the Societa Generale per la Cianamide, of Rome, and this company in its turn consists of the Cyanid-Gesellschaft, the Societa Italiana per la fabbricazione di prodotti azotati, edi altre sostange per l'agricoltura, and the Societa Italiana per il carburo di calcio acetilene ed altri gas, of Rome.

In manufacturing the substance, they employ the latest results of technical science. The atmospheric nitrogen must be separated from the oxygen with which it is mixed. They, therefore, liquefy the atmosphere and separate the two substances by fractional distillation. The oxygen passes off to be used for other purposes, but the nitrogen passes suddenly from the intense cold of liquid air into the highest heat of the electric furnace where, through contact with a mixture of coke and lime, it is caught and transformed into Kalkstickstoff The action of the, Cyanid-Gesellschaft in turning over the fertiliser phase of Kalkstickstoff to the guardianship of another company, has left their hands free to exploit its other uses. These uses are manifold. The fact that calcium cyanamide, under the action of high-pressure steam, passes over all its nitrogen into the form of ammonia leads to an elegant method of making this substance and other ammonium salts The company has at present a demonstration plant in operation for the production of 1500 tons of ammonium sulphate a year. But, mixed with carbonate of soda, or with common salt, and fused, the cyanamide passes over into the form of cyanide of sodium, and this cyanide is useful for a vast number of processes, from silver-plating to gold extraction. They have a plant for this purpose yielding 500 tons a year, and in Mexico, for mining purposes, they are beginning to manufacture the cyanamide directly at the mouth of the mine. A valuable use of cyanamide has been found in a curious function it has of causing the case-hardening of steel, and we find the great firm of Ludwig Loeve and Co., for one, continually using large quantities of it in the manufacture of tools and of arms for the government.

An interesting substance easily produced by the action of acids upon calcium cyanamide (with an apology to the reader for its hard name) is dicyandiamide, a beautiful crystalline body containing sixty-six per cent. of nitrogen. This substance, previously known only as a laboratory curiosity, is now made by the ton, and much of it is sold to the dye industries for a purpose that cannot be imagined by the manufacturers. Still other quantities are sold to manufacturers of explosives, owing to the fact that when mixed with other substances it lowers the temperature in the gun barrel. A very interesting property of cyanamide is the ease with which it may be made to unite with water to form urea—a substance occurring naturally in animal excretions. Tons of this artificial urea are now sold to manufacturers of pharmaceutical preparations, though, again, for purposes of which the manufacturers of the urea have no idea. Guanidine, another product of the animal organism, is also made from it, and, we are informed, tons of it are now being sold to America.

Still another reaction, of no practical utility to-day, but impressively significant of a thousand utilities awaiting the hand of future man to develop, is that by which sarcosin unites with this same cyanamide from atmospheric nitrogen to yield creatine—one of the actual substances of human muscle found in extract of meat.

From all these facts it is demonstrated that we may look forward with a very reasonable assurance to the creation of as many factories for the fixation of elemental nitrogen as we have smelting furnaces for the unfixing of elemental iron. Through all these processes we see the unwilling nitrogen, fixed by the genius of man into the active and useful form, working not only in the thousands of nitrogenous substances used in our civilisation, but in the soil in the plant, and causatively in the actions and thoughts and feelings of men, until, freed of its energy, it sinks back into the Nirvana of the empty air. We see, too, that the disaster of which the world actually stood in imminent deadly peril has been averted, and that if every pound of saltpetre in the mines of Chili were suddenly to dissolve into its elements, the human race would still be able to guard itself against the unhumanity of nature. Though, is there this unhumanity of nature?

Say there be;
Yet nature is made better by no mean,
But nature makes that mean; so, o'er the art
Which you say adds to nature, is an art
That nature makes.

Every atom within us moves in harmony with every atom without, and we that think we move them to suit our needs or our caprice are but the crude instruments of a Purpose unfilled and unimagined, but predestinated from the beginning of all things.

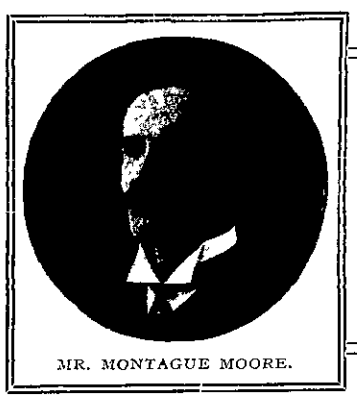
The present-day practical lesson of this whole strenuous successful work lies in the little object lesson it affords of the immense importance which technical science is assuming in our daily lives and in all our industrial operations. The substitution of real knowledge and high technical skill for the "rule of thumb" of our ancestors has created a revolution in industry. This revolution took its rise in Germany, and it is spreading rapidly to every corner. It is spreading silently, too, because it does not pay to tell. During the next five years, the small manufacturer who is swept out of existence will often wonder why. He will ascribe it to the economy of large-scale operations, or business intrigues, or what not, never knowing that his disaster was due to the application of pure science that the trust organisations and large manufacturers already are beginning to appreciate.

Copyright.

Photograph Copyright Good Consideration.—Section 2 of "The Fine Arts Copyright Act, 1877," enacts that the author of, *inter alia*, every original photograph shall have the sole right to sell, copy, engrave, reproduce and multiply it for the life of the author and seven years after his death, provided that when any negative of any photograph shall be made or executed for or on behalf of any other person for a good or valuable consideration, the person so making or executing the same shall not retain the copyright unless it be expressly reserved to him by agreement in writing, but the copyright shall belong to the person for or on whose behalf the same shall have been made or executed. Messrs Stackemann, photographers, were in the habit—as a speculation—of taking photographs of school buildings by permission of the principals it being understood that the principals need not buy any photographs unless they so desired. In 1904 Messrs. Stackemann, by permission of Rev. W G Price, the proprietor of a school at Harrow, took photographs of the school, certain rooms shown them by Mr. Price, and groups of the cricket eleven and of the boys of the school posed by Mr. Price. Subsequently Mr. Price purchased £15 worth of photographs. Mr. Paton published "Paton's list of Schools and Tutors" and the advertisers in this volume used to furnish him with photographs of their schools for insertion in the text. Accordingly, Mr. Paton published in his book one of the photographs taken by the Stackemanns which had been furnished to him by Mr. Price. The Stackemanns considered this an infringement of their copyright, and sued Mr. Paton accordingly Held, however, by Farwell, J., that the circumstances under which the photograph was taken constituted "good consideration" from the school proprietor to the photographers, and that therefore the copyright of the photographs belonged to the school proprietor and not to the photographers. *Stackemann v. Paton.* 75 L.J *Ch.* 590.

Company. Sale of Undertaking.—A provision in a Company's memorandum of association giving it power to sell its real and personal property does not confer on the Company power to sell its whole undertaking Such a transaction can only be effective if the memorandum of association reserves to the Company express power to sell its undertaking *The Rewa Co-operative Dairy Company v. Lonergan.* 25 *N.Z. L.R.* 540.

NITROGEN-INOCULATION EXPERIMENTS IN NEW ZEALAND:
BROAD BEANS, SHOWING DEVELOPMENT OF NODULES DUE TO SOIL-INOCULATION.



MR. MONTAGUE MOORE.

NEW DIRECT PROCESS OF Iron and Steel Manufacture.

MR T J HESKETT.

By W. S. Bayston,
Patent Attorney, Melbourne.

In this age of wireless telegraphy, radium, and other important scientific discoveries, with invention approaching ever nearer to the coveted secret of ærostation, and research seeking to unravel the very riddle of the Universe, the thinking portion of the commercial world, at least, will not be disposed to look askance at the introduction of a method for the production of steel by what is best described as the direct process. That is to say, the immediate conversion of iron ore into malleable iron, or steel, as the case may be, by a continuous system instead of the existing indirect method with its tardy process of manufacture. and its relatively large expenditure.

The advantages to be derived from such a system and its stupendous potentialities for the production of wealth need not be enlarged upon here: the millions acquired by Mr. Andrew Carnegie and other Iron Kings will convey sufficient idea of the opulence that is hidden in a discovery that should not only supersede existing methods of production throughout the world, but embrace all future productivity within its folds.

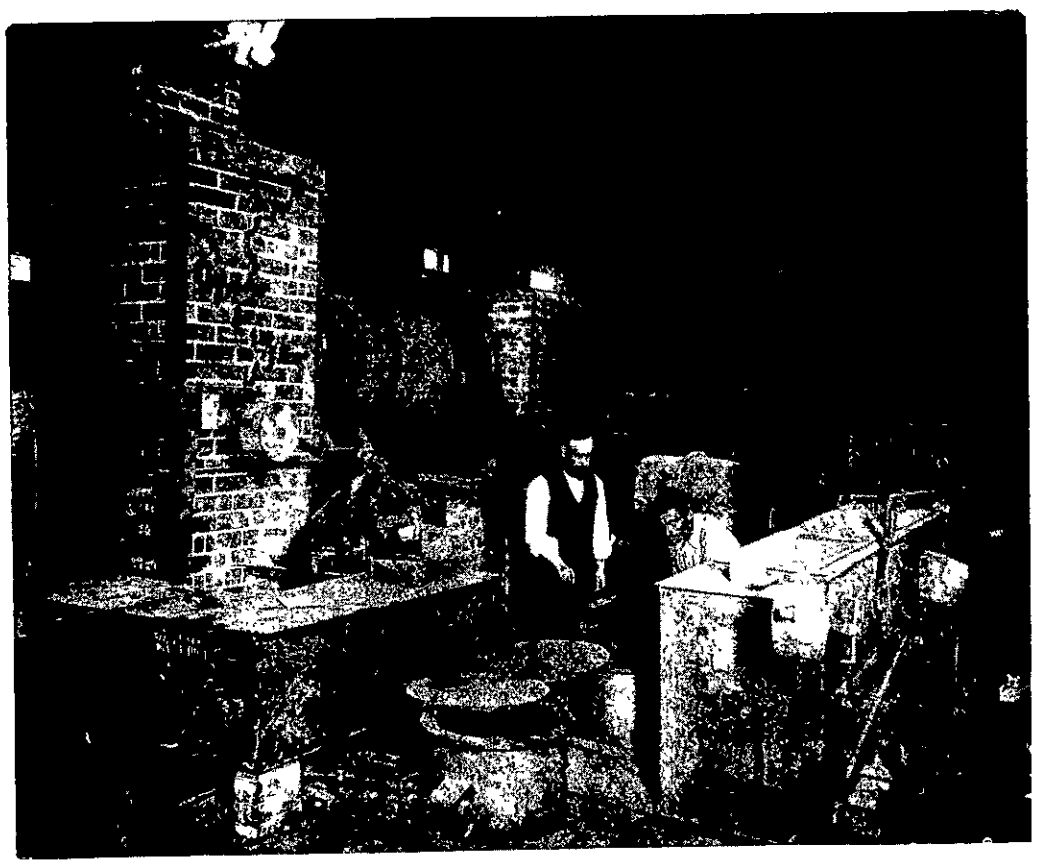
Such a system has been discovered, and is being daily utilised at large works erected at South Melbourne by the "Iron, Steel and Metals Manufacturing Company, Limited"; the object of this Company is to continue the work there and elsewhere on a scale commensurate with the wants of Australasia, besides introducing the system into all the great iron centres of the world.

Progress readers will be interested to learn how important a discovery was brought about. To so explain this it is necessary to go back to 1882, when Mr. T. J. Heskett, engaged as an engineer at Middlesborough, the great iron and steel producing centre, first conceived the idea—possibly as the outcome of sub-conscious speculation as to the enormous expenditure that might be saved if the old tardy process could be done away with and a direct method introduced in its stead. And so, after what was a natural conception in view of the atmosphere in which he was working, with huge blast furnaces roaring about him—many of them 100 feet high and with a capacity of no less than 40,000 cubic feet, after proceeding from the mere incubation of the idea to patient practical research, after having left the Old World and made experiments for many years upon the wonderful deposits of iron and sand on our West Coast, Mr. Heskett had found the "open sesame" to a valuable secret, the result of which, it is said, may be the revolutionising of the whole world's method of steel production.

In 1903 Mr. Heskett went to Melbourne in quest of the necessary capitalistic aid to enable him to carry out experiments on a large scale. It was then that he met Mr. Montague Moore, whose knowledge of chemistry immediately enabled him to perceive the drift of the mighty idea to which the patient experimentation of Mr. Heskett had apparently given substance; and it is perhaps equally due to this gentleman's kindly encouragement, finesse, and the courage with which he adhered to his conception of the possibility of the consummation of so long-felt a commercial desideration, that the many difficulties and embarrassments that beset the path of the inventor were smoothed away, and the Iron, Steel and Metals Manufacturing Company sprang into existence.

The works at South Melbourne were soon projected and established, and there with all the assistance the mind of the inventor could wish for, with the sympathetic collaboration of experts in chemistry and mechanics, Mr. Heskett proceeded from mere models and tests by sure and certain stages to the actual working gear for the manufacture of malleable iron and steel in marketable form. Nor is this all the malleable iron and steel have already been manufactured there, and have been adjudged by qualified experts as very good material, too. Excellent cutting tools of the finest quality have made from the steel manufactured, and may be seen at the offices of the Company.

FEEDING THE ORE.



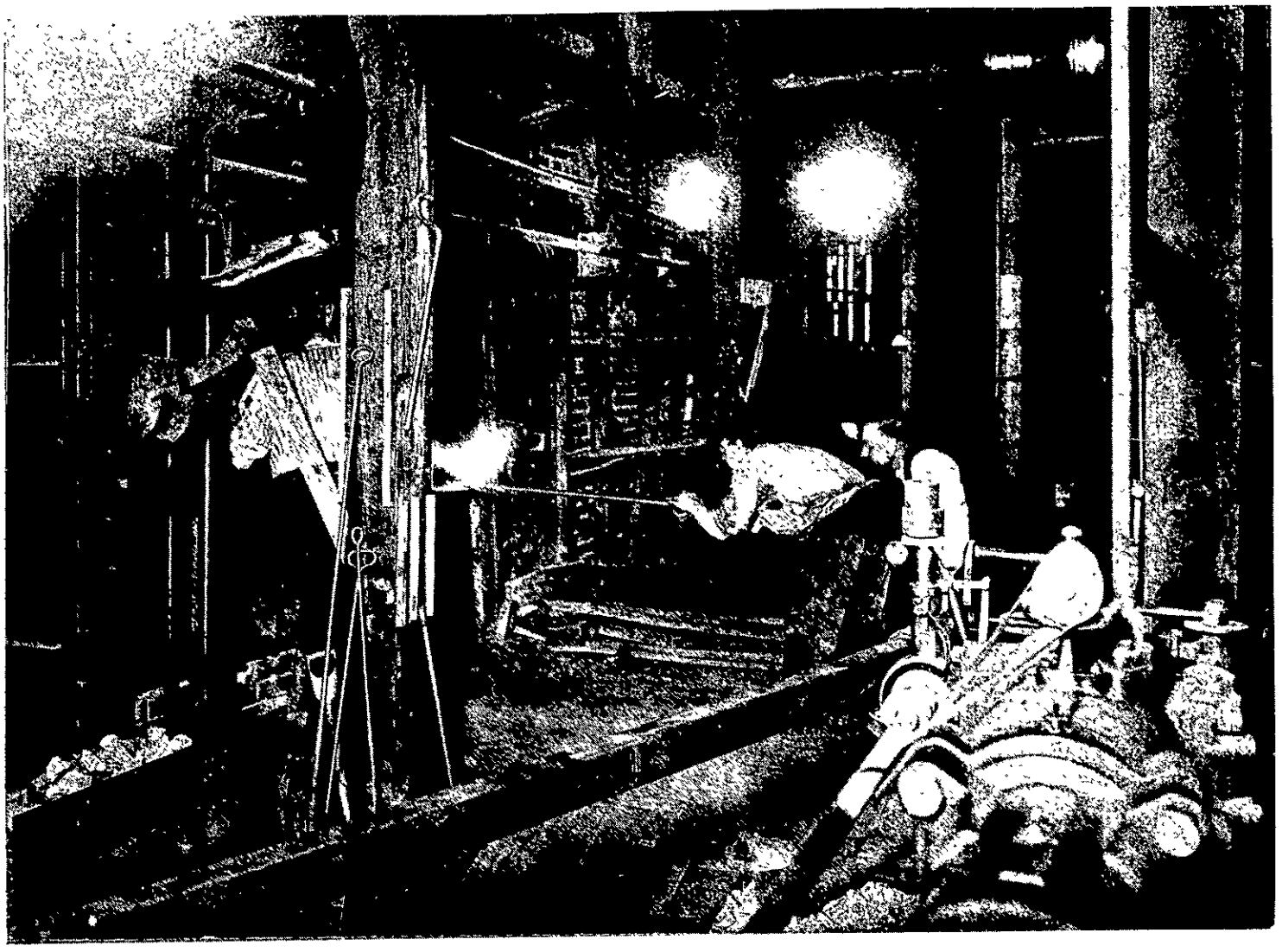
MR HESKETT AT HIS WORK.

In an article such as this a disquisition on the various degrees of calorics to be utilised in the process, or upon the chemical symbols and their equivalents, could not but be tiresome and confusing to the average reader. It will therefore suffice to give a general idea as to how steel is now made by the direct process.

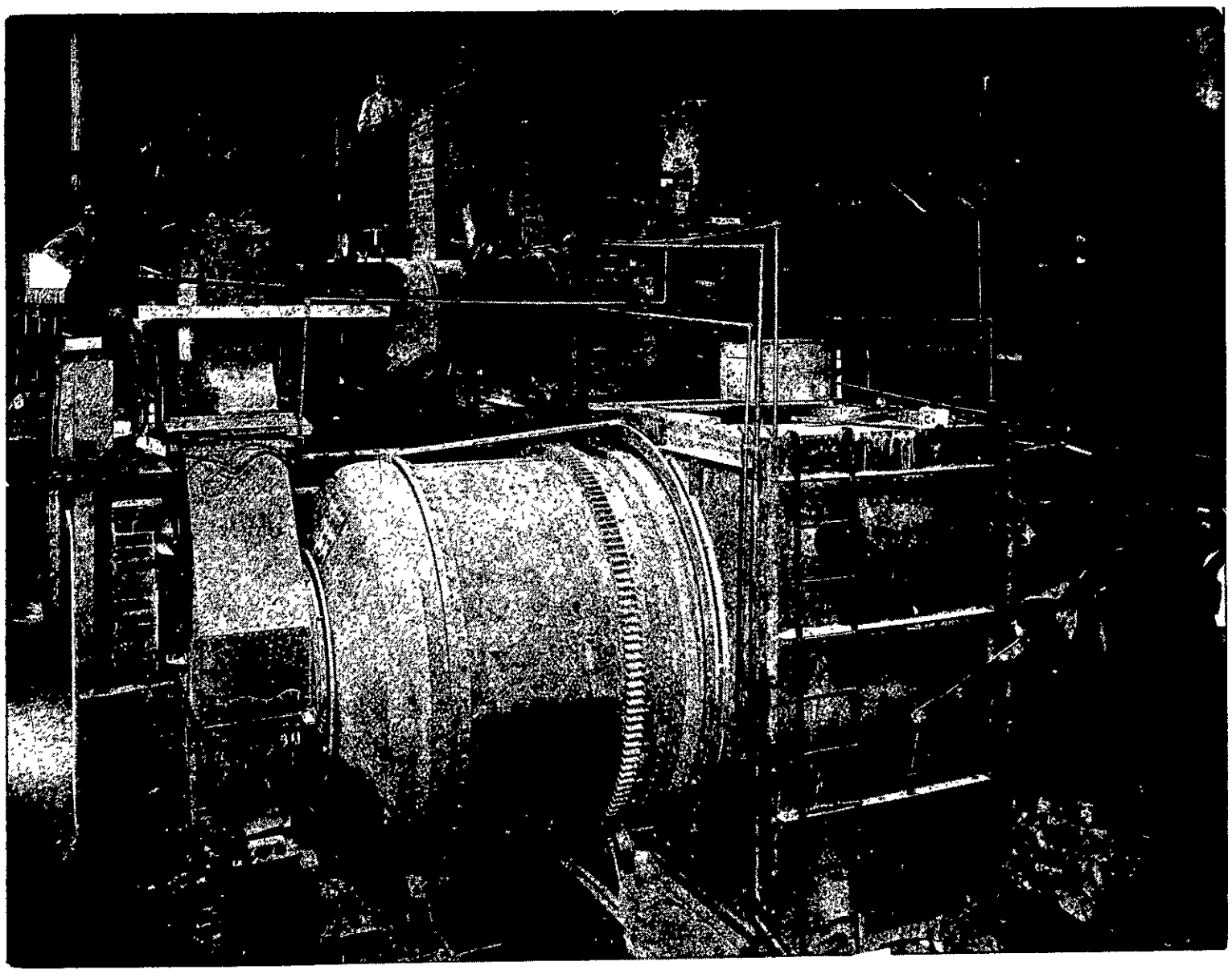
The prime factor in the system is the early reduction of the ore into a fine state, and the separation of the gangue by electro-magnetic treatment, or other approved methods of concentration, leaving behind a pure oxide of iron. From an ore-feeding hopper a constant stream of powdered iron ore is delivered into a revolving cylinder. This cylinder is lined with fire brick and is furnished with projecting shelves, the office of which is to continually raise the ore as the large barrel revolves. From this cylinder it passes into another and thence into a melting hearth. But the ore is heated to a certain point in the first cylinder, is deoxidised in the second, and is next "balled up" for wrought iron, or melted for steel, according to requirement, in the hearth.

The process appears quite simple, but has been arrived at by means of very careful calculations and patient scientific investigation. For instance, the fuel in the plant at South Melbourne is of crude oil or hydro-carbon gas, made from any carbonaceous material; and therefore either deoxidising or oxidising gas can be used as required. The deoxidising gas is passed into the second cylinder where it comes into contact with the ore, which has been heated by the waste gases from subsequent operations brought into the upper or first cylinder, after having passed through a regenerative gas furnace. Thus the deoxidising gas in the second cylinder has reduced the oxide of iron to

NEW DIRECT IRON PROCESS.



"RABBLING" THE HEARTH.



GENERAL VIEW OF PLANT.

to metallic iron without fusing or melting. These particles of iron are automatically passed from the second or reducing cylinder into the melting hearth in which is a bath of molten metal or slag.

The gas and reduced particles of iron enter the hearth through a fire clay pipe which is protected in front by the furnace lining, and by a forced down draught of deoxidising gas. The particles fall into the molten bath of metal or slag, where they are either melted or converted into steel, or fused and "balled up" as the case may be.

The deoxidising gas covers and protects the reduced ore as it falls into the hearth, and thus effectually prevents any possibility or reoxidation before the finely divided iron particles become absorbed in a bath of metal or slag.

No chemical reaction takes place in the furnace, and as a consequence the refractory basic lining is calculated to retain its form for a long time Electro-pyrometers are used in the working plant so that the temperature may be carefully watched, and valves are provided for regulating the heat in the various parts of the furnace.

