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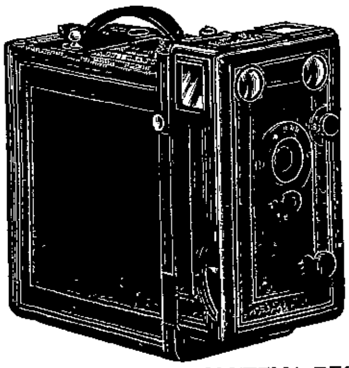

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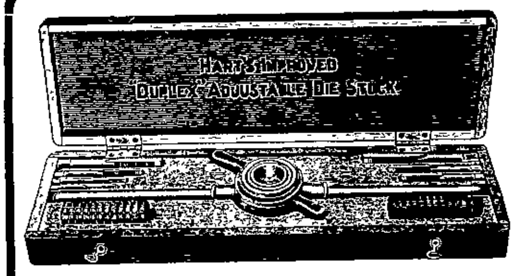

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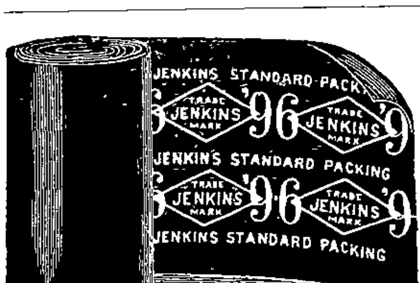

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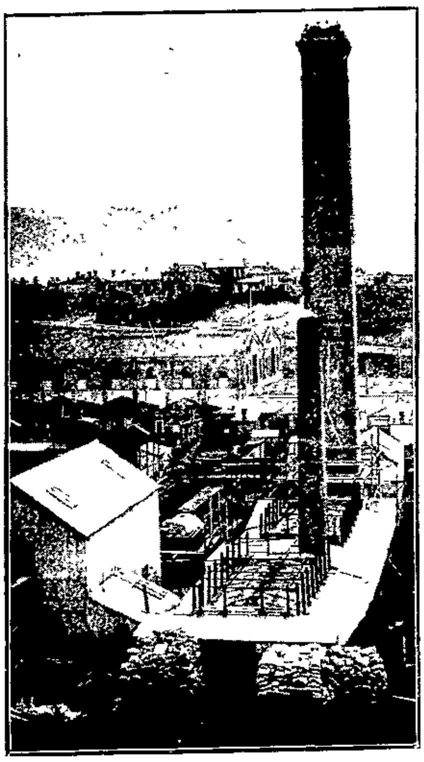

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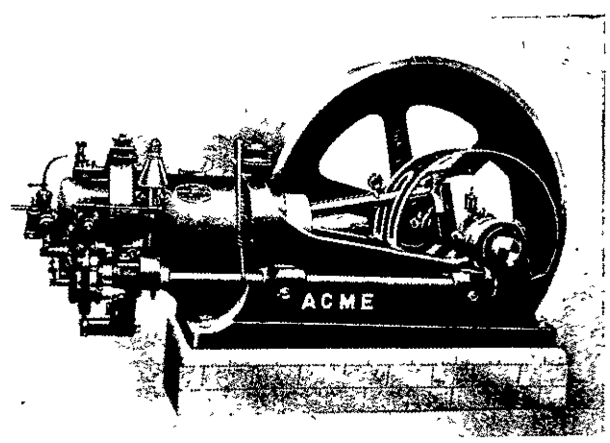

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THE SCIENTIFIC NEW ZEALANDER.

VOL. I.—No. 1. MONTHLY.] WELLINGTON, N.Z., NOVEMBER 1, 1905. [PRICE: 6d Per Copy; 5/- Per Annum.

Business Notices.

PROGRESS will be mailed regularly every month to any address in the Colony on payment of the Annual Subscription—FIVE SHILLINGS. To Australia or United Kingdom, 5/6.

The Editor invites contributions (which must bear name and address of sender, not necessarily for publication) dealing with progress made in any process or method directly or indirectly connected with mechanical, industrial or commercial work. In no case can rejected copy be returned unless accompanied by addressed envelope bearing half-penny stamp; neither can the Editor enter into correspondence concerning rejected contributions.

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

In case of change in address, or irregularity of this paper's delivery, subscribers should send immediate notice.

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BRIEF FOREWORD.