Such, in brief, is a rough outline of the manner in which commercially pure, malleable iron, or steel, of any desired quality, may be drawn from the furnace in two or three hours after the iron-sand or crushed ore has been passed through the hopper. And by this direct process results may be assumed of even greater magnitude than eventuated from the Bessemer or Siemens inventions.

Experts who have studied the new process affirm that amongst the many advantages that will accrue from it will be: —Reduced cost of plant by the direct method, as the outlay will not exceed one fifth of the cost of a blast furnace; the saving of fuel by about two fifths; the saving in fluxes by about nine tenths; the cost of labour will be reduced to a minimum, as the process from the feeding hopper to the ingot truck is absolutely automatic; and last, but by no means least, the saving of time. By the Moore-Heskett process pure iron or steel can be made within three or four hours, while the indirect process requires from thirty to forty hours. The saving claimed is equal to 25% as against blast furnace and converter process.

From a perusal of the above it will be found that by a fairy-like process, over which, by the way, the Company waves the wand of its patent rights, the intermediate stage of pig iron is done away with. It is claimed that any ore may be treated by the method, but that the New Zealand iron sand, as a consequence of its extreme natural fineness, is particularly adapted for treatment. Enormous deposits of magnetic iron sand exist on the beaches of the West Coast of Australia, and so clearly is its value recognised that the Government has offered to take sixty-five thousand tons of iron smelted from the sand at English prices, with carriage and expenses added, and to give, moreover, a bonus of £1 per ton for the first twenty thousand tons produced as an encouragement to the establishment of iron works there, conditionally upon a plant of a certain value being erected.

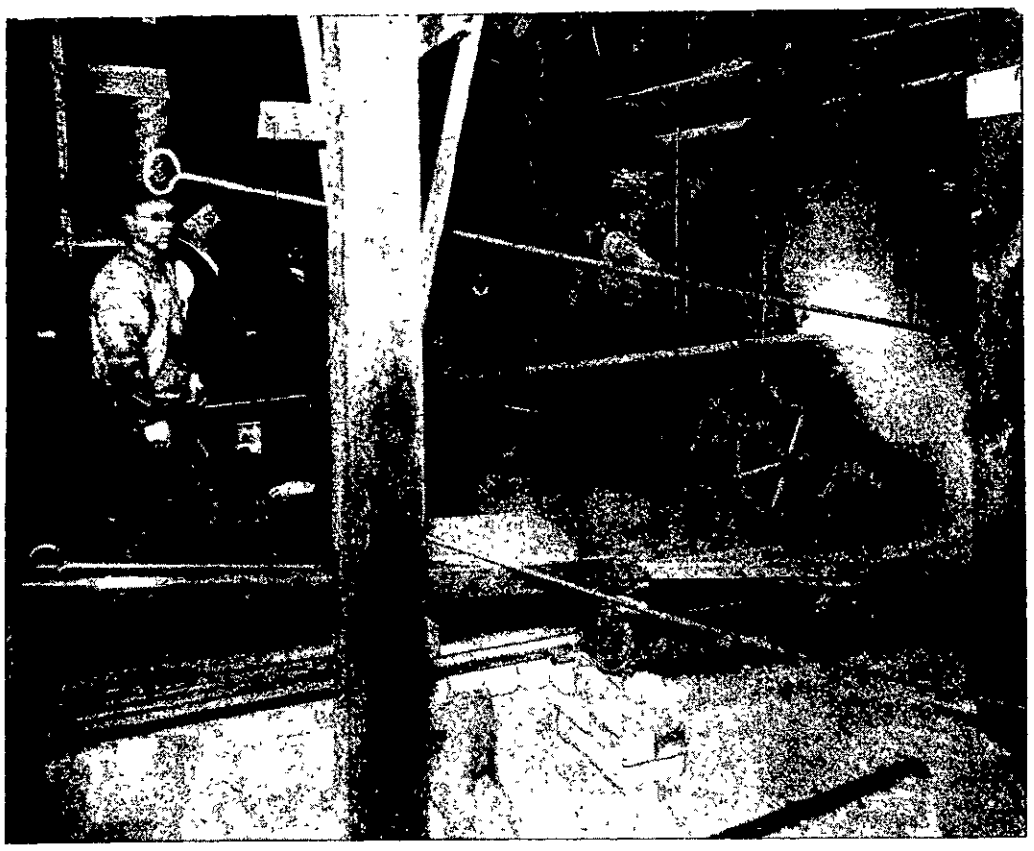
As the magnetic sand under the new process is treated automatically and without the addition of any fluxing agent, the profits due to saving of cost in this direction alone should be considerable.

Arrangements are being made for the erection of a plant in New Zealand, the scheme being financed by Sydney investors. The Company has also obtained a lease of three hundred and fifty acres at Lal-Lal, near Ballarat, upon which there is an extensive and rich deposit of hæmatite iron ore.

We expect to hear much more of the Moore-Heskett process of iron and steel manufacture in the near future.

The Block System and Ticket Collecting.

There appears to be as much ignorance of railway terms amongst colonial journalists as is to be found in the startling effusions on railway matters that occasionally appear in halfpenny papers. A Cape Town journal, referring to the greater activity displayed by the ticket collecting staff at Cape Town and in the vicinity, proceeds to state: "Until the block system is introduced at all stations no great improvement can be expected, for a large percentage of people will rob the Government whenever the opportunity occurs, and the present suburban traffic outside the terminus gives them an abundance of chances." We are here faced with a new railway problem: How does the block system of signalling prevent people from travelling without paying their fares?



NEW DIRECT IRON PROCESS: DRAWING A CHARGE. [*Photos by Sears.*

The Turbines of the New Cunarders.

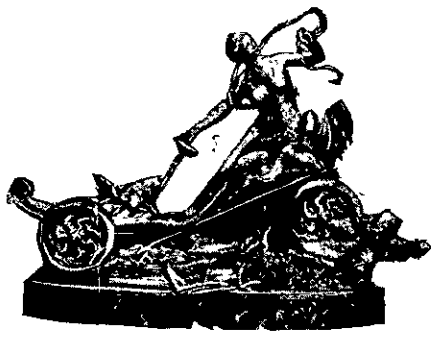
The most important feature of these vessels is the motive power. The installation of engines in a liner capable of developing some 80,000 horse power will be another triumph for British marine engineers. The power will be divided into four units, each complete in itself, and each driving a separate propeller. By this disposition, even should one set of engines fail, there will still be available sufficient power to propel the vessel at some 22 knots per hour. Each unit will develop the same horse power. Owing to the great breadth of the ship the four turbines will be placed upon the same platform, and each will drive its separate shaft. The propellers of the inner pair of turbines will be placed just forward of the rudder in the position generally occupied, while the screws of the outer pair will be situated some little distance forward.

The turbines will be of huge proportions. In the case of the *Caronia*, which is now plying between New York and Liverpool, and the machinery of which develops some 23,000 horse power, there are no fewer than 1,200,000 blades upon which the steam impinges. From this one gains some idea of the number required for these 80,000 horse-power engines. The turbine drums are some 12 ft. in length by 8 ft. in diameter and weigh 15 tons. In the case of the rotors for the low-pressure turbines an interesting record in casting operations has been created by Sir W. G. Armstrong Whitworth and Company, at the Manchester works, by their fluid-pressure system. This was the casting of a steel ingot weighing 120 tons, the largest ever made. The ingot mould, which weighs 180 tons, was filled with molten steel and was then submitted to enormous pressure in a hydraulic press, the ram of which, some 6 ft. in diameter, was brought to bear upon the mass with a pressure of three tons per square inch. The molten mass was thus subjected to a total pressure of 12,000 tons. In casting such mammoth ingots cracks and fissures detrimental to the soundness of the metal are liable to develop, whereas by the fluid-pressure system the ingot is rendered perfectly homogeneous.

Owing to the great beam of the ship it has been found possible to place the boilers four abreast and yet leave ample room for coal bunkers in the wings. The boilers are of the Scotch type and are of huge proportions, so that an adequate supply of steam can be raised in cases of emergency—if, for instance, the reserve power of the turbines were called into requisition in heavy weather.

Development of the United States Meat Trade.

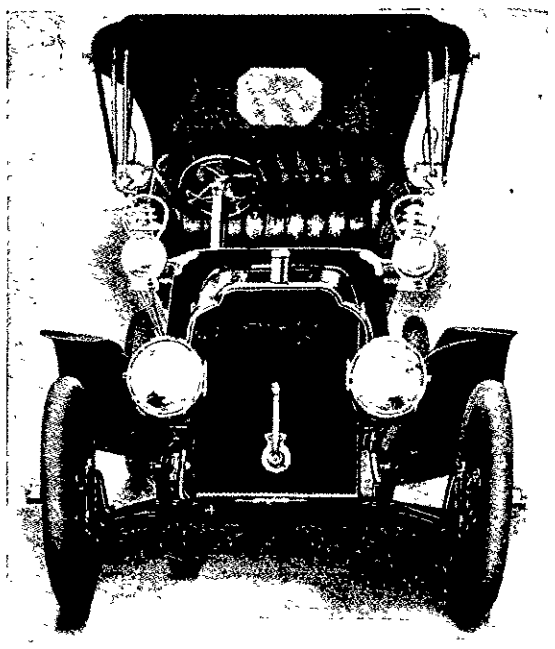
PERIOD.	IMPROVEMENT IN WORKING.	ORIGINAL PROCESSES.	ORIGINAL PRODUCTS.
1860–1870 1860–1870	Steam Power, Stationary Refrigeration, Artificial Cold Storage.	Killing, Curing, Smoking, Salting, Grinding and Cooking Pickling, Rendering.	Hides and Pelts, Smoked Meats, Salt Meats, Sausages, Pickled Meats, Casings, Tallow and Lard.
		ADDITIONAL PROCESSES.	ADDITIONAL PRODUCTS.
1870–1880	Refrigator Cars.	Canning.	From matter originally consigned to the furnaces as waste. Bones, Horns, Hoofs, Fertilisers, Glue, Wool, Bristles, Hair Skins, Oleo Oil, Stearine, Suet.
1880–1890	Chemical Laboratories. Factory Inspection. Electric Lighting.	Refineries. Fellmongeries.	Bone Oils, Phosphorous, Albumen, Chemical Fluids, Pelts, Dried Beef, Tongues, Potted Meats, Mince Meats, Game, Corned Beef, Refined Oils, Soap, Cottoline, Cottosuet.
1890–1905	United States. Meat Inspection Electric Power. Medical Dept.		Pepsine, Pancreatins, Glycerine, Extracts, Poultry, Eggs, Butter, Butterine.



The ....Motor.

The Ford Model "N."

This is the Ford four-cylinder 15-18 h.p. runabout which was announced last summer for sale in the colony at the very low price of £225; its appearance marks a revolution in the automobile trade The general public has been clamouring for a substantial car at a price commensurate with other manufactured commodities, and that such a car would eventually be offered has been the conviction of many who have closely followed the progress of motor-vehicle manufacture, and for that car they have been waiting. To build such a car, however, means more than is realised by the average citizen; it means that thousands of such cars must be constructed to reduce cost, and it is obvious that such a car dare not have one weak spot; every feature, every principle, must be thoroughly proven and its merit accurately determined. It must be of standard construction, free from freakish ideas and theoretical innovations, and once built, to remain without change or alteration for several years. So every detail of the Ford



FORD MODEL "N": FRONT VIEW.

model "N" has been thoroughly tested before beginning its manufacture, and the car is a known quantity from carburetter to muffler, from tyre to top.

The specifications are: wheel base, 84"; tread, 56"; wheels, 28"; fitted with 2½, interchangeable with 3", clincher tyres; engine, 4 cylinder vertical, 15" to 18", in front under the hood; planetary change-speed gear, with two forward and one reverse speeds; shaft drive; weight about 800 lbs. The engine is of $3\frac{3}{4}$" bore by $3\frac{3}{8}$" stroke; the cylinders are cast in pairs, with integral water jackets, the valves are single-piece forgings, inlet and exhaust being interchangeable. It is interesting to note that the flange at the bottom of the cylinder is extended so that it includes the bosses into which these guides are forced, thus insuring perfect alignment of valves and push rods. A drop forged crank shaft of the three-bearing type is used, the cam shaft and cams are cut from one solid piece of steel, eliminating all possibility of the cams working loose, a common occurrence heretofore. The pistons are fitted with four rings in two grooves. The upper ring is single and eccentric, diagonally split. In the lower groove are three rings—two thin, narrow ones, which are pressed outward by a wide ring beneath, this is commonly called bull-ring construction Contrary to the usual practice, the flywheel is in front, and its propeller shaped spokes suck air through the Whitlock cellular radiator, creating a forced draught. The change-speed gear is of the planetary type and no internal gears are used, each steel gear meshes with a bronze one, an aluminium frame supports the change gear, and the entire power plant is very compact and has a three-point support.

The rear axle is equipped with Hyatt roller bearings throughout, and is especially well constructed, the two-side radius, or strut rods, fastened to the axle near the rear wheels, are joined to the upper end of the sleeve enclosing the driving shaft—giving another triangular support.

The sleeve surrounding the shaft terminates in a large globe joint in the heavy frame cross bar; within the globe is the flexible universal joint connecting the power plant with the driving shaft. The carburetter is of the latest approved automatically compensating type. A constantly correct mixture of gasoline and air is supplied, regardless of engine speed or throttle position. The body is suspended at three points—on the full elliptic springs in the rear and swivelled on the centre of the transverse, half-elliptic spring in front, the front spring being shackled at each end near the steering knuckle yoke.

The New Zealand agents for the Ford Motor Company are the Automobile Co. of N.Z., Ltd., of Wellington, who are prepared to fix agencies for unallotted territory for the sale and representation of this car.

No Speed Limit for Motor Cars.

INCREASED TAXATION FOR BETTER ROADS

COMMISSION'S REPORT.

The feature of the report recently issued by the Royal Commission on Motor Cars is the recommendation of the abolition of the speed limit of twenty miles an hour.

Another striking point is that the Commission recommends increased and consolidated taxation on motor cars, the sums so obtained to be spent on improving English roads

The following are the principal recommendations of the Commissioners as contained in the *Daily Mail* of August 15th last —

DANGER AREAS.

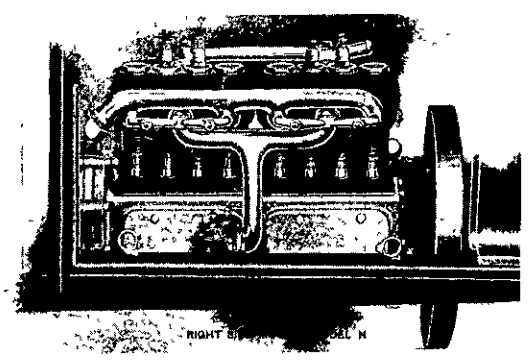
1. Abolition of the limit of twenty miles an hour for light cars, speed to be controlled by the section of the Act making it an offence to drive recklessly, negligently, or in a way dangerous to the public; a limit of twelve miles for inhabited places, dangerous corners, and hills, etc., where adopted by the authorities, to be indicated by signals, or in large towns by due advertisement.

2. Limit for cars weighing from two to three tons with non-resilient tyres to be five miles an hour.

3. A central department to allocate the revenue from taxation of cars to the authorities for the improvement of roads. Amendment of the law as to extraordinary road damage by heavy traffic.

4. Emission of smoke or visible vapour so as to cause annoyance or danger, and excessive noise or vibration—not momentary—to be an offence.

5. Owners to be liable if shown to have abetted drivers in committing offences, duties of owners as to giving information for identification of drivers



FORD MODEL "N" THE 4-CYLINDER MOTOR.

enlarged; special penalty for being drunk in charge of a car, and right of appeal when endorsement or fine of over £1 is imposed.

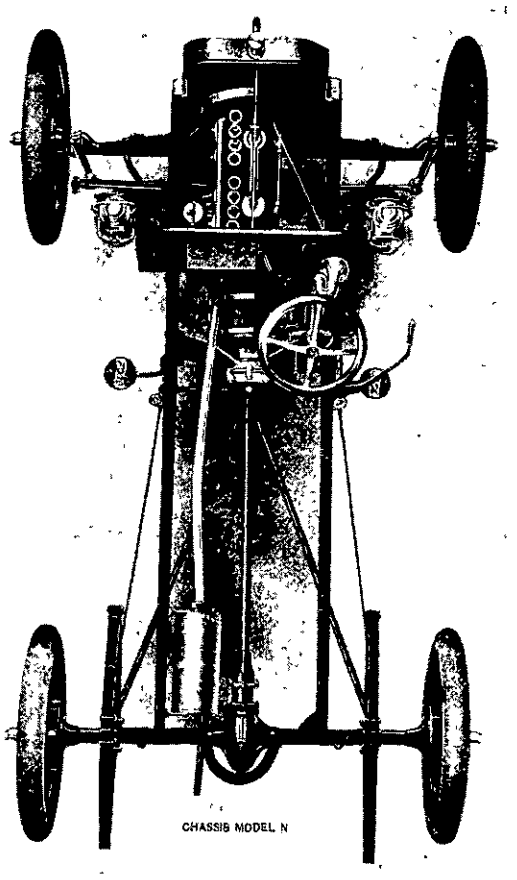
In dealing with the proposed abolition of the speed limit, the Commissioners admit that chief constables desired to retain it. Evidence showed that speeds of forty or fifty miles are rarely attained, though twenty is often exceeded. Statistics show that the police largely rely at present on the reckless driving clause of the Act, and in forty-six out of eighty-eight counties they dispense with limit section altogether.

A suggestion for specially trained constables for motor-car duty is considered worthy of attention.

THE DUST NUISANCE.

The Commissioners are convinced that the main roads, at any rate, must be made more capable of carrying heavy motor traffic. They point to the remarkable increase in cars from 51,000 to 88,600 between January 1, 1905, and May 1, 1906. They believe economy of upkeep will repay the extra cost of construction. They think a solid foundation surfaced with granite or hard stone, the binding being screened gravel or chippings of the same stone, the best type of macadam. The system of "armouring" with stone blocks parts of roads subject to heavy traffic—German "Kleinpflaster," Liverpool "random setts"—is worthy of careful consideration. Experiments with dust preventives—tar, Westrumite, etc.—have not yet supplied satisfactory information.

While no one method of road construction



FORD MODEL "N" THE CHASSIS.

can be recommended, the Commissioners unhesitatingly approve the idea of devoting revenues—not fines—derived from motor cars to road improvement.

The amount collected from motor cars in 1905-6 was about £100,000.

£10,000 IN MOTOR FINES.

A return of motor car offences from July 1, 1904, to June 30, 1905, is also issued. The number of prosecutions was 6,165. Of these 739 were withdrawn or dismissed, 452 discharged on payment of costs, 4915 defendants were fined, 54 were otherwise disposed of, and 5 committed for trial. The total amount of fines was £10,887.

There were 1,245 prosecutions for exceeding limits of speed; 1,152 defendants were convicted, and 93 charges dismissed.

Odourless Motor 'Buses.

Thirty Vanguard motor omnibuses fitted with the new automatic lubrication appliance, which it is claimed will have the effect of abolishing objectionable smells, made their appearance on the London streets recently, and more will follow every week until the entire Vanguard fleet of 110 cars has been converted odourless vehicles. The new system costs about £40 a car.

The Motosacoche.

Messrs. Herbert H. Smith have supplied us with the following extract from the *Motor Cycle*, of May 21st., 1906 :—

It is a matter of regret that the competition for light-weight motor bicycles held by the Allgemeine Motor-fahrer-Verband over a course of 178 kilometers in the Vienna and Semmering district on the 6th inst., was attended with such bad weather. The conditions were most unfavourable, as the rain fell in torrents, and turned the streets into a veritable quagmire, which proved a serious obstacle not only for the light-weight machines, but also for heavy ones, and even for autocars. Of the eleven motor cyclists who started, only two managed to complete the course. In the competition were three 1¼ h.p. Austria, three 1½ h.p. Motosacoche, two 1½ h.p. Schiebert, and three 1½ h.p. Bree motor bicycles.

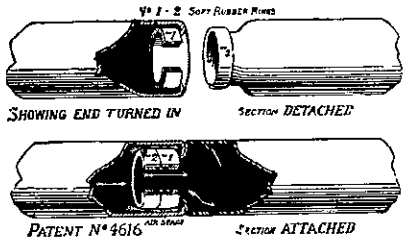
The winner was Heinrich Drager, on a Motosacoche, in 8 h. 15 m.., representing an average of just over thirteen miles per hour. Baumgartner, on a 1½ h.p. Bree, finished second in 9 h. 17 min. The result, considering the unfavourable weather, is very good. The bicycles complete, with the motor and fittings, weighed from seventy-seven pounds upwards, and the winner carried a twelve-stone rider over the 109 miles of heavy roads at a rate exceeding thirteen miles per hour, including the climb of the Semmering hill, which in Austria is considered a score for the light-weight motor bicycle.

Mr. Henry Sturmey, the well-known English motorist and authority on cars, recently wrote to *The Motor*, London, as follows :—

Admitting the pleasure of riding in a six or eight cylinder car, it must also be admitted that a great deal of comfort and smoothness of running will be found in a good single-cylinder vehicle, properly equipped in the way of fly-wheel. Last week I had a friend staying with me for a few days who brought his single-cylinder Cadillac with him, and I had a very pleasant run on it. Except for a few seconds at starting, or when the spark was left advanced a little too long on a stiff grade, the throbbing of the engine was barely noticeable, so that under general conditions of driving, the car ran as smoothly and as steadily as all but the most fastidious could desire, and when the remarkable difference in complication and number of parts is taken into consideration, I really do not think that, for the use of the "average man," there is much in favour of the single-cylinder. I took my friend for this run over a fairly undulating country, and it was really remarkable the way in which the little car took quite considerable grades "on her top," so that we only got on the low gear—there were only two speeds—three or four times in a 20 miles run, which, after all, is not very much to grumble at.

Rich's Detachable Air Tubes for Motor Cycles and Tricars.

THIS handy device, which we illustrate through the courtesy of Messrs. Dunhill, London, has a patent joint and can be entirely removed without



taking out the wheel, which is a great convenience when making roadside repairs, or when fitting a spare tube. Unlike those of other detachable tubes, the joint is said to afford free circulation of air.

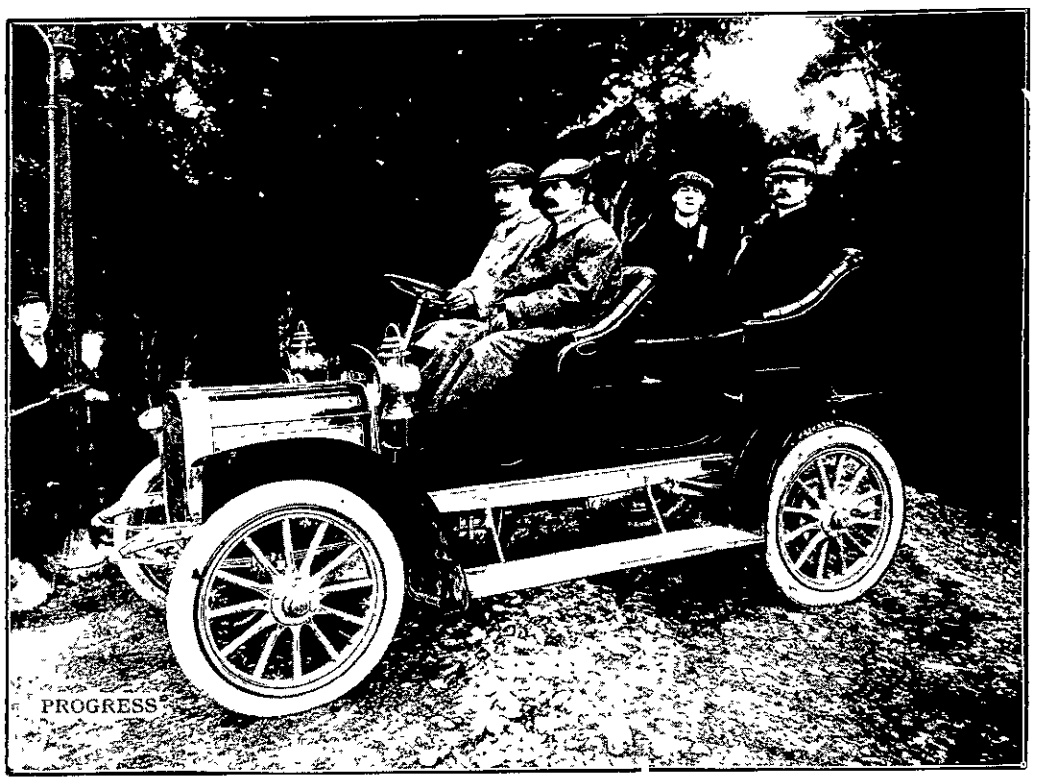
Dunhill's Duplex Lens Lamp.

The accompanying illustration shows the lamp that has become generally popular with English motorists. It has a self-contained generator and is of 1,500 c.p. Both lens and parabolic reflector are fitted, and the single burner gives light for five hours with one charge. Its particular use is directed to side lighting for large cars.

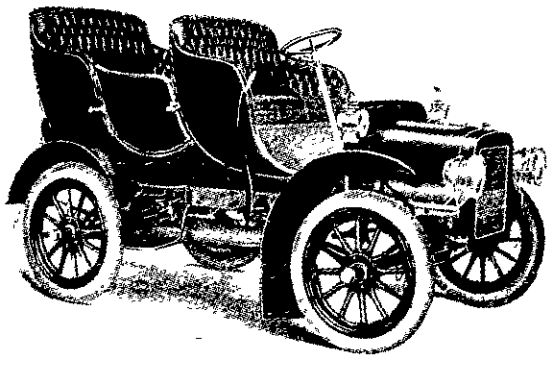
THE STEAM TURBINE.

BY THE HON. C. A. PARSONS, C.B., F.R.S.

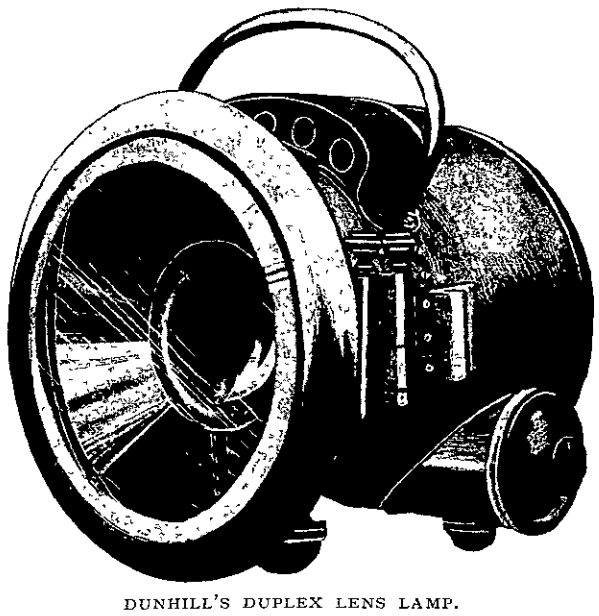
THE introduction of the turbine commenced in 1884 with a 10 horse-power turbine and dynamo. The system adopted in 1884 was that of causing the steam to pass through a large number of turbines in series suitably proportioned, so as to utilise the expansion of the steam which flowed at a comparatively moderate velocity because of its circuitous course through the many turbines of the series, just as is the case with water flowing through a long course of rapids from the lake of high level to one of lower level, the lake of high level corresponding to the boiler, and the one of lower level to the condenser. In the initial stages the course of procedure commenced with the construction of a few turbine engines of small size, these were carefully tested and sent out to work and closely watched by competent men. Defects were promptly remedied and improvements discovered which were adopted in new designs and resulted in gradual accumulation of experience and trade knowledge. In the first year three engines were set to work, in the next year ten, and so on, until at the end of the fifth year, three hundred and fifty had been put into successful operation, all of the non-condensing type aggregating four thousand horse power. In 1888 working plans were prepared for a turbine of the condensing type which presented hopes of realising unprecedented economy in the use of steam for motive power and a great step in the development of the turbine. It was not till 1891, however, that facilities were available for its construction, and the anticipations were at length fulfilled when in the following year a hundred unit condensing turbo-generator was found to consume only twenty-seven pounds of steam per kilowatt hour, thus equalling the performance of the best triple-expansion engine of that date in the driving of dynamos. The turbine which achieved this result differed materially from that designed in 1888 because of the temporary loss of patent rights under which the work had been carried on up to this period. In 1893 the patent rights were reacquired, this permitting of reversion to the original and parallel type, and subsequent experience has shown that had the 1888 design been constructed in its entirety in 1892 an economy would at that date have been obtained about 25 per cent. superior to that actually realised. There is now no question that the turbine in its present perfected and economicul form would in that case have come into general use about five years earlier, both for land and marine work. A simple explanation might be asked for as to why the turbine should be more economical than the reciprocating engine. The answer is that the turbine is able to expand the steam fully and economically from the boiler pressure right down to the condenser pressure while the reciprocating engine is unable to expand it the whole way, as a matter of fact it can only expand it usefully for about two thirds of the way. This is the chief difference, the other differences nearly compensate each other, for instance, the turbine has more waste from leakage, while in the piston engine there is a large waste from condensation and re-evaporation which does not occur in the turbine. Then again the turbine has fluid friction from steam and water and very little mechanical friction, while the reciprocating engine has much more mechanical friction and very little fluid friction.



THE LATEST 10-12 H.P. ARGYLL, SHOWING THE CAR AT THE ENTRANCE TO BELLEVUE GARDENS AFTER ITS FIRST RUN IN NEW ZEALAND.



CADILLAC 10-12 H.P. TOURING CAR.



DUNHILL'S DUPLEX LENS LAMP.
DIAMETER, 8½ IN WEIGHT, 6½ LB.

The *Overland Monthly*, published in San Francisco, has an illustration in its July issue depicting the San Francisco branch of the New Zealand Insurance Company, taken immediately after the earthquake. Under the picture it is stated that this was the first insurance company to start up on their old location in California street.

THE HON. SIR J. G. WARD, K.C.M.G.,
Premier of New Zealand, Minister for Railways during the Seddon Administration.

..North Island.. Main Trunk Line.

A NATIONAL UNDERTAKING.

By Our Special Commissioner.

THE HON. W. HALL-JONES,
Minister for Public Works and Railways.

PART I.

Every New Zealand colonist who takes any interest in the progress of his country has also an interest in the construction of the North Island Main Trunk Railway, but few are aware of the tremendous amount of pioneering energy and endurance, engineering skill and patient constructive industry which has already been expended, and must still be continued, before our national railway is an accomplished fact. The recent statement of the Minister for Public Works that he hopes to have the trains running all the way from Auckland to Wellington in about a couple of years has brought the subject prominently before the public, for there can be no difference of opinion as to the convenience, and even necessity, of such a railway for commercial purposes, while its value as a factor in settling the interior, and thereby contributing to the general prosperity of the colony, can be scarcely overestimated. In the centre of the North Island the colony possesses splendid assets in the enormous area of magnificent timber suitable for milling and conversion into wealth; an immense area of unused land, much of it of first-class quality; and wonderful mountain, forest and river scenery. The latter, though not so readily convertible, is none the less valuable, for it remains the property of the people, and is for ever the glory of the country and a source of enjoyment to our population and of wonder to our kin who visit us from over the seas. Few city dwellers have had the opportunity of viewing the panorama of the central mountain group—the snow-topped Ruapehu and Tongariro, with the weird-looking Ngauruhoe, and its continually steaming crater between. The means of access hitherto have been such that only few could take advantage of them, but the completion of the Main Trunk Line will afford a ready and comfortable means of obtaining one of the grandest views of mountain and forest scenery in all the world. The splendid timber resources, which are already being tapped at each end by the Line, will contribute in no small degree to the earnings of the railway and to the revenues of the State by royalties, and if the forest on such of the land as is best fitted to bear a timber crop is only re-planted as it is cut out, this source of revenue, both as regards freight and royalty may be made more or less of a permanent character. Much of the country is suitable for dairying or grazing after the timber has been felled, and will in time carry a fair population, which could hardly exist there without railway communication; while the line will undoubtedly serve another most useful purpose in supplying the native landholders with an inducement either to make their lands productive themselves, or to dispose of them to Europeans. In the future, too, when New Zealand takes her destined place among the nations, we shall have a strategical railway of supreme importance, secure against hostile attentions from the sea.

History of the Undertaking.

The history of the Line presents some novel features, and, in view of the interest aroused by the approaching completion of the work, the

NORTH ISLAND MAIN TRUNK RAILWAY:
TYPICAL COUNTRY THROUGH WHICH A GREAT PART OF THE RAILWAY HAS BEEN CONSTRUCTED.

This article was prepared by Mr. H. J. H. Blow, Under-Secretary of Public Works, with the assistance of Messrs. Holmes, Hursthouse and Ronayne. All were senior officers closely associated with the undertaking. The account of the incident with the Maoris, and of the turning of the first sod is first hand from Mr. Hursthouse. The above is evident from papers on Ministry of Works file 19/577.

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present is an opportune time to touch upon some of the incidents which came in the way of the men who were identified with the project in its earlier stages.

The inauguration of the "Public Works Policy" of Sir Julius Vogel, in 1870, may be taken as the starting point of railway-construction works in New Zealand. Prior to that date the Provincial Governments of Auckland, Canterbury and Otago had embarked on a railway policy of limited extent, and some of the works had actually been carried out; but as regards the North Island Main Trunk Railway practically nothing had been done. Under the provisions of "The Immigration and Public Works Act, 1870," the Central Government took

MR. P. S. HAY, M.A., M.INST. C.E., ENGINEER-IN-CHIEF.

charge of railway construction. Surveys of the various routes proposed were made, and the construction of certain lines determined upon; but very little in the way of actual construction was accomplished until the arrival of Mr. James Brogden, of the firm of John Brogden and Sons, a firm responsible for much of the railway works in the early days of the colony. On the 10th August, 1872, a contract was entered into with Messrs. Brogden for the Auckland to Mercer railway, and with this section the Main Trunk Line may be said to have had its beginnings. It is interesting to note that at this time a scheme of combined railway and steamer service with the lower Waikato was seriously considered. The idea was to use the railway from Auckland to Mercer, then to take steamer to Ngaruawahia, and again take to the railway at this point. The advocates of through railway communication prevailed, however, and the Line was gradually carried forward until it reached the frontier line of the King Country at Te Awamutu, 100 miles from Auckland. Regular traffic to this point was begun in July, 1880. By this time the idea of constructing a through line to connect Auckland and Wellington by rail had assumed definite shape. In the Public Works Statement of 1881 the following passage occurred:—"Unsurveyed intervals of 120 miles on the west, and 160 miles on the east, separate the extremity of the Waikato line at Te Awamutu from Waitara (Taranaki) and Napier respectively. The Government will lose no opportunity which may present itself of obtaining such information with regard to the intervening country, as will enable the best mode of completing this main arterial line to be determined." This contains no reference to a possible central route. Evidently, therefore, the idea at that time was to construct either an East or West Coast line. In 1882 the North Island Main Trunk Railway Loan Act was passed, which authorised the raising of £1,000,000 for the construction of the North Island Main Trunk Railway, but this Act also is silent as to the route to be adopted. The unsatisfactory relations existing between the Europeans and the natives, and the determination of the natives to maintain the King Country as a preserve for their own race, were, however, obstacles to the further progress of the Line southwards. Construction work, even in the Waikato, was at one time not considered any too safe, and a portion of the Line southwards of Mercer was carried out under quite unusual conditions. The Government considered it desirable to increase the defence force in the Waikato, and it was decided to effect the twofold object of having an additional armed force available in the district, and at the same time pushing on the construction of the railway. Thus, the Engineer Volunteer Militia, about 200 strong, was enrolled. These men marched under arms to the works, piled their muskets and took up their more prosaic picks and shovels, and then returned under arms to camp, where a sufficient amount of military drill and discipline was exercised to assure their being available for defence purposes in case of necessity. Their work was of course directed by the Railway Engineers, but they were under the command of military officers. The system worked very well, and the work done by the men was quite satisfactory.

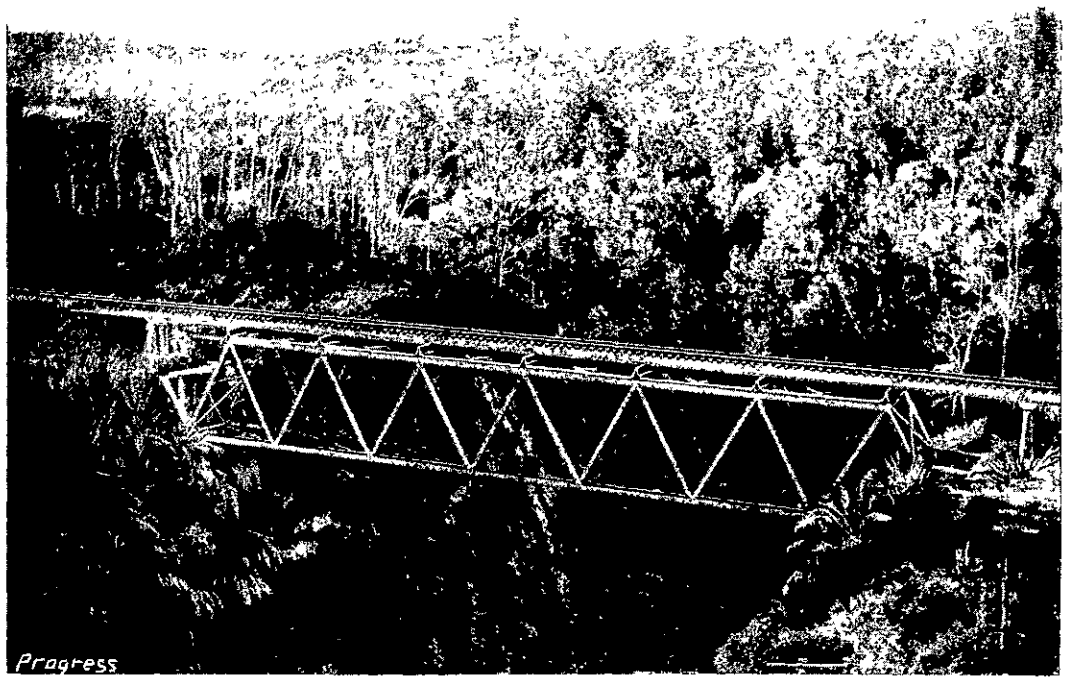
The Native Difficulty.

In the history of the Main Trunk Railway mention is always made of the native difficulty, and it may not be out of place to digress here and trace the origin of this difficulty and study its features and results so far as they affected the progress of the railway. The active hostilities of 1865 may be said to have come to an end with the battle at Orakau, a native village a few miles from Te Awamutu. Here Rewi, the famous Ngatimaniapoto fighting chief, with 250 brave but poorly armed warriors of his tribe, without water and with very little food, and surrounded by 600 British soldiers, well armed, resisted all attempts to take the pah by assault, and when called upon to surrender, after three days hard fighting, jumped on the parapet and defied his enemies, uttering words which have since become famous, to the effect that the fighting would go on "for ever, and ever, and ever."

One result of the war was the agreement between the two races upon a frontier line, beyond which the European and his law were not to go, but where the Maoris were to retain their own rule and customs. This line extended from the Puniu river, near Te Awamutu, on the north to Pukearuhe, in Taranaki, and ran down near Ruapehu on the east to some place not very well defined, in the upper Rangitikei, which was the southern boundary. On one point the Maori was firm: he would sell no more land to the European, and only by special permission of the chiefs were a few favoured white men allowed to travel through his preserve. This attitude of passive resistance was maintained without advantage or injury to either party, until Te Whiti, the prophet, by his sensational preaching and claims to divine powers, attracted a large following to Parihaka. Te Whiti had seen some civilisation in his youth; he had acted as chainman on a survey under Mr. Hursthouse, the present Chief Engineer of Roads; he had been educated by a missionary, and was a keen student of the scriptures. The story of his alleged superhuman powers attracted the tribes from all parts of the island, till over 2,000 natives were assembled at Parihaka. They were promised that the lands confiscated after the war would be restored through the influence of the prophet, but little harm was done till a crisis was brought about by the action of some of the natives, who, under Te Whiti's orders, boldly began to plough the lands occupied by some of the settlers, evidently with the object of asserting their right to the land. This arbitrary

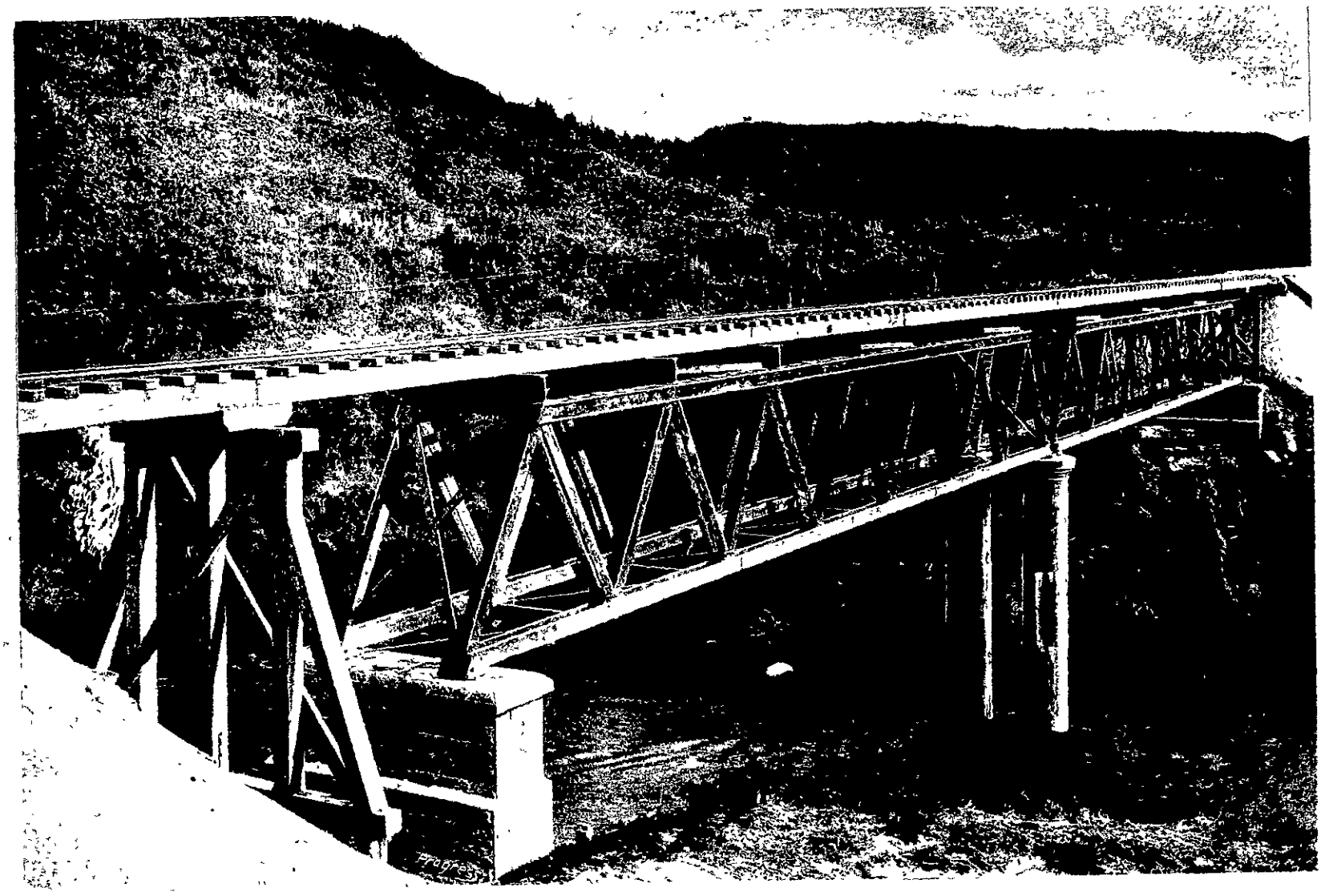
MR. H. J. H. BLOW, UNDER-SECRETARY FOR PUBLIC WORKS.

action forced the hand of the Government; a force of armed constabulary and volunteers was dispatched to Taranaki, roads and redoubts built, and offending Maoris arrested, and some lodged in prison; but, as this mild form of martyrdom was rather welcomed by them, and prisoners were becoming too numerous, they were restored in numbers to their homes. The Government force finally took possession of Parihaka without bloodshed, and the prospective rebellion was nipped in the bud. The effect of these incidents on the native mind was to bring forcibly home to them the hopelessness of pursuing further the policy of resistance and obstruction to the progress of settlement in the King Country, and their long-maintained objection to the construction of the railway through this stretch of country was overcome by the Native Minister, Mr. John

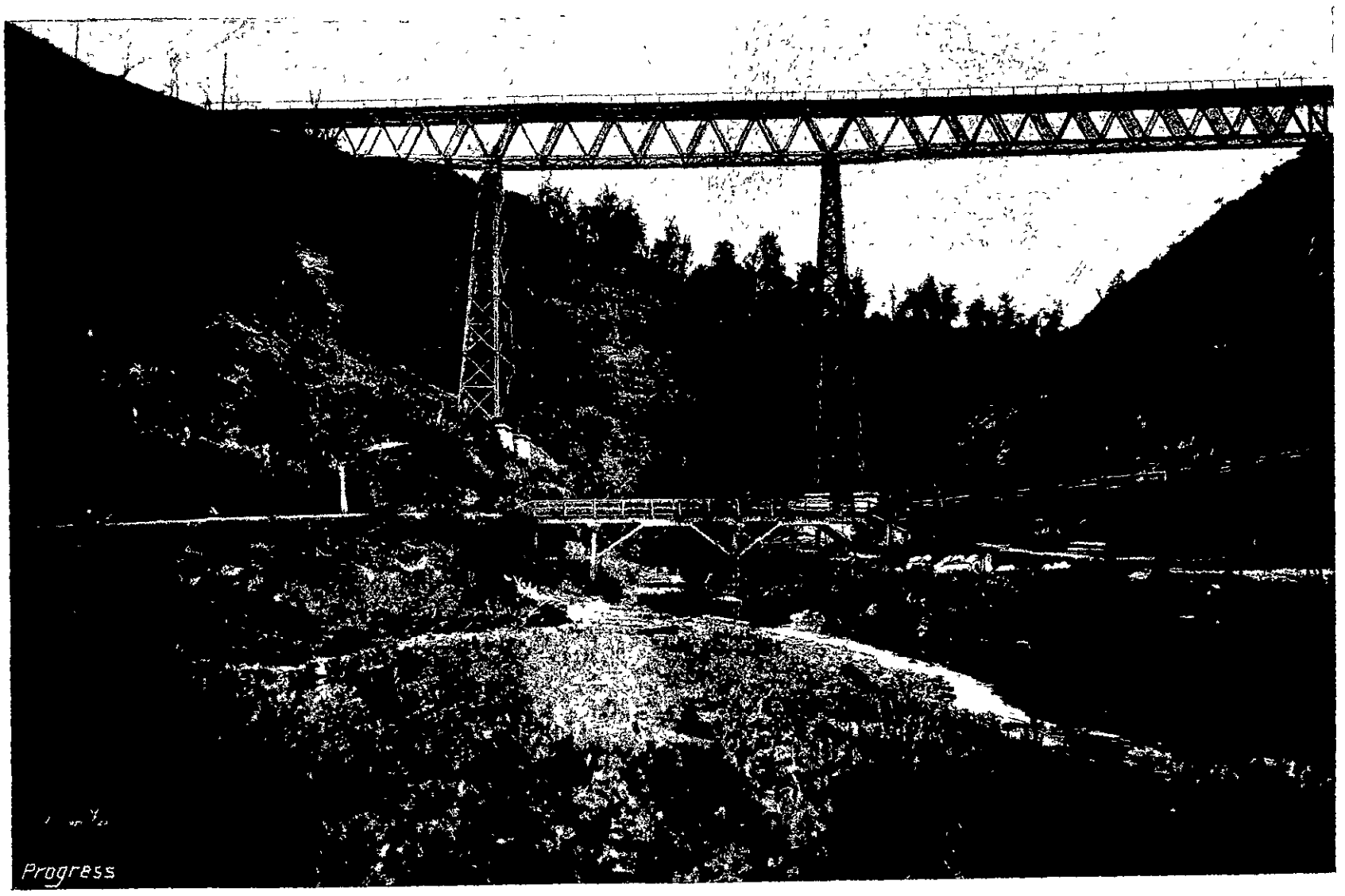


NORTH ISLAND MAIN TRUNK RAILWAY BRIDGE OVER TOI CREEK 37 MILES 54 CHAINS FROM MARTON JUNCTION; ONE STEEL GIRDER SPAN OF 156 FT., TWO TIMBER SPANS OF 20 FT., AND TWO 11 FT.; 187 FT. FROM CREEK BED TO RAIL LEVEL.