IT is well within the bounds of an obsolete and retarding conventionality for a new paper to make a trembling bow, and to simultaneously express a conviction that its advent will supply a "long-felt want." PROGRESS, however, does not proclaim itself as an instrument whereby the lessening of any void may be carried out, but it rather looks to the formation of its own appreciative circle of readers—from the intelligent schoolboy to the critical adult—as the outcome of the excellence of its mode in covering hitherto untrodden ground. As the title implies, the literary matter will concern progress—progress in every phase of commerce; and as commerce must be accepted as the generic head for the subordinate powers of the world, so will this paper treat of progress in engineering, processes, inventions, industrial work, and economics as applied to any of those subjects. The world's patents of importance will be discussed, and attention is to be given the colonial patentee and his work. In brief, then, the publishers' intention is to bear the onus of creating in PROGRESS a journal of first interest to every intelligent New Zealander, and a production in accordance with the advanced position of the colony in the world's commerce.

PROTECTION AND PROSPERITY.

IN almost every inhabited and civilised part of the earth to-day there is evidence of humanity's desire to keep in the van of progress by maintaining high moral standards, adopting the best fiscal policies, instituting laws in relation to peculiar national exigencies, and developing the natural resources of the land. In countries both rich in natural products and manufacturing facilities the policy of Protection has been adopted with a resultant benefit which, strange to say, the whole world has indirectly shared in.

Taking the United States of America as an instance, we find that, despite Henry George's prophecy that the States were ready a few years ago for a movement that would appeal to Americans on behalf of a real Free Trade, "the only true factor in industrial betterment," that country has enjoyed an unbroken record of prosperity under Protection from the day the McKinley Tariff came into operation, fifteen years ago. The progress of the States is more than passingly remarkable, inasmuch that while discovery and invention have been steadily increasing the productive powers of Labour in every department of industry, the condition of the working man has not suffered retrogression. This satisfactory state is coincident with the condition of the artisan in the Australasian colonies where, although the aggregate productive power of Labour has not reached the American standard, or even that of France, the combined States must continue to grow and prosper as long as Protection primarily imposes the acquisition of mechanical skill for the proper development of natural resources.

Some economists argue that a protective tariff is undesirable to the colonist, and harmful to the land under whose flag the colonies prosper; and, moreover, they obdurately hold that Protection is in reality the thin end of the Republican wedge. Probably the most direct contravention to such fallacies is voiced in the unswerving patriotism which has been identified with the colonies whenever the parent land needed their sympathy most—a patriotism that has struck the enemy harder than any missile of war. And again, Canada long ago demonstrated, in a practical manner, her loyalty to the Crown by modifying her protective policy in favour of British imports The preferential tariff introduced by Sir Wilfrid Laurier in 1897 was a bold step in the direction of imperial unity; and the illustrious French-Canadian premier is said to have never repudiated it. Six years after New Zealand adopted a similar measure in "The Preferential and Reciprocal Trade Act of 1903," whereby goods "when not the produce or manufacture of some part of the British dominions," are subjected to a duty as high as 50 per cent. in some cases, while 20 per cent. is levied on a class of goods hitherto admitted free.

Protection, therefore, is not indicative of a colony's disloyalty, nor in the least way harmful to the Motherland; but it is indisputably the practical voicer of democracy, and the most equitable of fiscal policies in a country like our own. New Zealand, under a protective tariff, has largely increased her volume of trade in the last ten years, The value of our exports in 1904, inclusive of specie, was £14,633,272; in 1894, £9,085,148. Industrially, a great advance has been made: the number of male hands employed in factories and industrial works in 1896 being placed at 22,986, while in 1904 it rose to close upon 40,000—female hands increasing at a slightly less ratio. Wages and values of land for factories increased in like proportion during the past decade; and a very satisfactory development will be noticed in the value of the colony's machinery and plant, viz:—from £2,988,955 in 1896, to over four millions in 1904.