NORTH ISLAND MAIN TRUNK RAILWAY.

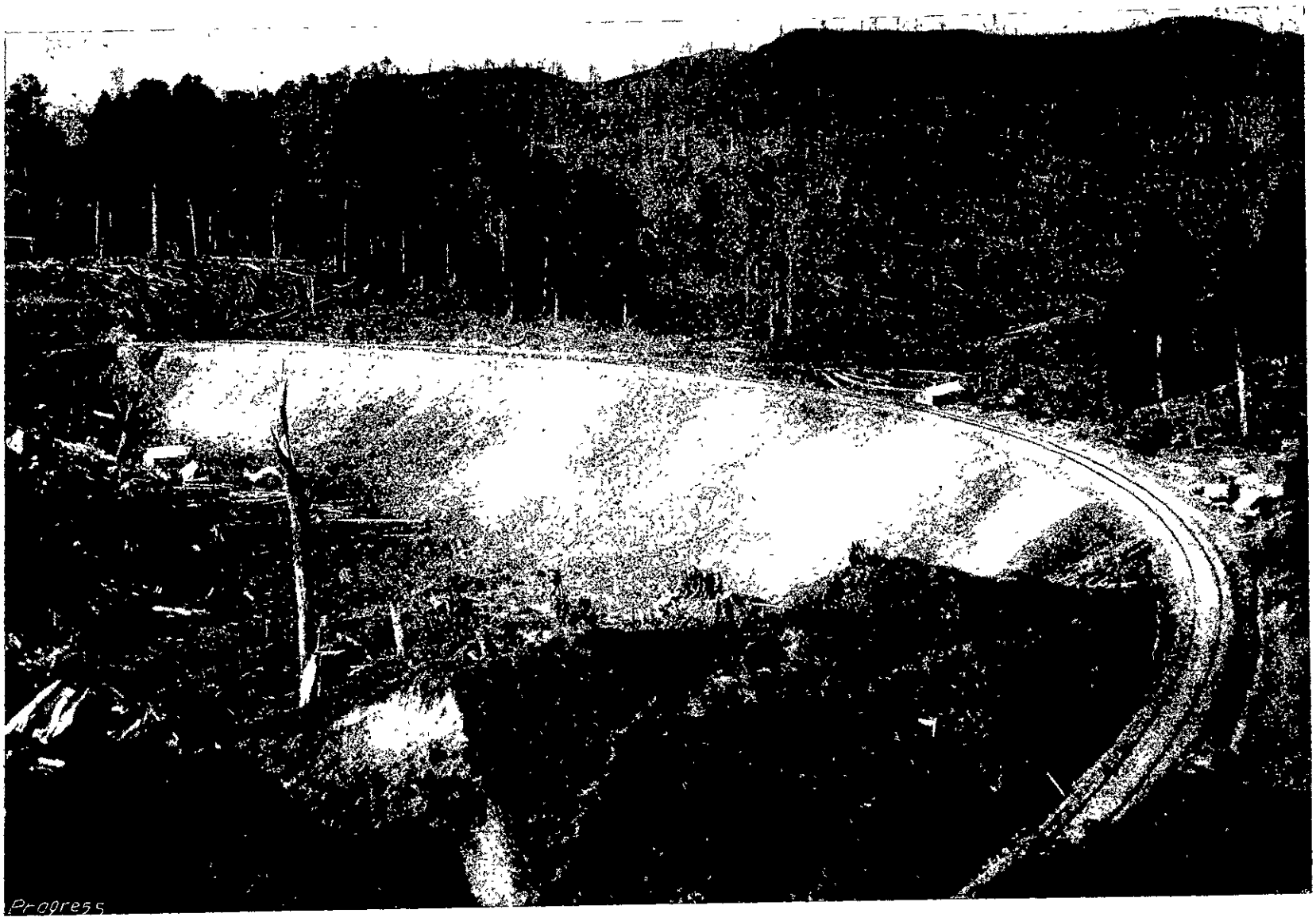


ONGARUE RIVER BRIDGE (No. 1 CROSSING). One 11 ft., four 20 ft., and two 100 ft. spans. Height from River bed to rail level, 60 ft.

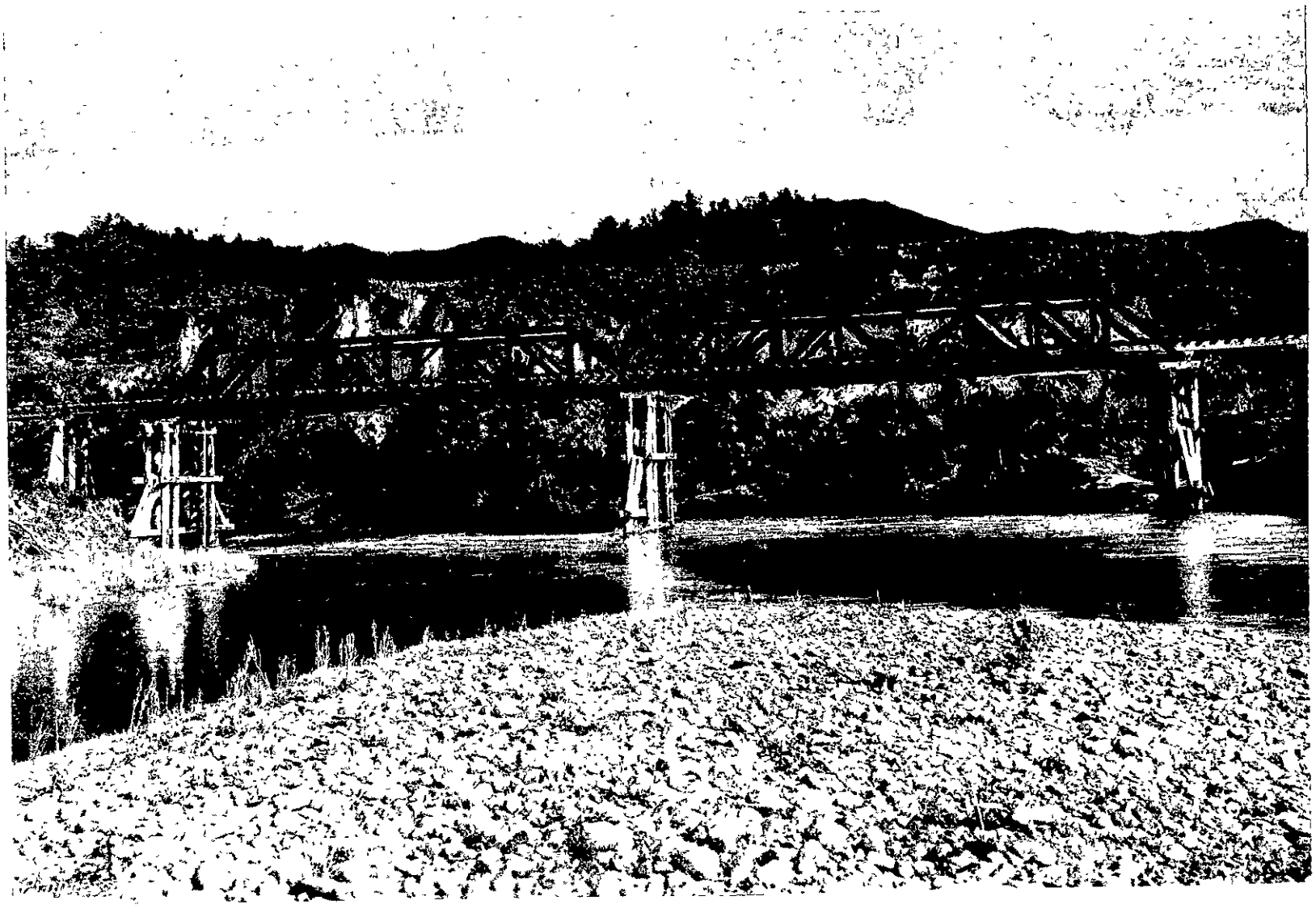


MAKOHINE VIADUCT. One centre span, 176 ft., two side spans, 247 ft., and two end spans, 40 ft. Height from river bed to rail level, 237 ft.

NORTH ISLAND MAIN TRUNK RAILWAY.



EMBANKMENT, about 2 miles north of Taihape, 63 ft. high; contents, 100,000 cubic yards.



ONGARUE RIVER BRIDGE (No. 3 CROSSING). Six 20 ft. and two 80 ft. spans. Height from river bed to rail level, 30 ft.

NORTH ISLAND MAIN TRUNK RAILWAY: 15 FT. WATER TUNNEL CARRYING TAIHAPE STREAM UNDER RAILWAY EMBANKMENT, AT 43 MILES 52 CHAINS FROM MARTON JUNCTION.

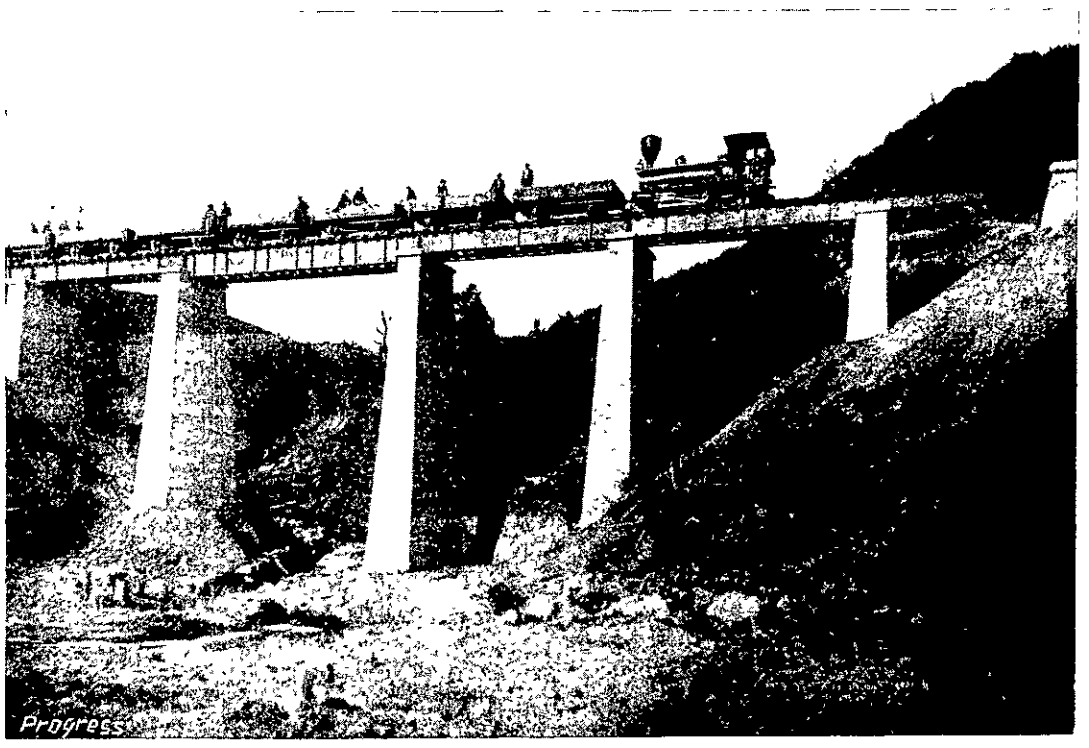
Bryce; and his successor in office, the Hon. Mr Ballance, was able to negotiate an arrangement whereby a strip of land one chain wide along the whole route, where it traversed Maori land, with additional widths at stations and elsewhere where required, was presented to the Government free of cost.

Exploration Surveys.

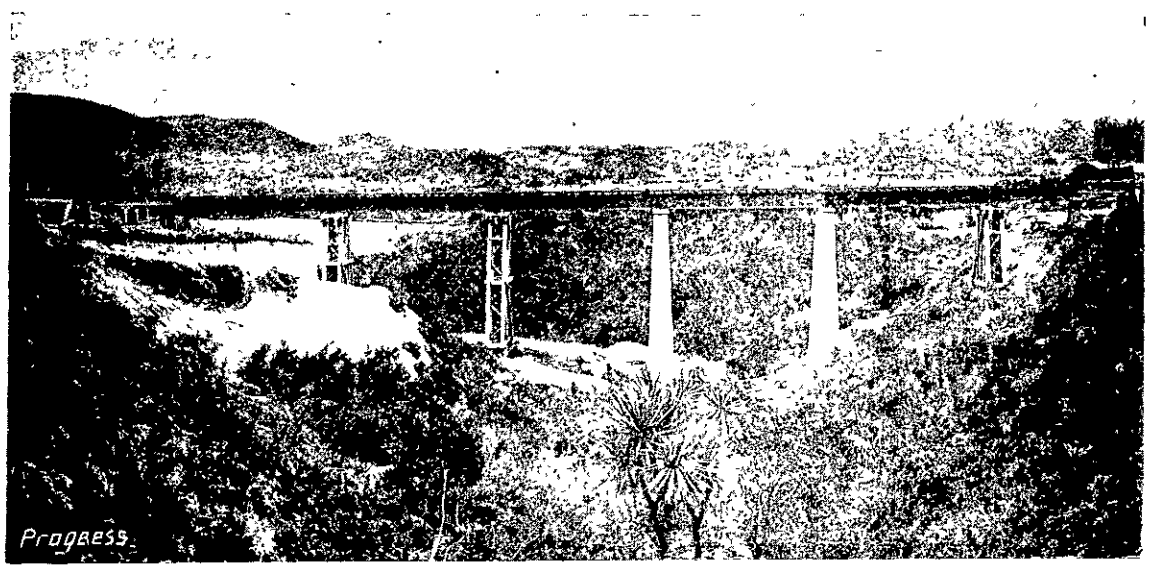
The way was now clear for the establishment of through railway communication between the two provinces, and the project was taken up with much enthusiasm. Exploration surveys to ascertain the best available route were put in hand in three different directions. A line to connect with the existing railway system of Taranaki appeared to be the most favoured. Very little was known by the authorities of the nature of the country in the interior of Taranaki, so that exploration had to be made of the whole of the area from Stratford northwards to Te Kuiti. Dense forest was met with in every direction, and the topographical features were mainly sharp ridges and narrow gullies, so the work of exploration was long and tedious. Mr. C. W. Hursthouse was in charge of one party on the Taranaki side, another part of the country was examined by Messrs. R. W. Holmes and Morgan Carkeek, all of whom are still in active service under the Government. Investigation of what was called the Central Route was made by a party under the direction of Mr. John Rochfort, about the same time; and, so that no possibilities might be overlooked, a line was also explored by Mr. G. P. Williams, now of Christchurch, which took a more easterly direction from Te Awamutu and connected with the southern railway system at Hastings, in Hawkes Bay. Mr. Williams was allowed to go through his survey in peace, his only complaint being that in examining the Maori country he found that the work occupied twice as much time as it should, owing to the dilatory habits of his native assistants, and the difficulty of moving about anywhere without constant long talks with them. Mr. Holmes' progress was interrupted by natives once; Mr Rochfort's party was stopped at Kariot, and he was told that if he persevered he would be shot. Some dispute about a sale of land, in which one of his chammen played a part, was the cause of the trouble which was settled by a long korero and the discharge of the offending assistant, the tribe afterwards helping Mr. Rochfort to cut his survey line through their lands.

Assault on Mr. Hursthouse.

Mr. Hursthouse had a far more disagreeable experience in the northern portion of the country, and for a time it was feared that the incident in which he played a leading, though unwilling, part might result in fresh hostilities between the races. In March 1883, by direction of the Government, he set out from Alexandra (now known as Pirongia) with Mr. W. Newsham, as assistant, to explore the country from Te Awamutu south and westward towards Waitara in Taranaki. They were unable to obtain a guide, so were compelled to attempt the undertaking alone. They got as far as Otorohanga by the evening of the first day, where they were told by the resident natives that they would not be allowed to go further, and must return. This they refused to do, telling the Maoris that their orders were to go on to Mokau, on the way to New Plymouth, and that they intended to do so. Mr. Hursthouse had been provided by the Hon. Mr. Byrce, Native Minister, with a letter addressed to the chiefs whom he was likely to meet in the course of his exploration, asking them to assist him in the undertaking. This letter he presented to the natives, who held a meeting that night and decided that, notwithstanding the request of the Native Minister, they would not allow the party to proceed further. Next morning after breakfast the party started on their way southwards, but were arrested, brought back to where the Maoris were assembled, and told that, whatever their personal feelings in the matter might be, they could not allow the exploration to go on. Mr. Hursthouse told them he could not listen to this, and that unless he was taken back by force he would continue his journey; whereupon the Maoris told off two of their number, Aporo and Rawhiri, as an escort to convey the two men back to Alexandra. This Aporo was the man who had, some time prior to the Maori war, headed the party who broke up the printing press in use at Te Awamutu by Sir John Gorst. On arrival of the party at Alexandra Mr. Bryce was communicated with and informed of what had taken place. He went to Alexandra and arranged with Wahanui and Rewi Maniapoto, the principal chiefs of that part of the country, that the exploration party would start again on the following Wednesday; meanwhile, messengers were to be sent in advance of the party to tell those on the road that they were to be allowed to pass unmolested. The party, with Wetere te Ringaringa as guide, made a second start from Alexandra on Tuesday, one day before the time arranged They breakfasted at Te Kopua with the chief Wahanui, who, in reply to an enquiry if the date of departure made any difference, said: "All days are Wednesdays while you are with Wetere." On arrival at Otorohanga the party were informed by Aporo, their recent escort, that, although the road as far as that point was open to them, they would encounter opposition further south. At a place called Te Uera on the afternoon of the same day, Te Mahuki a native of doubtful reputation, and some thirty others, who were waiting on the side of the track, called out to the travellers to stop and go back. This invitation was declined by Wetere, upon which Mahuki called upon his followers to arrest the two white men A scuffle ensued, during which the surveyors were pulled off their horses amidst great clamour and excitement. They were then taken a short distance and told by Mahuki to return. Wetere te Ringaringa replied that they would not do so. Thereupon the Europeans' coats and haversacks with their contents were taken from them, and, at Mahuki's command the prisoners were taken to Te Kumi, about a mile distant, where they were placed in a cooking-house, their hands tied behind their backs, and their ankles secured by chains. Wetere, the guide, seeing that further resistance was useless, left for Alexandra, the nearest telegraph station, and managed to get a message through to Mr. Bryce, then in Auckland, who took immediate action for the release of the prisoners. With Messrs. Hursthouse and Newsham, a Maori named Te Haire, one of Wetere's followers, was imprisoned, but was not tied up, and it was through his good offices that the two Europeans were able to obtain some food and drink. They remained in the uncomfortable position described



NORTH ISLAND MAIN TRUNK RAILWAY. BRIDGE OVER WAITEA RIVER, AT 127 MILES 45 CHAINS FROM MARTON JUNCTION; ONE STEEL GIRDER SPAN OF 22 FT., FOUR OF 33 FT., AND ONE OF 44 FT. CREEK BED TO RAIL LEVEL, 55 FT.



NORTH ISLAND MAIN TRUNK RAILWAY. KAKAHI RIVER BRIDGE, 125 MILES 64 CHAINS FROM MARTON, FIVE STEEL GIRDER SPANS OF 44 FT., ONE OF 22 FT.; HEIGHT, 62 FT. FROM CREEK TO RAIL LEVEL.

for nearly thirty-six hours, when they were rescued and liberated by a party of the Maniapoto tribe headed by Kahu, brother of the chief Wahanui, and Huirangi, eldest daughter of Wetere te Ringaringa. Te Kooti, of evil reputation, was at the time on his way from Te Kuiti to rescue the men, and took charge of them immediately afterwards and escorted them to Te Kuiti, where they received every possible kindness. Messages reporting the circumstances were despatched to Mr. Bryce and the public mind was somewhat relieved. Mahuki was something of a religious fanatic, and at a large meeting at Te Kuiti, announced his intention of making a raid on Alexandra the following week. He claimed to have received from Jehovah power to render the pakehas incapable of offering resistance, and although some of the chiefs endeavoured to dissuade him, with twenty odd followers he made an abortive attempt on the promised day; but, with most of his men was arrested by a party of armed constabulary, who had been in waiting. He, with several of his followers, was tried at Auckland for the assault on the surveyors and sentenced to a short term of imprisonment. He fell into the clutches of the law for several offences later, and spent a considerable time in gaol.

Messrs. Hursthouse and Newsham resumed their exploration a week later and completed their work without interruption The Native Minister himself, with a party which included two ladies also went through the same country from Alexandra to New Plymouth shortly afterwards without molestation.

Selection of the Route.

In 1884 the preliminary surveys were brought to a conclusion, and a Parliamentary Committee, consisting of seven members, all representing South Island constituencies, carefully enquired into the relative merits of the rival routes The report of the Committee states that they had held nineteen meetings, and had examined thirty-four witnesses, and had arrived at the following resolution: "That in the opinion of this Committee the best route for the North Island Main Trunk Railway is that from Marton, *via* Murimotu to Te Awamutu." This resolution was approved by six out of the seven members of the Committee, and was afterwards endorsed by the House of Representatives, and the construction of the railway, by the route referred to, was a little later formally sanctioned by both Houses of Parliament in the Railways Authorisation Act of the same year. In October of that year detailed surveys were commenced at Te Awamutu by Messrs. R. W. Holmes, Jas. Blackett and C. W. Hursthouse, and later on carried by Mr Holmes as far as Mokau. At the Marton end similar survey work was being done under the direction of Mr. D. Ross, who carried it as far as the present Taihape station. From this point Mr. Holmes again took charge, and completed the survey, with a little assistance from Mr. J. D. Louch, to its junction with his previous work at the north end.

Construction Work.

By this time the natives had been won over to a more friendly attitude towards the projected railway, and the practical work of construction was taken in hand at both ends The turning of the first sod at the northern starting point on 15th April, 1885, was made the occasion of a picturesque ceremony on the bank of the Puniu river, which had long formed the frontier line between the Waikato and the King Country. The then Premier of the colony, Sir Robert Stout, was present, together with a representative party of officials, settlers and citizens from Auckland, while the Maoris were represented by the famous chiefs Wahanui and Rewi Maniapoto about fifty natives of rank, and some hundred of others. In all, about 1500 people were present, and a brass band enlivened the proceedings at intervals. The spot selected for the ceremony was on the Maori side of the river, only about four miles distant from the battlefield of Orakau, where Rewi had twenty years before distinguished himself at the head of his tribe This day Rewi, wearing a black velvet coat and a tall hat, stood before the gathering as a friend of the Europeans—his old hatred of the race exchanged for a feeling of brotherly companionship At the request of the natives Wahanui dug the first three sods, which were wheeled some distance by the Premier and deposited on the ground; later on most of the earth so dealt with was carried away by the spectators as mementos of the occasion. There were, of course, many speeches Sir Robert Stout addressed some words of good advice to the Maoris exhorting them to cultivate their lands, educate their children and refrain from the use of strong drink. Wahanui replied on behalf of the native race in a peaceful and dignified speech, approving the restrictions on the sale of liquor in the natives' country, and with characteristic Maori eloquence urged that the clear water of the Puniu should be the boundary across which liquor should not be carried. The natives requested that a section of the Line should be reserved for construction by them and their wish was acceded to—about six miles of construction being carried out entirely by Maoris on a system of piecework. Later on many of their race were employed by contractors in the construction of further lengths of the Line, and the work done by them was to the entire satisfaction of the authorities.

Construction work at the north end under contract progressed steadily for the next three years, fifteen miles being contracted for in 1885, nearly twenty miles more in 1886, besides the long Poro-o-tarao tunnel, a tender for the construction of which was accepted in 1885. At about this period the revenue of the country fell off considerably, and the financial outlook became less satisfactory. One of the earliest consequences of the resulting depression was the diminution in expenditure on public works, and the idea of carrying the Line to completion in a few years, which invested the work with some enthusiasm at the beginning, seems to have been abandoned. It became evident, also, that the early estimates of cost would be considerably exceeded, and it is perhaps not surprising, in the face of such discouraging circumstances, that no further work was undertaken for some time, although of course the contracts already let were being steadily pushed on to completion. In 1889, therefore, we find the line completed to the Mokau valley, 34 miles south of Te Awamutu, and work at the northern end in progress only at the Poro-o-tarao tunnel, an isolated spot 10 miles lower down.

Meanwhile construction works at the southern end of the Line were also in progress. Eighteen miles of comparatively easy work carried out by contract took the Line as far as Rangatira, and a contract had also been entered into for the Mangaonoho section, comprising nearly four miles of heavier work, when, for the reasons already mentioned, progress came practical to a stop.

Changes of Government brought new ideas and policy; the co-operative system was evolved, and work resumed at both ends on this principle, under which it has been since carried out.

The section at the north end between Mokau and the Poro-o-tarao tunnel was taken in hand and completed and opened for traffic in 1896. Steady progress southwards continued, and in 1903 the Ongarue section, terminating at Taumarunui, within a mile of the Wanganui river, was also opened. A handsome road and railway

NORTH ISLAND MAIN TRUNK RAILWAY OHINEMOA SECTION—BANK FORMED OF RHYOLITE DEBRIS.

bridge of steel, 465 feet long, erected by Messrs. Scott Bros., of Christchurch, carries the line across the Wanganui river. This bridge was completed in 1903, and the earthworks had already been constructed for about five miles beyond to Piriaka, where the line enters the celebrated Waimarino forest, and no time was lost in laying the rails after the bridge was available. In 1905 the railhead had been advanced to Owhango, another ten miles, a lot of heavy country having been negotiated in the interval, and at present the rails are laid to Oio, 194 miles from Auckland, with a prospect of shortly reaching Raurimu, five miles further on.

At the southern end renewed activity was also displayed. The construction of the Makohine and Pawhakaroa sections was commenced in 1891-2, and during the following year the section to Mangaonoho was opened for traffic. Early in 1896 tenders were invited for the Makohine viaduct, but as no satisfactory offers were received, the work was undertaken by the Public Works Department's own workmen, and the Mangaweka viaduct was subsequently undertaken in the same way. Formation works were also put in hand beyond these viaducts, so that in 1902, shortly after the completion of the former structure, the railway was opened for traffic to Mangaweka, and the further section to Taihape was similarly opened in September, 1904. The rails now extend to Turangarere, and are expected to reach Waiouru during the coming summer.

(To be continued).

[Editor's Note.—This article is to close in next issue, when the opportunity will be taken to present our readers with many interesting and hitherto unpublished matters bearing on the Main Trunk Line. The work of our Special Commissioner will be accompanied by diagrams and maps showing grades and deviations, illustrations of the types of locomotives to be constructed for the Line, and proposals with regard to time-tables, fares, etc., etc.]

Railway Carriage Cleaning in France.

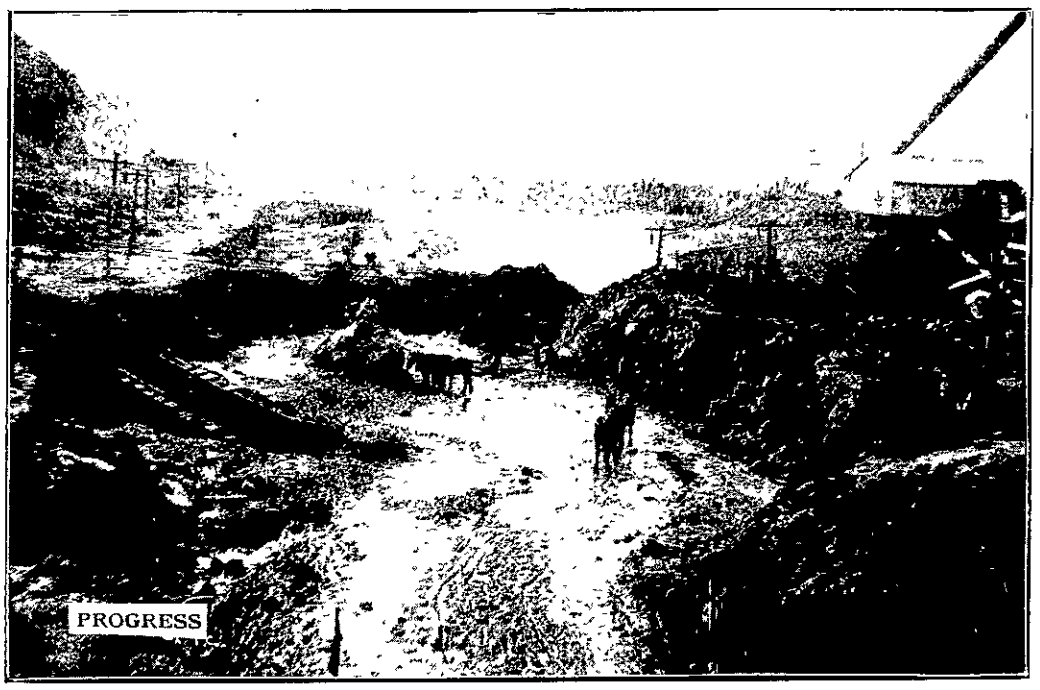
In England cleanliness is supposed to be next to Godliness, and the railways keep an army of carriage cleaners constantly engaged upon removing the dust from the exterior and interior of railway coaches. The French Minister of Public Works has recently addressed a special circular to the managers of French railways, entitled, "Hygiene, Cleanliness, and Disinfection of the Carriages and Railway Buildings." The Minister reminds the managers of the various regulations that have been issued to them on the subject from time to time, and adds significantly that by the decree of March, 1901, the Minister is empowered to prescribe the measures that he may think necessary with respect to public safety and hygiene. The circular, particularly in respect to railway carriages, requires that:—(1) The interior surfaces of the compartments of passenger carriages, excepting the seats, backs, and elbow-rests, shall be covered with material that can be washed easily, and the furnished parts should be movable if possible. (2) The cleansing of the washable parts of passenger carriages should be rigorously carried out, whilst the cushions and furniture shall be cleaned in such manner as shall remove the dust. (3) The disinfection of passenger carriages must take place periodically—at least once a month, and without fail immediately after contamination. (4) Passenger carriages must be disinfected according to regulations already issued. (5) Disinfection, or at least cleaning, after each journey must be effected under the following conditions:—(*a*) when the carriages have served to carry invalids or pilgrims; (*b*) in the case of carriages that habitually run to sanatoria and watering-places (seaside or otherwise) if frequented by consumptives, and immediately after a case of epidemic disease has been officially announced by the Minister of the Interior. (6) All passenger carriages should be heated according to the season and suitably ventilated without inconvenience to the passengers. (7) A notice forbidding spitting shall be shown in all carriages and places frequented by the public or employees. (8) The provision of suitable spittoons in all stations and waiting-rooms is insisted upon, as well as in passenger carriages when there is convenient accommodation for them. A long series of similar regulations is added for application to railway buildings, offices, etc.

With all the numerous inventions that have been made from time to time in pumps, it might appear to many that there would be little room for improvement, but Hawera sends out a patented pump which is much enquired for.

The New Dock at Port Chalmers.

This fine dock, excavations for which are proceeding, is being constructed by the Otago Dock Trust, a body corporate acting under the provisions of the Harbour Act, 1876. The dock was designed by Mr. Robt. Hay, M.I.C.E., of Dunedin, and the dimensions are:—length on sills, 500 ft; width at coping, 90 ft.; width at bottom, 67 ft.; width at entrance, 70 ft.; depth from coping to floor, 29 ft.; depth of water on sill, 22 ft. The contract is let to Messrs. Luttrell & Scott, of Christchurch, for £58,961. The Dock Trust supplies the cement and pumping plant, separate contract for which has been entered into, making the total cost of the dock £74,000. The time allowed for completing the work is sixteen months. The Trust has borrowing powers up to £100,000, and it has exercised these powers up to £75,000. The loan was raised locally at par bearing interest at 5 %.

Patea Meat Preserving Co.—A considerable addition has been made to this Company's works in the form of a detached insulated building fitted up with a Linde refrigerator driven by a suction gas engine, supplied by Niven & Co., of Napier, under a guarantee that the plant will do the work of refrigeration, etc. Mr. Watt is superintending the erection of the machinery for Niven & Co. The freezing this year, instead of being carried out at the butter-grading depot, will now be done on the Company's own premises, and altogether will comprise extracting, canning, tallow rendering and freezing.



EXCAVATIONS AT THE NEW PORT CHALMERS DOCK.

Electrically Immune.

REMARKABLE FEATS.

The possession of a remarkable power of withstanding electric currents has led Senor Francisco Godinez, of Brooklyn, to issue invitations to any one who would like to try to "electrocute" him (writes the New York correspondent of the *Daily Express*). He even asked Mr. Davis, the New York State electrician, to attempt the task, but Mr. Davis pleaded that the execution of criminals at Singsing Prison took up too much of his time already.

Senor Godinez thrives on 5,000,000 volts of electricity. At Singsing they give a man only 7,000 volts to put him to death. Lord Kelvin, the famous British physicist, once took a million volts of electricity, and lived through it. Senor Godinez says The world wondered at it, and then Nikola Tesla went a step further, and took a half-million more. This was the record up to the time that Senor Godinez completed an electric machine, from which he occasionally receives mild shocks of 2,000,000 volts, and recently, he says, he took the limit of 5,000,000.

The secret which enables Senor Godinez to make his body a safe conductor of almost any amount of electricity was discovered, he says, after long experimental work. He has given an exhibition, turned on 5,000,000 volts, and he never quivered. Around his wrists were coils of copper wire, and between the two hands lightning flashed back. His is soon to go on the stage, where he will have himself handcuffed to the electric generator, and invite any expert in the audience to come on the stage and turn on the current. Another of his performances will be to let a constant stream of lightning pass straight through his body. The lightning will strike Senor Godinez, who is a tall young man, just beneath the ribs and go out at the small of the back.

"When the doctors tested me," Senor Godinez declared in an interview, "they made me wash my hands in some kind of acid, thinking I might have some chemical painted on them to conduct the electricity around in a circle. I washed my hands in what they gave me, and I convinced them that the electricity passed through my body."

Remarkable Whispering Telephone.

The dictograph is the latest in telephones. One can stand 10 feet away and whisper a message, or when 30 feet distant speak in an ordinary tone of voice and the message will be clearly and audibly transmitted. Its construction is a secret of the inventor. It can very easily be used by an employer for dictating to a short-hand writer, as the latter could take the dictation at any distance from the speaker, without having to hold a receiver to the ear. It, of course, works both ways, allowing both persons to converse equally well. This explains the name "dictograph." In detective work it promises to prove an exceedingly valuable adjunct. Where a third party is desired to hear an interview between two others it will no longer be necessary for the witness to hide behind screens and in other inconvenient places. The dictograph can be hung behind a picture or under a desk, or even placed in a partly opened drawer of the desk, and will transmit faithfully the entire conversation to one or more witnesses in another room, or to a stenographer.

The treatment of milk fever by sterile air is so successful that two hundred of the Simplex Sterile Air Syringes have been sold in the Taranaki district, including a number for the Government experimental stations.

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.

PROVINCIAL NOTES.

MESSRS. Maisey & Johns, architects, Lambton quay, Wellington, report having let the contract for three residences and a two-story factory and stable in brick at satisfactory prices. The same firm have also in hand plans of the projected Royal arcade, Wellington, for a syndicate, and the new Primitive Methodist church, Newtown.

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A new Presbyterian church with a lofty spire of 96 ft. is nearing completion at Hastings. Architect, C. Tilleard Natusch.

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The Taranaki County Council have raised £12,000 for re-erecting bridges in the County. Steel alone was first tried, and a ninety-foot span bridge was erected over the Waiongona river near Sentry hill, and one fifty-five feet over the Waipuku. The decaying flooring and corrosion through rust, accentuated by the exceptional rainfall, prompted the Council to avoid that system where possible, substituting steel buried in concrete.

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Twelve tenders have been received for the erection of a shop at Karori. The contract will be signed in a few days. Architect, John S. Swan.

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A residence is in course of erection at Eyreton, near Kaiapoi, for Mr. R. O. Dixon This building is of timber, and has ten rooms with rough-cast gables and chimneys with tarred chimney tops. A notable feature of this structure will be the front, which is to consist of two wings converging on a central bay forming a forecourt where it is intended to lay out a winter garden. Architect, H. L. White.

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A ten-roomed house is in course of erection for the head master of the Gisborne school. Architect, C. Tilleard Natusch.

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The Piaku bridge, thirty feet span with a twenty-foot roadway, is now finished and will soon be opened for traffic. Considerable skill has been shown in building this bridge; the traffic was not stopped at all during the progress of the work—the new bridge practically enclosing the old one.

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A contract has been let for steel girders and cast-iron work at Nelson. Architect, John S. Swan; contractors, Robertson Bros.

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A two-story brick building to be used as showrooms, workshops and foundry is in course of erection in Manchester street, Christchurch, for Messrs. W. H. Price & Son, brass-founders, pump makers, etc., of Carlyle street, Sydenham. The contract price of this building is estimated to be £2,300, and the firm expect to occupy their new premises before November.

A gallery and adjuncts in connection with St. Peters church, Ferry road, Woolston, is in course of erection. Architect, H. L. White.

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Mr. Ernest Leslie, second master of the Gisborne school, has recently entered into occupation of his picturesque residence. Architect, C. Tilleard Natusch.

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The bridge over the Wanganui river on the Tariki road is of three spans, the centre span being 60ft. and end spans of 20 and 24 ft. The height above water is 32 ft. and the piers are of concrete reinforced with steel railway rails. The centre span has under-truss beams encased in concrete, with a floor six inches thick, having expanded steel reinforcement.

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A contract has been let at £170 for the erection of a cottage at Petone. Architect, John S. Swan; contractor, W. Olliver.

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A two-storied building of brick with bands of Oamaru stone the bays and gables of half-timbered work, is in course of erection for Mrs. Cook, Armagh street, Christchurch. Architects, Collins & Harman; contractors, Thos. Henshall & Son.

A contract has been let at £3,400 for the erection of a brick warehouse on Taupo quay, Wanganui. Architect, John S. Swan; contractors, Davis and Browman

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When the plans are out for the renewal of the Waiwakaiho bridge we shall be able to give further information. The proposal is for a concrete and steel structure of four spans, two of 66 ft. and two of 30 ft., clear.

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Messrs. Bradley Bros., Christchurch, wish us to state that they executed the lead lights in the West End Chambers, a building illustrated in our last issue.

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The plans have just been completed for extensive additions and alterations to Mr. John Marshall's residence at Tutu Totara. Architect, C. Tilleard Natusch.

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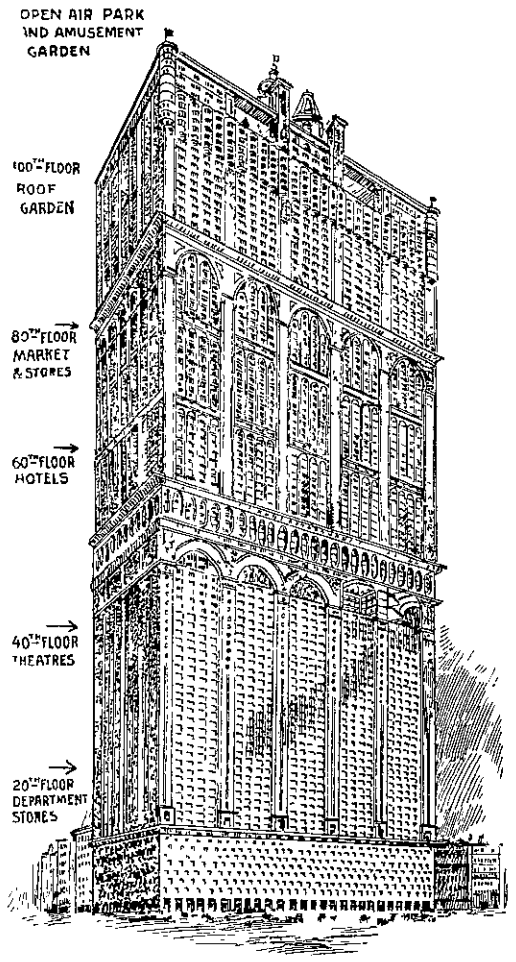
A contract has been signed for the erection of additions to a residence at the Upper Hutt for £300. Architect, John S Swan; contractor, Humphries Bros.



BUILDING OF 100 STORIES FOR NEW YORK CITY.

A large arch bridge is to be erected over the Waiongona river, Mountain road, having a clear span of 45ft.; the arch is reinforced with steel rails and expanded steel. The height of this bridge is 29 ft. above the river. The plan shows a very massive structure, having concrete piers 8 ft. thick with steel rails embedded in them.

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Mr. Leslie Gorton, of Feilding, is having a residence erected from the designs of Mr. C. Tilleard Natusch, who, during the past few years, has acted as architect for Col. Gorton & Mr. Norman Gorton.

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Another small span arch bridge is going over the Maketehinu stream near to the Norfolk road railway station. This is an arch bridge of 14 ft. span reinforced with railway rails. The piers are erected over the Oakura river, South road, for another bridge. It was intended to build this bridge of wood, but it is now proposed to use reinforced concrete; plans are not yet prepared, but it should be a good structure, as the height of the piers above water is 25ft. and span 62ft.

Extensive additions, covering 150 ft. x 82 ft., are being made to Messrs. Williams & Kettle's stores at Port Ahuriri from the plans of Mr. C. Tilleard Natusch, his son Mr. Rene Natusch, being in charge of the works under his father. All the foundations and the party wall are of reinforced concrete.

Building of 100 Stories.

CONCRETE is the building material of the future—that is, concrete reinforced with steel rods and small rails. Not destructible by fire, and defying the disintegrating powers of other elements, the compound is easily worked and is cheap, and these things make the ideal material for modern construction.

There are predictions that an office and general mercantile building, as illustrated on this page, will rear itself in lower New York in the not-far-distant future to a height of one hundred stories—close on a thousand feet high.

American engineers began the study of concrete and the uses to which it might be put many years ago, and it is believed they have mastered its problems. There is no steel framework, strictly speaking, in the modern concrete building; there is neither brick nor wood. The foundations are generally of concrete laid on the same base that foundations for other buildings of like dimensions are laid upon, and on these concrete foundations the concrete superstructure is raised.

On the concrete foundations, instead of the erection of heavy steel posts and pillars, four or five small steel rails of perhaps the weight of light railroad rails are placed on end where there is to be a pillar, and around these a mould is built, and into this the concrete is poured and tamped. This mixture dries, and if properly made is harder and more enduring than granite. It will not crack under heat, no matter how great, nor crumble under the beating of the weather. The longer it stands, the harder it seems to become. Stone of most kinds will crack, and steel will warp under stress of extreme heat, but concrete will do neither.

Another thing that gives value to concrete in the eyes of builders, and also in those of the owners of the structures, is its comparative cheapness. For one thing, there are no excessive profits. It is as well known as mortar, has been used as long and is nearly as easily mixed, although more care must be taken.

For ordinary concrete the formula is one part of Portland cement, two or three parts of sand and four or five parts of well-broken stone. The mixing is done by machinery and at a speed which in some cases keeps a steady procession of men with wheelbarrows carrying the mixed product from the machine. The cement is the most expensive ingredient of the mass, and the greatest danger in handling the concrete is in not having the pieces of stone properly distributed in the mould. The question of the proper preparation is one that must be answered by the man in charge of the mixing.

As an illustration of what can be done with fireproof materials, Mr. Starrett, a New York contractor, referred to a building which his company is now finishing for the United States Express Company in New York. From basement to roof there is not an ounce of wood or other inflammable material. Most of the fittings are of metal These things are required by the building laws of the American city, which provide that any structure more than one hundred and fifty feet high must be fireproof. Experience has shown the architects that to be fireproof, a building must be as free from inflammable materials within as without.

The Building Situation in San Francisco.

OF the many accounts which have appeared in the British and American press of the devastation wrought by the great earthquake and fire at San Francisco, one of the most interesting is that contributed by the special correspondent of the New York *Carpentry and Building*, who

was an eye-witness of the conflagration. He confirms the statement of other observers to the effect that the great steel-frame buildings are those best adapted to resist both fire and earthquake. The Palace Hotel, for instance, which was among the first of the buildings to use iron in its construction was designed to be both fire and earthquake proof. The earthquake test was successfully passed. Not a square glass fell from the glass roof of the immense court, and guests were breakfasting in the grillroom when the second shock, about 8.30, drove out the timid ones.

The effect of the earthquake and the fire upon many of the most notable buildings of the city is described and illustrated, and the writer concludes with an estimate of the building situation as it appeared in the early part of June, when his communication was despatched. Considerable delay has been caused (he says) by the uncertainty as to the provisions of the new building regulations, but the Board of Public Works will not revoke any of the permits for new buildings granted previous to the fire. It is held by the Commissioners that the rules of the committee appointed to revise the municipal building laws cannot affect cases already decided. Work on several buildings in process of construction will be continued immediately In addition to these about sixty permits had been granted for buildings where actual work had not commenced The plans call for structures of classes "B" and "C." They will be built of brick, with wooden interiors, in most instances. The Board has been notified that construction will commence as soon as material is available.

A big seven-story hotel will be built by Charles Stewart on Geary street, opposite the Francis hotel. The building will be a class "B" edifice. A six-story brick structure, originally intended as a storehouse, will be erected on the corner of Jackson and Drumm streets. A six-story building will also go up in East street, between market and mission.

No class "A" permits are out, except for buildings which were partially erected before the fire. No permits will be granted from now on until the new laws are formulated and passed. Applications for building permits of all kinds received daily by the Board of Public Works are being kept on file pending developments.

The Commissioners have requested that City Architect Shea be allowed to confer with the Commission on Revision of the Building Laws. The architect does not favour the drastic regulations proposed by many. He believes that unless some latitude is allowed in the use of inflammable material the building industry will be paralysed.

San Francisco Building Regulations

The following are the building rules in San Francisco for the temporary period until new building laws are completed, as adopted by the Reconstruction of Buildings Committee and Board of Public Works :—

Rule 1. Permits will not be required to erect temporary one-story structures of galvanised iron or wood, but they must be removed at ninety days' notice.

Rule 2. All permits for permanent structures must be obtained from the Board of Public Works.

Rule 3. Permits will not be required for repair of chimneys or roofs damaged by falling chimneys or other causes, but permit for use of said chimney must be obtained from the Building Committee before any chimney can be used or fire started.

Rule 4. All buildings outside burned district which were badly damaged by being thrown off their foundation or out of plumb must secure a permit for repair of said buildings from the Board of Public Works.

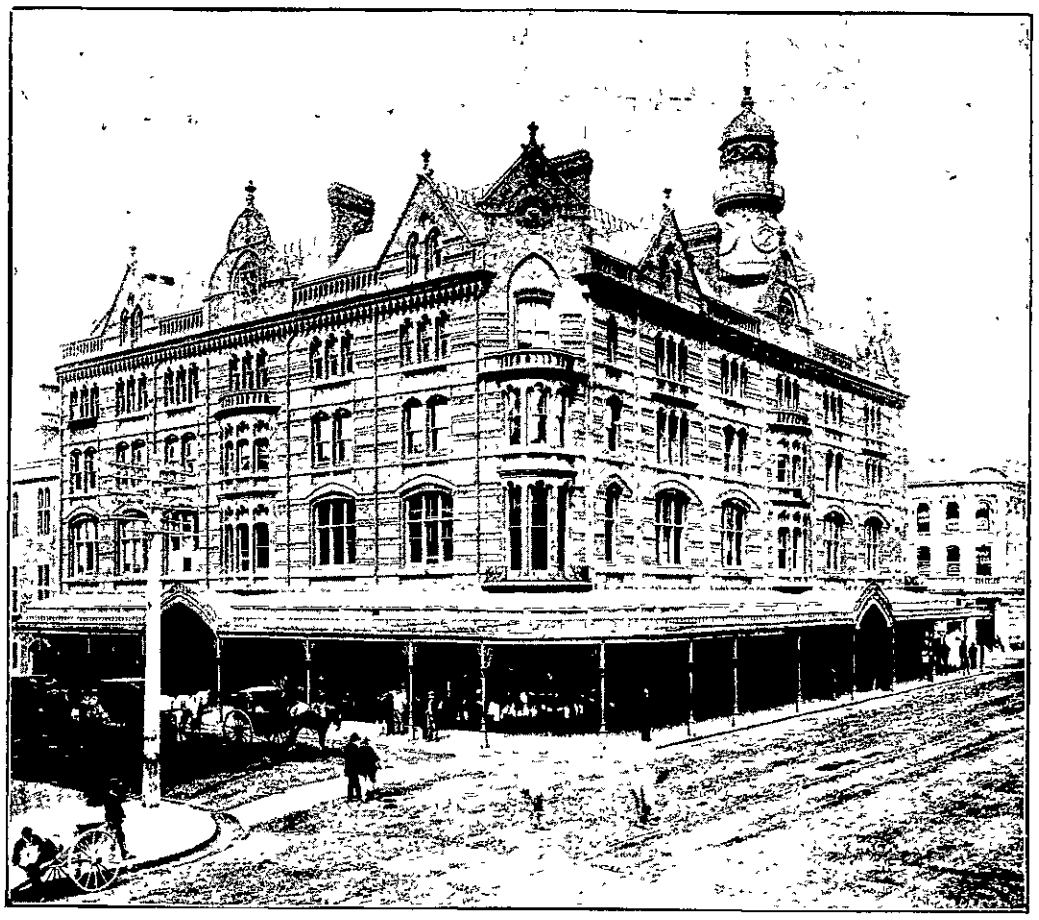
Rule 5. All matters pertaining to side sewers must be referred to the Board of Public Works.

Rule 6. Permits for operation of factories using steam or other power except electricity must be obtained from the Building Committee.

Rule 7. All factories operating by electrical current must obtain a permit from the Department of Electricity, and a further permit from the Committee, before operating their plant.

Capital is also waiting for the new building ordinance. So far there is no inkling as to what the new permanent restrictions and limitations will be. But there is not the slightest doubt that new skyscrapers will be built. The State Board of Architects makes a number of suggestions in relation to the restrictions of the coming building ordinances. Thorough inspections and investigations have been made through the burnt district, and it has been found that safety is not a question of style of architecture, but quality of workmanship.

Cornices and arches need not be excluded from the new city. Where they were properly anchored and built they withstood the shock and the fire both. It is the opinion of the Board that the city need not be without its picturesque cornices and decorations.



VICTORIA ARCADE, AUCKLAND. THIS HANDSOME BUILDING IS ACKNOWLEDGED TO BE THE BEST EXAMPLE OF BRICK CONSTRUCTION IN THE NORTHERN CITY. IT WAS ERECTED BY THE NEW ZEALAND INSURANCE CO. AT A COST OF £29,000.

We learn that since the above was written the Council on Building Laws have decided to recommend the following ordinance —

"On streets 800 ft. wide, or over, the height of buildings facing thereon shall be unlimited. On streets 80 ft. wide, or over, the height of buildings shall be limited to 200 ft."

Internal Decoration of Houses

The days of plaster, as applied to ceilings and walls, are already numbered. We live in a progressive age: fireproof materials such as metal ceilings and walls, combined with the rapidly expanding use of ferro-concrete, are effecting a transformation in building construction that will undoubtedly tend in the future to the increased durability and beauty of the home. In countries, too, where the danger of earthquake is ever present, the new materials have increased value, and in New Zealand the reformation in building construction set in long ago with the introduction of metal ceilings, which may be noticed in almost every up-to-date house that is now completed. We have yet to experience, however, a modern building constructed entirely of metal, similar to that which is often fitted out by the Metallic Roofing Co., of Toronto, Canada, and which we hope to illustrate in a future issue. The metal ceilings made by this Company are specially adapted for use in business houses, churches and private residences They are made from soft steel plates embossed into an almost countless variety of designs, with harmonious adaptations of each pattern to suit the walls, ceilings, cornices and other members. These plates are made so mathematically correct, and the designs embossed with such absolute precision, that when put into place the joints are totally imperceptible, and the pattern continues throughout the entire ceiling or wall as though it were put on in one great piece. Once in position the decoration is commenced—the scope for the decorator's art being quite unlimited. A great advantage connected with the use of these metal plates is their ease of fixing, so that when placed in a new building they are simply nailed on rough lining or wood furring strips; and when it is desirable to install a metallic finish in an old building where it would be inconvenient to remove the plaster, these furring strips are run over the plaster and the steel plates fastened to them, thus enabling the whole to be firmly stayed into place and at the same time obviating the litter usually associated with the handling of plaster.

The sanitary feature in metal ceilings and walls is of almost equal importance to that of proof against fire or earthquake; for though a fire or earthquake may not occur for years, the danger from disease germs is ever present. Metal finish, however, gives no chance for such germs to get a foothold, for it may be cleansed by washing, without any injury to the decoration, and a possible hiding place for germs is thus rendered out of the question. The costs of metal finish for walls or ceilings is cheaper than plaster, and their durability and pleasing effect are incomparably superior.

The system adopted by the makers is for prospective purchasers to send

GRAND STAIRCASE, WELLINGTON TOWN HALL.

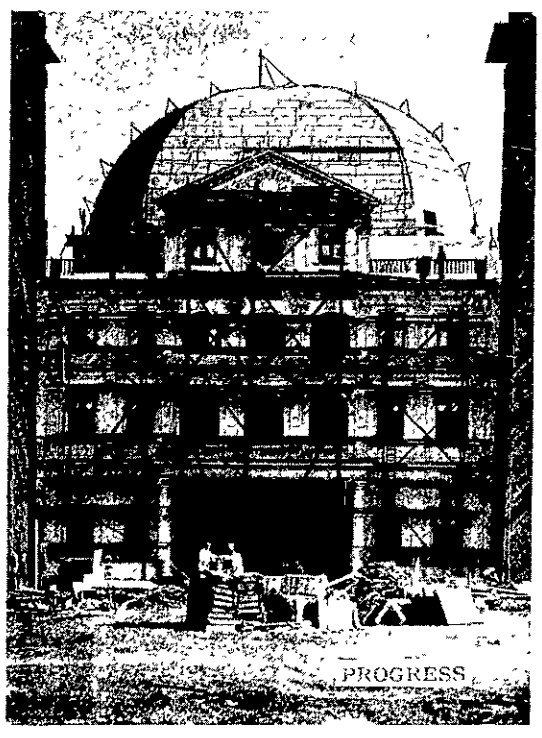
in an outline sketch of the room or rooms to be fitted out showing the shape and exact measurements of the walls and ceilings. Any skylights, windows, doors, stairways or other offsets require to be accurately located on this diagram, as well as the size and location of beams. If a cornice is required, then it is necessary to show how far it comes down on the wall, and the height of walls should be taken from top of wood base or dado, where there is one, to the ceiling.

Through the courtesy of Messrs. Smith & Smith, New Zealand agents for the Metallic Roofing Co., we are enabled to show on page 354 two very fine interiors equipped with the "Interior Metal Finish."

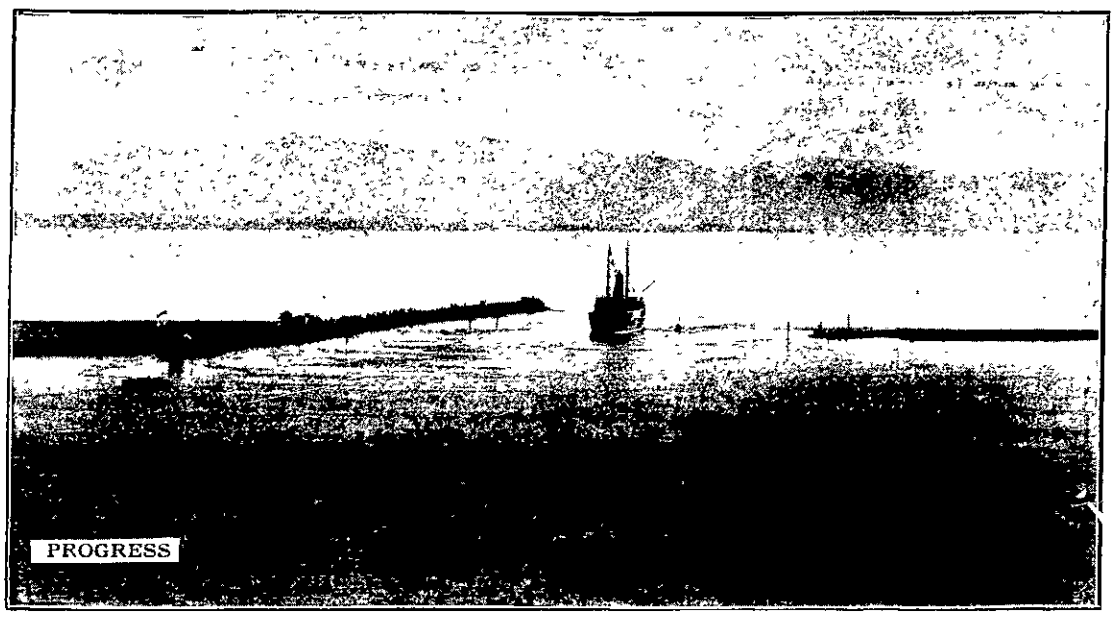
MR. GEO. HUMPHRIES. A SUCCESSFUL INVENTOR.

HUMPHRIES' SCAFFOLD BRACKET.

A few months ago we published in these columns a description of Humphries' Patent Scaffold Bracket, which had already commanded a large sale in New Zealand. Since that article appeared patents have been applied for in nearly every country of the world, and Mr. Humphries has been in Australia to place his invention upon the market there. The success of the bracket in Australia has been immediate and phenomenal Builders have at once recognised its manifold advantages, many thousands have been sold and the demand is greater than it is possible to immediately supply. The inventor has now adapted his bracket for use on brick buildings, a simple yet exceedingly strong claw arrangement being used which passes into a space left in the brickwork and having an eye which receives the hook of the scaffold bracket. This arrangement very much extends the scope of the invention, and the result of the employment of the bracket on brick buildings has been a very large saving in cost of scaffolding. One of our illustrations shows the bracket in use upon the dome of the main building of the International Exhibition, Christchurch, and another illustration shows the bracket employed upon a brick signal station in course of erection near Melbourne. There is no doubt that the invention fulfils a want which has been felt by builders for centuries past, and it is satisfactory to know that a New Zealand builder has supplied the deficiency.



HUMPHRIES' SAFETY SCAFFOLD BRACKET IN USE UPON THE DOME OF CHRISTCHURCH EXHIBITION.



THE ROTOITI ENTERING THE NEW CUTTING IN THE BOULDER BANK, NELSON.

THE NEW ENTRANCE TO NELSON HARBOUR.

BY E. COWLES, RICHMOND.

PROBABLY no public work ever undertaken in Nelson has aroused keener interest among Nelson residents, as well as the frequenters of the port, than the new entrance to the harbour, through the boulder bank, now in course of construction. As may be expected opinions, both professional and lay, have differed; and it has needed a large amount of perseverance on the part of the managers of the undertaking, the Nelson Harbour Board and its staff, to bring the work to its present satisfactory position.

It may fairly be said, taking a practical view of what has been accomplished, that the main difficulties of the enterprise have been overcome. When the idea of cutting a new entrance through the boulder bank was first brought within the domain of "practical politics," it was feared that the redoubtable "bank" might have a rocky foundation, or core, which would involve expensive blasting operations Trial borings, however, were made, and the results encouraged the engineers to hope that no rock would be met with. The subsequent dredging operations have fully realised their expectations and a channel has been cut through the bank, 15 ft. in depth at low water spring tides, and 200 ft. in width at its maximum depth. While the dredge was digging out the channel a wall was constructed on the south side to protect the bank from the scouring action of the tide. This wall consists of rough masses of a species of granite or metamorphic sandstone, the heaviest pieces, ranging up to over 8 tons, being placed on the outer face of the wall, which has been extended 630 ft seaward, from the outer line of the boulder bank.

In order to test the utility of that portion of the channel which had been carried to its full depth right out to deep water, the Nelson Harbour Board, in July last, resolved to temporarily put it into actual use, accordingly, the new entrance was officially opened on 30th July.

The Union S.S Co's Rotoiti left the railway wharf with 800 passengers on board—the largest crowd that has ever left Nelson wharf in one vessel. Captain Collins, pilot and harbour master, was in charge, and the steamer passed through the new channel, breaking the ribbon stretched across it, amidst the cheers of the crowd on board, the spectators on the bank, and those lining the wharves and hills. On the return of the vessel to the wharf congratulatory speeches were delivered and a presentation made to the chairman of the Board, Mr. John Graham, M.H R. In the course of his speech Mr. Graham quoted the appended interesting and important figures of expenditure to date in connection with the new cut —

RECEIPTS AND EXPENDITURE ON ACCOUNT HARBOUR WORKS LOAN TO JULY 14, 1906.

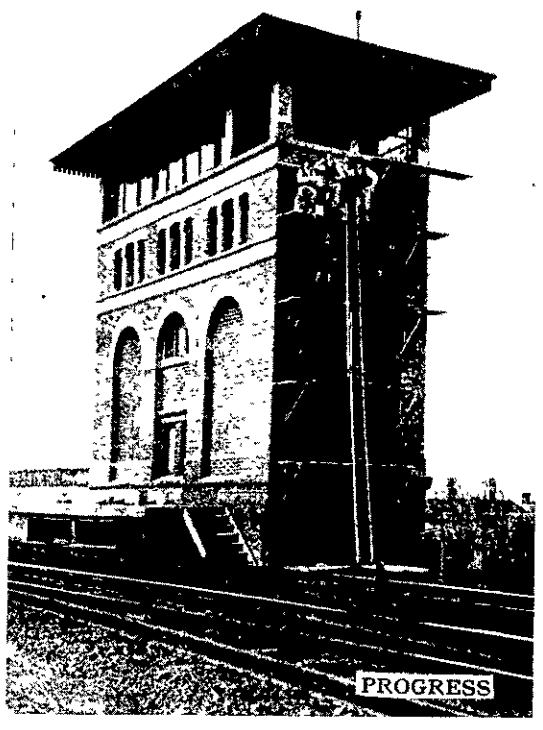
RECEIPTS.

A M P Society, at 4 per cent. interest ..	£45 000
Debentures at 4 per cent interest ..	6,200
Miscellaneous receipts	56
General account (part savings transferred to Loan Account)	2 454
Total	£53 710

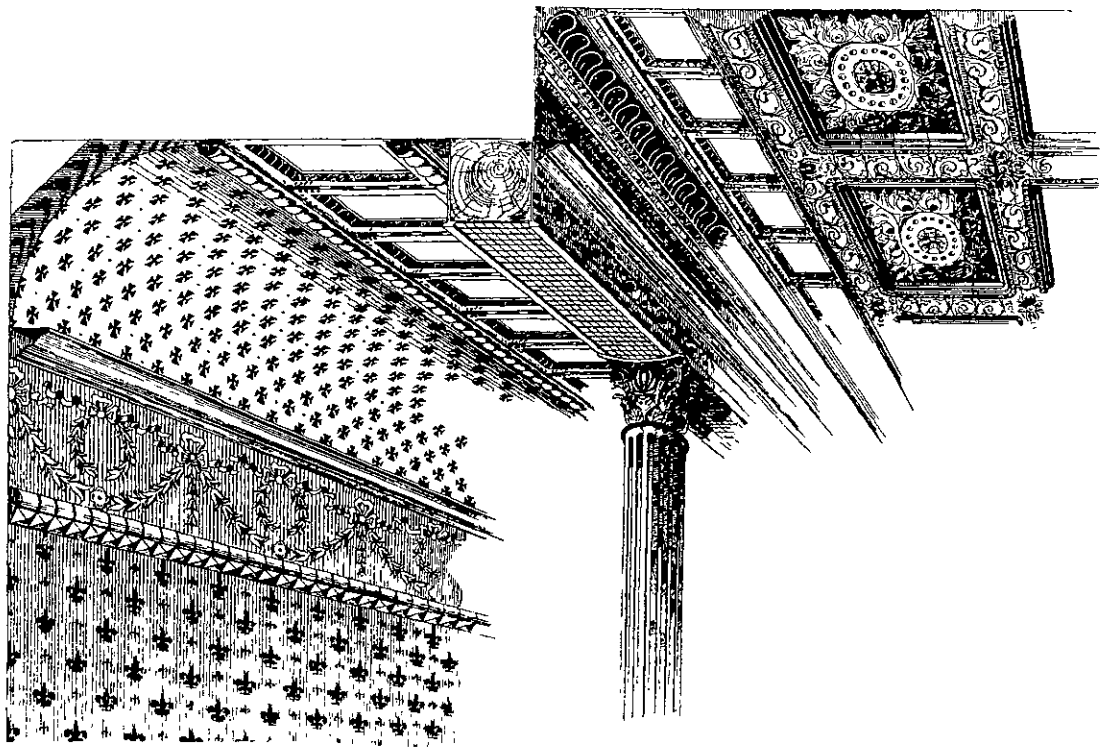
EXPENDITURE.

Cost of dredge and other plant	£24,577	
Engineer's commissions and fees	2,770	
Accident insurance and miscellaneous	250	
		£27,597
Cost of stone (contract) for rubble wall		10,795
Dredging—		
Wages (including Dredgemaster)	£5,933	
Coal for dredge	2,233	
Stores	1,253	
Total	£9,419	
Shore works—		
Wages (including Resident Engineer)	£4,515	
Coal for crane	100	
Stores	495	
Total	£5,110	
		14,529
Total		£52,921
Funds still available—		
Balance, Current Account	£689	
Balance, bank deposits	6,940	
Balance, debentures	13,800	
		£21,429

This statement shows in simple form that the total cost of wages, coal, and stores expended on dredging and shore works combined has been not much more than one-half the cost of the plant



HUMPHRIES' SAFETY SCAFFOLD BRACKET USED IN THE ERECTION OF BRICK SIGNAL STATION NEAR MELBOURNE.



CEILING DESIGN CARRIED OUT ENTIRELY IN METAL FINISH THE PIECES SUPPLIED INCLUDE CENTRES, BORDERS, MOULDINGS, CORNICES BEAMS AND SOFFIT LARGE COVE, FRIEZES, FOOT MOULDING, AND WALLS. THIS DESIGN IS SUITABLE FOR LARGE ROOMS.

and engineer's commissions, etc., viz £14,529 against £27,597—and the amount still available is almost half as much again as the sum already spent on dredging and shore work added together, viz. £21,429, against £14,529.

The occasion was undoubtedly one of great importance to Nelson. It demonstrated that, though not complete, the new cut is now available for traffic, and at times, too, when the old entrance could not be safely used. The Rotoiti on a subsequent visit was detained at the outer anchorage by a dense fog, when it lifted it was too late to go in by the old entrance, and the new one became temporarily blocked by the lines of the dredge, which was at work widening the channel. But the lines were let down and the Rotoiti entered the haven in fine style, passing the dredge in the fairway of the inner channel. Detention at the outer anchorage for several hours was thus avoided. Other Union steamers have used the new entrance several times, and the largest of the Anchor Company's fleet has gone out at dead low water.

Captain Collins, the pilot, stated in his report to the Harbour Board that in his judgment and experience the new entrance, even in its present incomplete state, is so much better than the old one, that he would "unhesitatingly use the new channel under all conditions in preference to the old one."

Since the official opening in July, the dredge has been at work deepening a channel over a bank inside the harbour. When this is completed, the present opening is to be widened by cutting away a "bench" 150 ft wide, so that the total width at maximum depth will be 350 ft. It is confidently anticipated that this width will be sufficient for all practical purposes, and if experience justifies this anticipation, the extra expense of a wider passage will be avoided. When the dredging operations reach the base of the south wall, the other blocks of stone will probably slide down the sides of the bank, and form a protective lining to the south side of the channel, where the current is stronger than on the north side.

The question of a wall on the north side of the channel is at present in abeyance The north bank does not at present appear to need protection from the tidal currents; and it seems probable that the south wall will give ample protection from the wave action. The erection of a north wall would have the effect of lengthening the narrowest part of the entrance, where the current is strongest, a result which would be obviated if possible. But a final decision has probably not yet been arrived at, and the Board will be able to construct the wall if needed, after the rest of the work has been completed.

A well-defined current has been set up through the new opening, and has already deepened the soundings outside the harbour by about 3 ft. In the middle of the cut the softer material has been washed out below the dredge level, so that it will be comparatively easy to get a greater depth than originally intended, if that should be found desirable. The channel over the bank inside the harbour will doubtless be kept clear by the current.

To sum up the present position, it may fairly be stated that the Nelson Harbour Works have, as far as completed, proved a decided success; and it is not too much to expect that when the projected operations are finished, Nelson will be able to receive visits from the largest ocean liners that visit our shores. When it is remembered that this result will, in all probability, be achieved at a cost well within the original estimate, the Nelson district is to be congratulated on the prospect of obtaining a harbour suited to present-day navigation, which will not be a burden on local finances. It is believed that the ordinary revenue of the Harbour Board will be sufficient to provide for working expenses as well as interest and charges on the loan

In the course of his speech at the official opening of the entrance, Mr Graham, the chairman, acknowledged the powerful aid the old members of the Board had given him, and thanked the new members for the assistance rendered. He also referred to the encouragement given to the undertaking by the late Mr. Seddon, and by Mr. Hall-Jones. Referring to the executive officers of the Board, Messrs. Barrowman (engineer), McHarg (dredge master), R. Catley (secretary), and Captain Collins (harbourmaster and pilot), Mr. Graham said he was proud to be the nominal head of such a staff of men who had the interests of the work so much at heart.

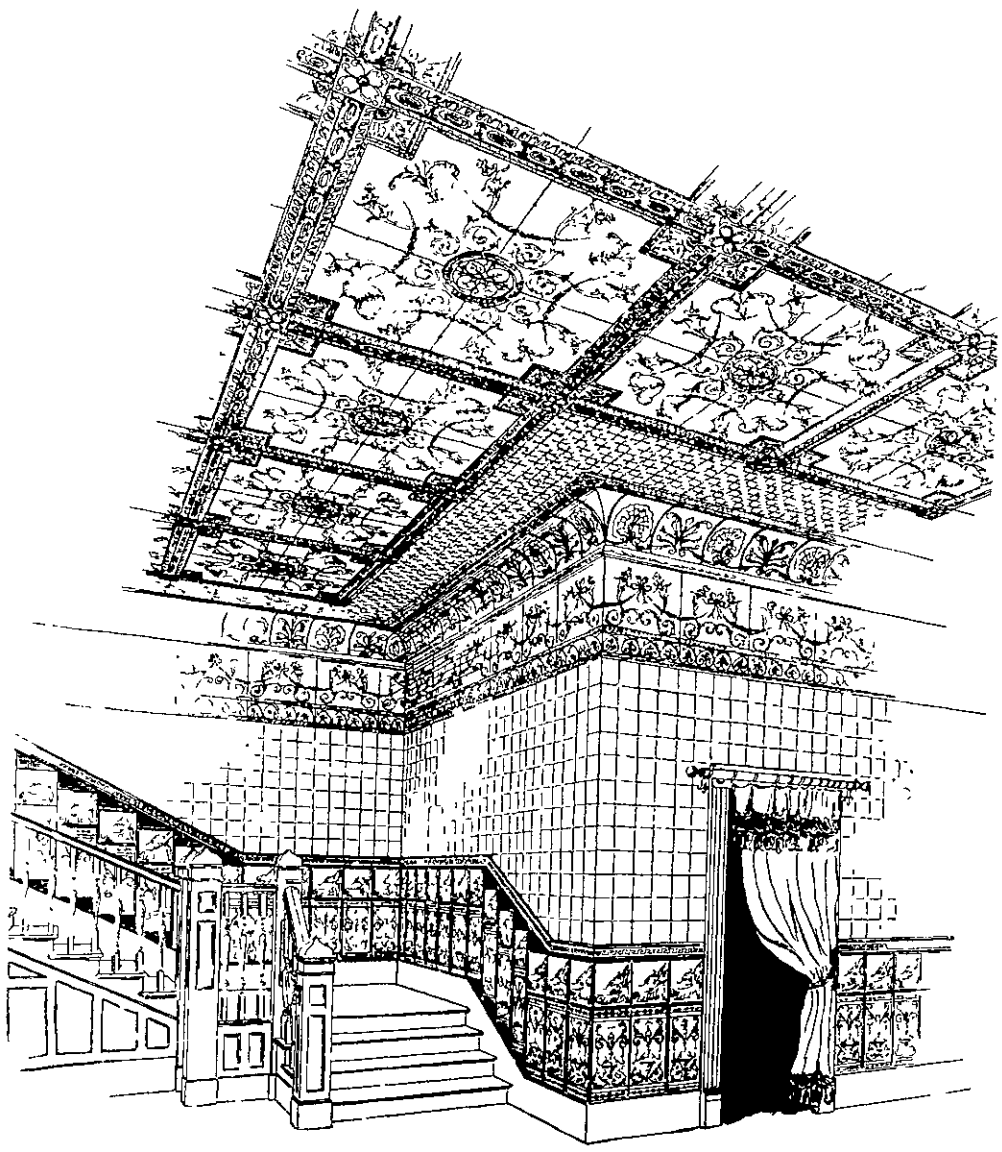
The following are the members of the Board:—Messrs. J. Graham (chairman), G. Talbot (treasurer), R. McKenzie, M.H.R., W. Coleman, W. N. Franklyn, O. W. Hauby, F. Trask, M.L.C., A. Hounsell, P. Best and A. Bisley.

Japan Objects to State Ownership.

The prospect of State-owned railways meets with no greater approbation in Japan than in other countries that are thus blessed. Already part of the railways in Japan belong to the State, and a writer in a Tokyo contemporary thus caustically refers to the shortcomings of the State-managed railway —

"In connection with the movement in favour of the railways of Japan being nationalised and made a Government monopoly, it is most sincerely to be hoped that the common sense of the people at large will prevent the scheme being carried into effect as if all competition is removed there is no knowing to what extent travellers may be inconvenienced. I am a daily traveller on the section between Yokohama and Yokosuka, and if the management on that section is a fair sample of the administration on other parts of the line, I can only say that it would seem as if the Government Railway Bureau must be managed by persons who have undergone a State examination and been selected on account of their incompetency.

"Between Kamakura and Yokohama, a distance of only about 13 miles, the trains usually take about one hour to 'crawl' the distance, the carriages are filthy, uncomfortable at any time, and bitterly cold and draughty in winter, and the service is simply rotten Delay and confusion takes place at almost every point of the line."



RESIDENCE DESIGN CARRIED OUT ENTIRELY IN METAL FINISH. HALL IN RESIDENCE, FINISHED WITH EMBOSSED METAL. THE PIECES SUPPLIED INCLUDE DADO CAPPING, WALL PLATES, FRIEZES, CORNICES BORDERS, MOULDINGS, AND CEILING PLATES.

Applications for Patents.

The following list of applications for Patents, filed in New Zealand during the month ending 15th September, has been specially prepared for Progress.

21645—G. Euston, Melbourne, Vic, and H. S. Williams, Toowoomba, Queensland Step-ladder.
21646—M. A. Grant Kalgoorlie, W.A. Roasting auriferous earths
21647—M. A. Grant, Kalgoorlie, W.A. Conversion of burnt auriferous clays into pottery, etc.
21648—M. Juriss Wellington Securing outer wearing faces to soles.
21649—A. Murdoch, Dunedin Soap.
21650—A J. Hoban, Scargill Stirrup iron.
21651—H. Corrick, Wellington Ascertaining temperature of baled goods
21652—H. J. Bettany, Nelson Compressing and storing compressed air on bicycles.
21653—H. Stephenson, Edenham Fencing standard.
21654—E. H. A. Lambert, Wellington Ascertaining temperature of baled goods.
21655—F. T. F. Evans, Auckland Tripod harrow
21656—H. Pike, Mount Albert Child's cot attachment to bedstead.
21657—G. H. Herbert, A H Byron, and R. R. Richmond, Wellington. Castors and bearings for machines.
21658—J. Anderson, Dunedin Ball valve.
21659—D. Hayward, Bloxwich, Eng. Curry-comb and brush.
21660—A H and D J Byron, Wellington Band-cutter, sheaf-carrier and feeder for thresher.
21661—Barber's Interchanging Heel Company, Limited, London, Eng Securing tips and protectors to soles. (W Barber).
21662—The Witch Dust-extractor Company, Limited, and W. Griffiths, Birmingham, Eng. Removing dust from carpets
21663—L. B. de Laitte, London, Eng. Producing carburetted air.
21664—F. Burks, Manchester, Eng Dumb-bell.
21665—A. T. W. Allan, Thames Timber jack.
21666—A J. Hall, Thornleigh, N.S W. Feeding brush with pigment.
21667—G. W. Leadley, Wakanui Turnip cutter and slicer.
21668—T. Dobeson, Sydney, N S W. Incubator and brooder.
21669—S. J. Emery, Windsor, Vic Combined collar and harness.
21670—J. D. McLaurin, Pohangina Toaster and griller.
21671—E. C. Powell, C. MacArthur, and F. Smith London, Eng. Rotary engine
21672—J. H. Johnston, Christchurch Linoleum polisher and window cleaner.
21673—E. H. A. Lambert, Wellington Testing heat of baled goods.
21674—G. S. Morison, Melbourne, Vic. Brake-actuating appliance
21675—F. H Maxwell, Kerang, Vic. Crushing battery.
21676—W. H. Wharfe, Auckland Separating fibre from kauri gum.
21677—H. Doyle, Sydney, N.S.W. Vacuum cleaning apparatus.
21678—W. T. Wingfield, Melbourne, and C. W. Hermann, Windsor, Vic.: Stamp pad.
21679—J. A. Sayward, Victoria, B.C. Loading and unloading lumber.
21680—W. F. Darling and S. T. Chancellor, Hobart, Tas. Levelling staff.
21681—G. Turner, Blenheim · Tomato-forcing house.
21682—D. W. McLean, Methven Surveying and range finding.
21683—J. Foster, Wellington Candle extinguisher.
21684—A. H. Baker, Ascot Vale, Vic. · Rock drilling.
21685—F. Henry, Waikiwi Flax dressing.
21686—S. Philip, Taita Hoe.
21687—F. de J. Clere, Wellington Glazing bar.
21688—R. S. Tonkinson, Dunedin · Trolley pole.
21689—W. Dall, Dunedin Bias adjustment for bowls.
21690—J M. Crabbe, Dunedin · Door and gate closer.
21691—J. Greenfield, Dunedin. Nosebag.
21692—J. Nelson, Dunedin · Cutter for sand or suction pump.
21693—A. L. Speden, Timaru Caster.
21694—E. Hayes, Rough Ridge Wire coiler.
21695—J. D. McLaurin, Pohangina Reducing risk of fire in wool, etc.
21696—J. D. McLaurin, Pohangina Lamp-glass cleaner.
21697—W. H Nisbet, Sydney, N S.W. Pneumatic brake.
21698—J. Gill, Edinburgh, Scotland Rotary motive-power engine.
21699—G G Holmes, Pigeon Bay, Window fastening.
21700—E. Deister, Fort Wayne, U S.A Ore concentrator.
21701—S J Gallagher, Christchurch · Horse-controlling means.
21702—J. A. Steele, Tamaheri Apron of harvester-binder
21703—W. Tate, Sydenham. Lifting jack.
21704—W L Davidson, Cheviot Butter presser, etc
21705—G W. Poulsen, Kaiapoi and F. W. Walshaw, Richmond Flooring and lining cramp.
21706—F T. Page, Dannevirke Retaining kerosene pump in position.
21707—A. Parker, Dannevirke Vending postage stamps
21708—S Kinzett, Kaimatarau Pump.
21709—J. P. Maloney and H. Chisholm, Fortrose: Station or street indicator.
21710—J. H. Warren, Albert Park, T. Blades, Footscray, and J. Wren, Kew, Vic.. Preventing locomotives overrunning the danger signal
21711—W. Thorburn, Seattle, U.S A Levelling and projecting angles
21712—H Thomson Petersham, N.S W. Door stop.
21713—W H Nisbet, Sydney, N.S.W. Pneumatic brake valve.
21714—J. Parker, Euroa, Vic. Rabbit trap.
21715—E T. and J. A. Munro, Leongatha, and D J Chandler, Fitzroy, Vic. Branding tool,
21716—W. Baldwin, Sydney, N.S.W. Fastening and joining roofing
21717—P Brown, Rakaia Turnip and root cutter.
21718—F. Peters, Melbourne, Vic.. Milk cooling or heating.
21719—P Price, S. Hill, A. Taylor, A. and W. P. McElhone, and H. S. Bracy, trading as the Acme Manufacturing Company, Sydney, N.S.W.: Nail-making machine.
21720—T. Grainger, Hobart, Tas. Stock feeder.
21721—E. C Kilgour, Albert Park, Vic. · Acetylene-gas generator.
21722—F. J. Newberry and A Walker, Geelong, Vic Chimney.
21723—W. Moore, Mataura Hand sheep shears.
21724—W. C. Lawrence, Waitara Spade.
21725—F. W Payne, Dunedin Directing current to wheel.
21726—F. C. Brown, Komata Using products of combustion to drive turbine engine
21727—F C Brown, Komata Ore treatment.
21728—W. Beamish, Cromwell · Collapsible box.
21729—E C. Hutton, Dunedin Flax dressing. (E W Hutton).
21730—A. J. Border, Wellington. Flax-bleaching process.
21731—A. J. Border, Wellington Flax-drying process
21733—G. Coates, of Winterslow, Eng. · Wire strainer
21734—E W Hart, Luton, Eng, and W. P. Durtnall Brockley, Eng Propulsion of vehicles
21735—N. J. Gooder, Wellington Trolley head.
21736—T. Milburn, Invercargill: Artificial minnow
21737—J. B. E. Hird, Tomoana Testing condition of wool bales
21738—C R Rodgers, Melbourne, Vic. · Winnowing and seed grading apparatus.
21739—F W. Meakin, North Carlton, Vic. Storing fresh fruits and produce.
21740—J. B. Marshall, Broken Hill, N.S.W.: Rock drill
21741—F. W. Smith, Paekakariki Ascertaintaining temperature of baled goods
21742—Wood, T. A. V., London, Eng. Cleaning and dyeing wool, etc.
21743—T. J Whelan, Hawthorn, Vic.: Knife cleaner and sharpener.
21744—J. C. Drewet, Auckland. Trolley head.
21745—W H. Patterson, Otahuhu, and G. B. Jones, Auckland Roller tug for harness.
21746—Pickering. P., Wellington Wall hook.
21747—Hebbard, J, Broken Hill, N.S.W. · Grinding ores in pans.
21748—W. Levinson Christchurch · Water cooled chamber.
21749—F. A. Pim, Glenferrie, Vic. · and W. H Blakeley, Melbourne Double action lift and force pump.
21750—J. Christie, Warepa, Dunedin Street or tram-rail cleaner.
21751—A. W. Jaggers, Gisborne Roofing tile.
21752—H. A. Cutting, Radley. Paper file.
21753—R. O. Clarke, Hobsonville · Pipe, drain etc., inlet.
21754—F. W. Smith, Paekakariki · Ascertaining temperature of baled goods.
21755—P. Maher, Wendonside Draw gear for vehicles.
21756—D P Palmer, Christchurch: Folding chair.
21757—G. E D. Seale, L. C. Knight, and F. G. Simb, Christchurch Electrically controlled gas lighter and extinguisher.
21758—H C. Radmussen, and J. F. Smith, Lyttelton Candle stick and match holder.
21759—F. Keats, Sheffield · Reel for fencing wire.
21760—A. M. McNeill, Wellington. Leg roping cows. (A. C. MacNeill, Brunswick).
21761—H. W. Pennington, Gisborne: Marking board.
21762—R. J. Laird, Auckland Concrete mixing machine.
21763—J. C. Fountain, Parkhill, Canada, and J. E. Wilkinson, Petrola, Canada. Exhaust condenser.
21764—A Polson, Hoquiam, U.S A. Collapsible box (P. Henrich, Hoquiam).
21765—C. B. C. Story, Lanes, Eng., and J. A. Wauchope, Schull, Ireland Ore crusher.
21766—A. H. Byron, D. J. Byron, and R. R. Richmond, Wellington Treating flax fibres.
21767—S. T. Smith, Dannevirke Cheese cutter.
21768—S. T. Smith, Dannevirke Collapsible box.
21769—J. W. Cloud, London. Compressed air brake apparatus.
21770—P. B. Delany, South Orange, U.S.A. · Telegraphy
21771—J. H. Krause, Nightcaps, Southland: Hedge slasher.
21772—J. Morris, N. Wales, U S A.: Artificial teeth
21773—A A. Stephenson, Melbourne, Vic. Vaporiser and burner for liquid fuel.
21774—P. J. Owens, San Francisco, U.S.A. Furnace burner for liquid hydro-carbons.
21775—G. E. Partridge and J. McLoughlin, Cromwell Pasting and hanging wall papers.
21776—A. J. Border, Wellington Treatment of flax.
21777—J. Keats, Sheffield Hillside and single furrow ploughs.
21778—E. P Blake, Waverley Power generator.
21779—J. Tinker, Christchurch Speed indicator for vehicles.
21780—W. Pickering, J. W. Boultree, and H. O. Ekensteen, Sydney, N S W Hat and programme holder.
21781—H. L. Mainlands, Burkes Animal trap.
21782—W. H. Scharf, Montreal, Canada · Linotype machine.
21783—W. H. Scharf, Montreal, Canada. Linotype machine.
21784—H. O. Cassels, Invercargill Attaching covers to horses and cows.
21785—W E. Hughes, Wellington: Operating railway indicator boards. (J. Gleeson, Redfern, N.S.W., and F. C. Allen, Ashfield, N.S.W.).
21786—E Moss, Christchurch Stamping or franking letters, etc.
21787—Aktieselskabet Burmeister and Wains Maskinog Skibsbyggeri, Copenhagen, Denmark. Centrifugal drum or apparatus. (P. and O. Prollins, Copenhagen).
21788—D. J. Smith and J. J. Scott, Dunedin.: Hair pin.
21789—J. T. Jebb, Auckland Egg carrier.
21790—J L Rastrick, Auckland. Tube scraper.
21791—W. Whyte, Wellington: Temperature indicator and fire alarm.

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, &c.

The New Cunarders.

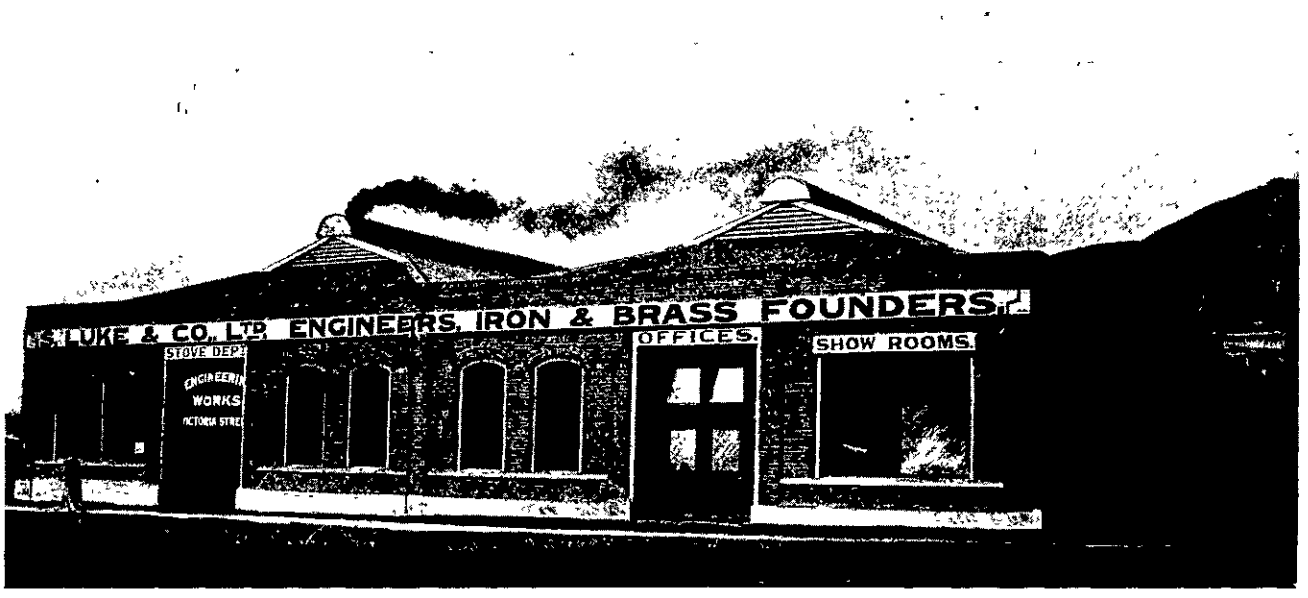
It is difficult to realise the immensity of the proportions of these new liners. They will each be approximately 800 ft. in length, 88 ft. wide, by 60 ft. deep. They will displace 43,000 tons; and in order to obtain the minimum speed of 24½ knots per hour, the gigantic turbines will develop some 80 000 horse power. If stood on end beside St. Paul's Cathedral they would tower to twice the height of that edifice, while if floated beside it the top of the masts would almost reach to the dome of the building. Their superiority in all dimensions over the largest existing vessels is complete.

Our Industries: No. 8. S. Luke & Co.'s Stove-making Branch.

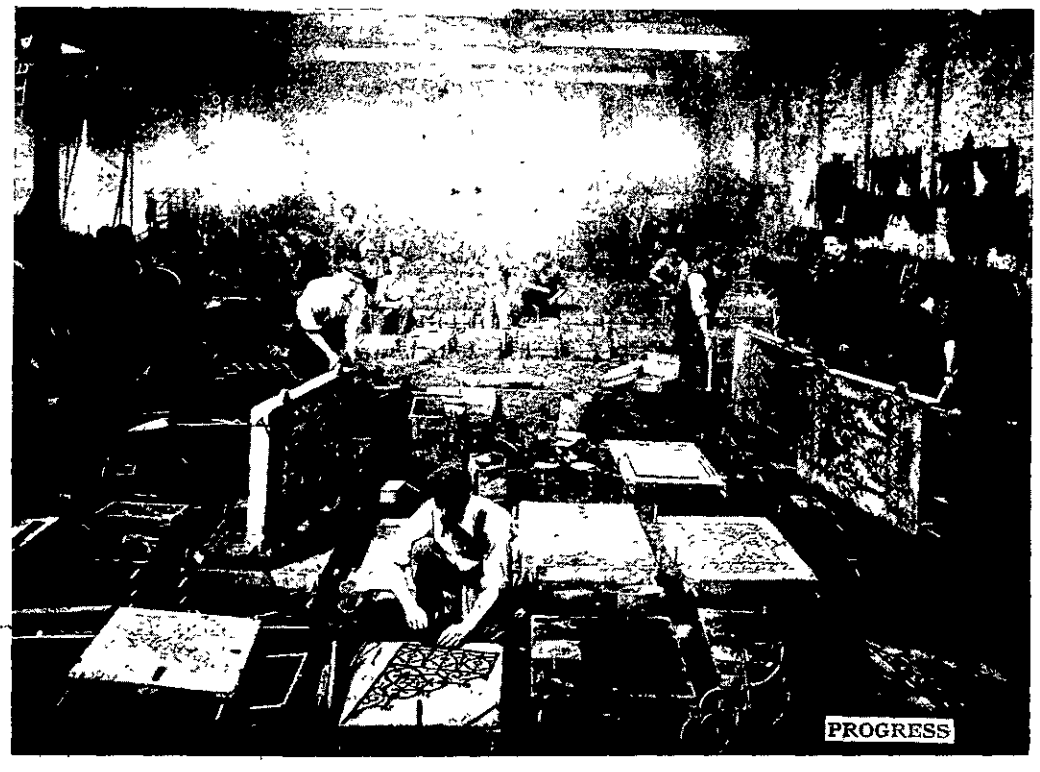
It is now close upon thirty-five years since the first stove-making business was established in New Zealand. Up till that time we were almost wholly dependent on the foreign-made article, the number of stoves imported in 1870 and distributed amongst a population of 250,000 being 5,000. This, compared with 200 stoves imported last year to serve a population of 857,539, demonstrates very clearly that importations have decreased by a considerable amount. Time has brought some notable inventions, even in such a prosaic device as the cooking-stove. Benjamin Franklin, great electrician and engineer of the 18th century, invented the apparatus known in America for many years as the Franklin stove, which was entirely open in front and was used generally for the dual purpose of cooking and heating. From that date to the present improvements have accompanied each new stove model to such an extent as to give us in the article of to-day an appliance of the highest efficiency for use in the kitchen. It is interesting, also, to note that the introduction of chimneys into houses took place in the 14th century, and opened the way to all modern improvements in the kitchen stove; thus, the efforts of inventors have not only been directed towards bettering shape and introducing compactness, but to securing draught for the thorough combustion of fuel and the utilisation of a maximum heat therefrom in the most useful and healthful manner.

In New Zealand stove-making has become an important industry, because it is possible to turn out a stove which is in all respects equal to the imported article landed at an advance in price of 25%. Another advantage gained through this industry is that we manufacture stoves in accordance with our own requirements. The foreign manufacturer is not aware that the majority of stoves used in this colony must be designed for burning wood, and that, consequently, they should possess abnormally large fire-places; therefore, it may be fairly assumed that he has not troubled himself as much over the constantly changing conditions of living, away from his own land, as in persistently exporting stoves built up on principles which he thinks we ought to accept.

Twenty-five years ago the capacity of Messrs. Luke's works in Wellington was a modest two stoves per week; now eighty to one hundred a month can be manufactured with ease—stoves measuring from 2 ft. up to 15ft. in length. The building in which this industry is carried on, and which will in time have three stories added to it, has a frontage of 100ft., and a depth of 200 ft., with two entrances, one facing Blair street, the other Allen street. At the Blair-street end of the moulding-shop stand a large and a small cupola, the former being always in use while the latter is kept as a stand-by, or for the purposes of work not requiring the fullest possible supply of metal. These cupolas furnish the grim side of an iron-founder's business, and to witness the molten metal running at a white heat and the flying sparks enveloping the men, as they alertly shift from one place to another in disposing of the glowing torrent, is a fascinating sight at any time. There is one man amongst this company of smoke-begrimed and silent workers who occupies an important position, and he is the smelter, or furnace-man. He can either make or mar the cast. Not only is the smelter required to scientifically charge the furnace with coke in order to maintain a uniform heat, but he has to gauge the right amounts of pig and scrap iron intended for conversion into "stove" metal. The adept smelter, too, can have his metal ready for the moulding box in a quarter of an hour after the starting-up of the furnace, and thereafter he is able to supply 1 cwt. of metal every three or four minutes. The forced draught for the cupolas is furnished by a 7½ h.p. electric motor driving a Barker centrifugal fan; while the removal of slag is carried out by means of a flux inside each cupola, so that when the metal is poured out the quantity of impurities deposited with the metal in the ladle is reduced to a minimum. Busy hands are waiting to hurry the liquid mass to the moulding boxes, of which there are 200, where sandy receptacles, fashioned by brass moulds into the shape of the oven door, or fire front, or whatever the particular moulding is to be, are waiting. Part of the outfit of this moulding department includes nearly six tons of brass moulding plates which effect a considerable saving of time in the moulding of the parts, while tending to a more satisfactory production than that which used to be identified with the old-fashioned pattern moulding, and it is now possible to witness at Messrs. Luke & Co.'s establishment a complete casting carried out with a brass moulding plate in ten minutes.



MESSRS. LUKE'S STOVE-MAKING BRANCH, ALLEN AND BLAIR STREETS, WELLINGTON.



MOULDING-SHOP. IN ADDITION TO STOVE CASTINGS MESSRS. LUKE EXECUTE ORNAMENTAL IRONWORK IN THIS DEPARTMENT.

From the moulding-shop the crude casting is transferred to the fettling-shop, where the fettlers brush away the remaining sand and trim up the parts prior to handing over to the fitters. The stove faces intended to be bright, and which are always the delight of the neat housekeeper, are now handed to the polisher who is seen plying his occupation to the accompaniment of the whirr of highly revolving grinding stones, emery buffs and calico mops, which in turn do their work so well that the polished piece of metal held up to the eye appears as reflectent as a looking-glass. Fitters next take the parts and assemble them for the shaping of the stove, which, when put together, is finally passed on to the paint shop to receive finishing touches.

Several minor departments, such as the smithy and iron-working shop, are situated at the Blair-street end of the works. The iron-workers prepare the ovens, ash pans, copper boilers, etc., while for the angle-bending of ⅛″ plates, when cold, a powerful Rhodes bending machine is installed. The high-pressure wrought and cast boilers, and those of copper for both high and low pressures, are made in this department, and they are important features of modern stoves in a cold climate, being designed for a maximum steam pressure of 80 lbs. per sq. inch, and tinned inside for the purpose of warding off the injurious effects that would otherwise supervene

FITTING-SHOP AT MESSRS. LUKE'S STOVE-MAKING BRANCH.

on the use of copper alone. These boilers are constructed on the horseshoe principle and they are said to heat much more rapidly than those of the old-fashioned shoe type. Another specialty carried out under the same roof as the stove-making business is cast and wrought iron work of every description; thus, the variety of products extends beyond ranges and oven work of all kinds to fences and gates and ornamental iron work generally.

In concluding an interesting visit to Messrs. Luke's stove-making branch the representative of PROGRESS was conducted through the showroom and general offices situated on the Allen-street front. The showroom contains many samples of the products of the works, and the general offices are both roomy and well-lighted, two features conducing to the rapid despatch of the firm's engineering, boiler-making and brass-founding business conducted at the Te Aro Foundry.

The whole of the works, both in connection with the range department in Allen street and the Te Aro Foundry in Victoria street, are under the joint management of Messrs. Chas. M. and J. P. Luke, as managing directors.

THE GALLITZIN TUNNEL.

BY PRESTON CHAMBERS, C.E., AUCKLAND.

By last mail news reached us of the completion of the Gallitzin tunnel on the Pennsylvania Railway, U.S.A. It was designed to relieve the traffic across the Alleghany mountains at an elevation of 3,000 ft. above sea level 11 miles west of Altoona.

Until recently all east-bound traffic passed through the original double-track tunnel known as the old Gortage road, built in 1851–5 and widened for railway use in 1898; and all west-bound traffic took the Alleghany tunnel about 200 yards north of it. This latter tunnel, while unnecessarily wide for a single track, has been found to be rather dangerously narrow for double lines. It has a horseshoe cross-section of 24 ft. wide by 20ft. high, and could not therefore advisedly be simultaneously used for both freight and passenger service. Since the completion of the new tunnel each west-bound track passes through a separate tunnel while both east-bound tracks take the old Gortage road.

The new Gallitzin tunnel is parallel with the Alleghany one, and 80ft. distant from it. It has a down grade west to east of 1 in 100, and is driven chiefly through rock at a depth of about 300 ft. It has a cross-section of 17½ ft. wide by 20 ft. high in the clear above the top of the rail. The side walls are rubble for 9 ft. with a concrete roof arch 22 in. thick, with a springing line 15 ft. above the bottom of the side wall. Safety alcoves are placed 200 ft. apart on alternate sides.

The rock negotiated is of a variable character. At the west end of the tunnel sandstone was encountered; at the east end chiefly shale. Limestone, coal and slate were also in evidence, with a little fire-clay. No trouble was experienced from water, the tunnel being driven from both ends without air shafts. The headings were started 14 ft. wide by 9 ft. high, and enlarged to the full dimensions in advance of the bench work. This was removed in two lifts. The first one was 7 ft. high, and the second 10 ft. The total excavation for the tunnel in progress was 21 cubic yards.

The work in the heading at the west end was easier than that at the east end. Four pneumatic Ingersoll-Sergeant drills operated on two columns, making 16 holes about 10 ft. deep in a full shift of 8 hours. The heading was then enlarged by three holes on each side drilled during the night while the permanent timbers were being set, and the top bench, which was kept about 50 ft. behind, was being perforated with a transverse row of six holes. These were fired at 5 a.m. and all debris removed by 10 a.m. Forcite gelatine was the explosive used throughout the workings. All debris was shifted by Marion "A" steam shovels, with the shortened dipper handles and booms, in conjunction with 3 yd. wooden side-dump cars running on a 3 ft gauge track. At the west end, where the grade rose from the head, the ballast trucks were switched out by a Lambert hauler. At the east end no hoisting was required.

At this end of the tunnel the material in the heading was often so loose that satisfactory blasting was extremely difficult. The charges blew out instead of bringing down the rock, and a large amount of extra timbering had to be resorted to in the way of intermediate verticals and side posts for the support of the arching. Although the bench work was rendered easier the general progress at this end averaged only 80 ft per month as against about 200 ft. per month at the west end where little timbering was found to be necessary.

Air was delivered from a power house at a pressure of 100 lbs. through a 6in. pipe carried between the rails of the track to the old parallel tunnel. At the west-end entrance a 4 in. branch was taken from this pipe and carried to the west heading, being reduced as it advanced to 3 and 2 inches. The main pipe was reduced to 5 in., and carried through the old tunnel to the east end, where it was reduced to 4in. and carried to the new tunnel and returned through it towards the west heading, thus providing an air supply always conveniently accessible throughout its entire length.

The side walls were built by the day shifts. Single lengths of 6 in. cast-iron drain piping were placed at 20 ft. intervals horizontally into the foot of the walls and connected, by reducing elbows, to 4 in. cast-iron piping carried up to the solid masonry, or concrete backing, to the haunches where the open ends of the piping were covered with broken stone to facilitate drainage. The facing of the walls was battered to a line fixed by carefully adjusted wooden turnplates. This system of drainage was found perfectly satisfactory throughout the tunnel, except for a short distance near the western end, where a persistent leakage was rectified by stripping the arch-packing and laying in a waterproofing of tar. The cavity was then carefully repacked with dry rubble around the permanent timbering, and no further trouble was experienced.

After the completion of the tunnel very great inconvenience was occasioned by the smoke and fumes ejected by the passing locomotives. The atmosphere at times became so overcharged with carbonic-acid gas as to be unbearable, and remedial action was absolutely imperative. Relief was effected by the construction of a ventilating apparatus, consisting of a sheet-iron hood about 50 ft. long enclosing a track, and having an inner surface coincident with the soffit of the tunnel arch and walls. The outer surface converged from the outer end of the hood to the entrance of the tunnel so as to give a wedge shaped cross-section. A Sturtevant blower was installed at the extremity of the hood on each side and which delivered air through it to the tunnel entrance, where a narrow opening in the inner face of the hood permitted the blast to be forced into the tunnel parallel with its axis. Trains now pass through the tunnel in one direction only, and as the grade is up from this end they are usually drawn by two locomotives in front and a pusher behind. As soon as the leading locomotive enters the tunnel the fan is started and the large volume of air forced into the space between the train and the tunnel lining drives the smoke in advance of the locomotive, and, there being an abundance of fresh air, the driver can keep the cab windows open. The second locomotive does not work in the tunnel, and the smoke from the pusher never reaches the front of the train.

The total amount of concrete used was 12,000 cubic yards, for which 12,400 bushels of Portland cement were required. On an average 2½ lbs. of explosive were expended per cubic yard. About 2 000,000 ft. of permanent timbering was erected. The tunnel was built in 22 months with a force of 300 men and an outlay of £100,000. It is a very striking example of what can be effected by well-directed energy supplemented by the necessary funds

INTERIOR OF SHOWROOM AT MESSRS. LUKE'S STOVE-MAKING BRANCH

..Legal..

Contributed by H. F. Von Haast, M.A., LL.B.

RECENT DECISIONS.

Landlord and Tenant. Annexation to the Freehold. Intention to make house part of Land.—Mr. Smith was the transferee of a lease, granted by Mr. Reid's predecessor in title, which contained a covenant by the lessee to erect on the land a building worth £50. When Mr. Smith became transferee, the lessee had already erected on the land a small wooden building affixed to the soil. To this Mr. Smith attached a wooden dwelling house, and on another part of the land he erected another wooden dwelling house. Both rested by their own weight only on brick piers. To each building wooden steps nailed to the verandah were attached, and the bottom tread of each rested on a piece of timber on the ground. It is the practice in Queensland to build houses upon piers or piles with iron plates to break the continuity between the building and the ground, and not to attach the buildings by spikes or nails to the piers, in order to prevent the white ants getting to the building. Mr. Reid sued Mr. Smith for an injunction to restrain him from removing the buildings at the end of the tenancy. Held by the High Court of Australia that the true test in determining whether a chattel has lost its character of chattel, and become part of the freehold, is to enquire what is the object and purpose of its being attached to the freehold that if such object and purpose is not the enjoyment of the chattel itself, but the better enjoyment of the freehold, it must, be taken to have become part of the freehold, and that, having regard to the intention of the parties as manifested by the degree and object of the annexation, the buildings in question had become part of the freehold, although not fastened to the soil, and that the injunction should be granted. *Reid v. Smith.* 3 *Commonwealth L.R.* 657.

Landlord v. Tenant. Lessor's Covenant to Repair.—Mrs. Torrens was the assignee of the lease of three floors of a house near Piccadilly Circus, which contained a covenant by the lessor, Mrs. Walker, to "keep the outside of the premises in good and substantial repair." The house, which was about 200 years old, was absolutely worn out, and when the adjoining houses were pulled down for rebuilding purposes, the London County Council served notice on the premises that the house was in a dangerous condition, and that certain walls must be taken down so far as they were decaying and out of form. Mrs. Torrens immediately notified Mrs. Walker's solicitor, and in a month had to give notice to the guests in the hotel to leave. Nothing was done by either lessor or lessee, and after an order had been made ordering the owner to do the works and not complied with, the County Council pulled down the walls and left the house uninhabitable Mrs. Torrens then sued Mrs. Walker for an injunction to restrain her from keeping the outside walls of the premises out of repair and for damages. Held by Warrington, J., that the lessor's covenant was a covenant to repair on notice, and not otherwise, that there could therefore be no breach of covenant until the notice of the L C.C at all events, and that after that date there was no breach of covenant because "the house had by its own inherent nature fallen into the condition in which it was then found to be; repairs were out of the question, and nothing could be done but to rebuild the front wall and the greater part of the back wall, to do which was not within the lessor's covenant" *Torrens v Walker.* 75 *L J. Ch.* 645.

Landlord v. Tenant. Covenant to Pay Outgoings. Paving Expenses.—Mr. Greaves leased premises in Sheffield to Whitmarsh Watson & Co. for 21 years, the latter covenanting to pay "all rates, taxes and outgoings, now payable or hereafter to become payable in respect of the demised premises" During the term the Sheffield Corporation did paving work in front of the premises Mr. Greaves had to pay £22 as his proportion of the expenses, and sued the Company to recover this amount as an "outgoing" within its covenant. Held that the paving expenses were outgoings payable in respect of the premises and must be paid by the Company. *Greaves v. Whitmarsh Watson & Co*, 75 *L.J. K.B.* 633.

Master and Servant Secret Commission. Dismissal Without Notice. Mr. Swale agreed to become manager of the Ipswich Tannery, Limited, for five years The agreement provided that he should give his whole time and attention to the business and that he should be entitled to six months notice of the determination of his employment. The directors of the Company consulted him and he advised them about the insurance of the tannery buildings. Without their knowledge he accepted the position of cash agent to the Alliance Insurance Co. with which he insured the tannery buildings, and from which he received commissions in respect of such insurances. The Company gave him three months' notice only. He sued it for six months' salary. Held by Kennedy, J., that, although Mr. Swale had not actively concealed his insurance agency and had apparently not shown the slightest bias, yet that his secret receipt and retention of the commissions from the insurance company was misconduct which constituted a ground for immediate dismissal without notice. *Swale v. Ipswich Tannery Limited. XI. Reports of Commercial Cases* 88.

Employer's Liability. Defect in Condition of Ways.—Section 2 of "The Employers Liability Act, 1882," enables a workman injured by reason of any defect in the condition of the ways, works, machinery or plant connected with or used in the business of the employer to claim compensation from the employer, as though he had not been a workman. In other words it excludes the defence of common employment in such cases. Mr. Metcalf was a tool carrier in the employment of the Great Boulder Proprietary Gold Mines, Limited, and it was his duty to descend the shaft, about 2,000 feet deep, at certain times and visit every level Owing to the negligence of the "platman" in omitting to raise certain "chairs" or frames attached to opposite sides of the shafts by hinges, the cage at the 1,100 feet level came violently upon these "chairs" and the plaintiff sustained serious injuries, in respect of which he sued the Company Held by the High Court of Australia that the term "defect in the condition of the ways" means a defect in original construction or subsequent condition, rendering the appliance unfit for the purpose to which it is applied when used with reasonable care and caution, and does not apply to the negligent working by a fellow-servant of an appliance in itself without defect. *Metcalf v. The Great Boulder Proprietary Gold Mines, Limited.* 3 *Commonwealth L.R.* 543.

Sale of Milk. Adulteration. Written Warranty.—Mr Stevens, a milk dealer, bought his milk from Mr Mott under a contract for fixed periodical deliveries of milk, and, being a cautious man, before the delivery of any milk obtained from Mr Mott the following warranty "I guarantee that the milk supplied by me to Mr. Stevens is perfectly pure and with all its cream as the cow gives it. Francis Mott." Four months later, however, Mr Stevens was prosecuted for having sold new milk not of the nature, substance and quality demanded, inasmuch as it contained 16 per cent. of added water. He proved that he had sold the milk in the same state as when he purchased it from Mr. Mott and produced Mr. Mott's warranty, relying on the section of the English statute from which section 9 of "The Adulteration Prevention Acts Amendment Act, 1895" is taken. Held, however, by Lord Alverstone, C. J., and Darling, J. (Ridley, J., dissenting) that there must be a written connection between the warranty and the particular consignment in question, and that, in the absence of evidence to show such connection Mr. Stevens could not rely upon the warranty. Mr. Stevens should have seen that Mr Mott affixed to each can of milk a label in some such form as this "This milk is supplied by me under an agreement, dated the —— day of —— and I warrant the same to be pure and unadulterated new milk with all its cream *Watts v Stevens* 22 *Times L R* 622

Company Voting Papers.—The articles of association of the Le Roi Mining Company provided that votes might be given either personally or by proxy, and that if a poll were demanded it should be taken in such manner as the chairman of the meeting should direct A poll being demanded, the chairman directed the poll to be taken by means of voting papers. Held by Joyce J. that taking the poll by voting papers was unauthorised and invalid *McMillan v Le Roi Mining Co XIII Reports of Bankruptcy and Company Cases* 65.

Bankruptcy. Preferential Payment Commission.—Among the claims entitled to preferential payment in bankruptcy are the wages or salary of any clerk or servant in respect of services rendered to the bankrupt during the four months immediately preceding the date of the bankruptcy petition Mr Goodwin was employed by Mr. Klein as a commercial traveller at a salary of £2 per week and a commission by way of salary of $3\frac{3}{4}$ per cent upon all business transacted by him. When Mr. Klein became bankrupt Mr Goodwin had received his £2 per week but about £25 was due to him for commission Held by Bigham, J., that the commission was part of his "salary" and was entitled to priority *In re Klein.* 22 *Times L R.* 664