Without going into extensive figures it may be safely concluded that this colony is flourishing because of the protective measures taken to preserve her industries; and the more industries New Zealand can foster and establish the greater will be her prosperity. Men, being members of a civilised community, are indebted to the labours of that community, both past and present, for the privileges they enjoy, and to orderly government for the welfare and security of possessions. It is therefore clear that a moral obligation underlies our contributing, chiefly by the indirect taxation of a protective policy, to the cost of the State's upkeep in discharging its effective measures for the colony's advancement. And to what end is this advancement pressing? Surely, that with colonial expansion will come increase of facilities for inter-imperial trade; and with colonial expansion, too, will come a demand to be heard in the counsels of the Empire. England must eventually join Canada, Australia, New Zealand, and her other over-sea colonies in a regular partnership, with a proportionate control and responsibility in respect of imperial affairs. This is what the colonies are to look for—the fruition of the long-cherished hopes of every true Briton over the Seas.

Paragrams.

Cape Colony has increased her population 100 per cent. since 1890.

* * * * *

A Christchurch motor 'bus, running between Cathedral square and the railway station for fifteen months, covered 15,000 miles in that time, and carried 80,000 passengers.

* * * * *

New Zealand mines produce one-thirtieth of the world's gold output. Since first discovered our gold mines have produced metal valued in excess of £60,000,000.

* * * * *

Since 1890 New Zealand butter exports have grown from about 4,000,000 lbs. to nearly 28,000,000 lbs. at the present time. Frozen meat exports since 1882 have increased from 2,000,000 lbs to 240,000,000 lbs.

* * * * * *

The world's output of gold last year was, according to the estimate of the United States Director of the Mint, of a value of £69,500,000, or in excess of all previous records. That, of course, was due to the larger output of the Transvaal.

* * * * *

New Zealand's crops for 1904-5 are returned as having yielded 6,966,405 bushels of wheat 10,950,048 bushels of oats, and 884,520 bushels of barley, the areas for these crops comprising respectively 258 015, 342,189, and 29,484 acres.

* * * *

The Union Co's. s.s. "Loongana" continues to make splendid steaming time between Port Phillip and the Tamar. She recently covered the distance, 196 miles, in 9 hrs. 28 min., or at an average of over 20 knots an hour. The "Loongana" is not unlike the new "Maheno," although the latter is twice the size and embodies a slightly different deck plan.

* * * *

The immense possibilities of development in the London butter trade will be realised when it is stated that London expends each year over £20,000,000 for imported butter. New Zealand only receiving about one-twentieth of this sum, while Denmark receives £8,400,000.

* * * * *

The ores found on the Rand average only about ten dwt. to the ton, which means that out of every 60,000 particles of rock dealt with, only one particle of gold is obtained. Fifty-three per cent. of working expenses are represented by labour. There are over 15,000 Chinese at work on the Rand, or nearly twenty-five per cent. of the existing black labour.

* * * * *

Novel and beautiful effects come of a recent invention whereby laces and the most delicate fabrics, as well as art furniture, are electrically given a metal coating of gold, silver, or bronze. The cheapest material may be made to appear costly and striking. Committees of fancy and charity balls will be very glad of cloth of gold and silver at twopence a yard.

* * * * *

A new method of manufacturing wire-fencing is said to have been recently adopted. A number of galvanised iron wires are fed from reels arranged vertically and parallel to each other, and from another reel placed transversely to these lengths of wire are cut off and fed horizontally across the vertical wires. Where the horizontal and vertical wires intersect, they are welded together by small transformers. The welded material then moves forward, and the operation is continuously repeated.

Experiments made by highly trained officials of the Geological Survey Department of India show that the demand for coke for the blast furnaces will render profitable the extraction at Indian collieries of coal tar and ammonium sulphate. For this purpose sulphuric acid factories are to be set up in Western Bengal, to utilise the deposits of sulphuric copper ore which have long been known to exist in the Chota, Nagpur district. his means that India is about to enter the field as a producer of both copper and chemical manure, as well as of iron and aluminium. Its cheap labor, abundant raw material, and enormous local markets give it a position of great advantage in this connection.

* * * * *

Steam turbine machinery is certain to come into increased use for land purposes, now that it is being officially adopted in earnest for marine service by the Admiralty. The Government have decided to introduce turbines into the new battleship to be built under this year's programme, and engineers on the Navy List have been invited to tender. Hitherto, turbines have been confined to torpedo craft, but the Admiralty has now sufficient data to encourage their application to large battleships. The new vessel will be capable of developing 23,000-h.p., and will not only be the most powerful yet designed, but the fastest of her class in the world.

* * * * *

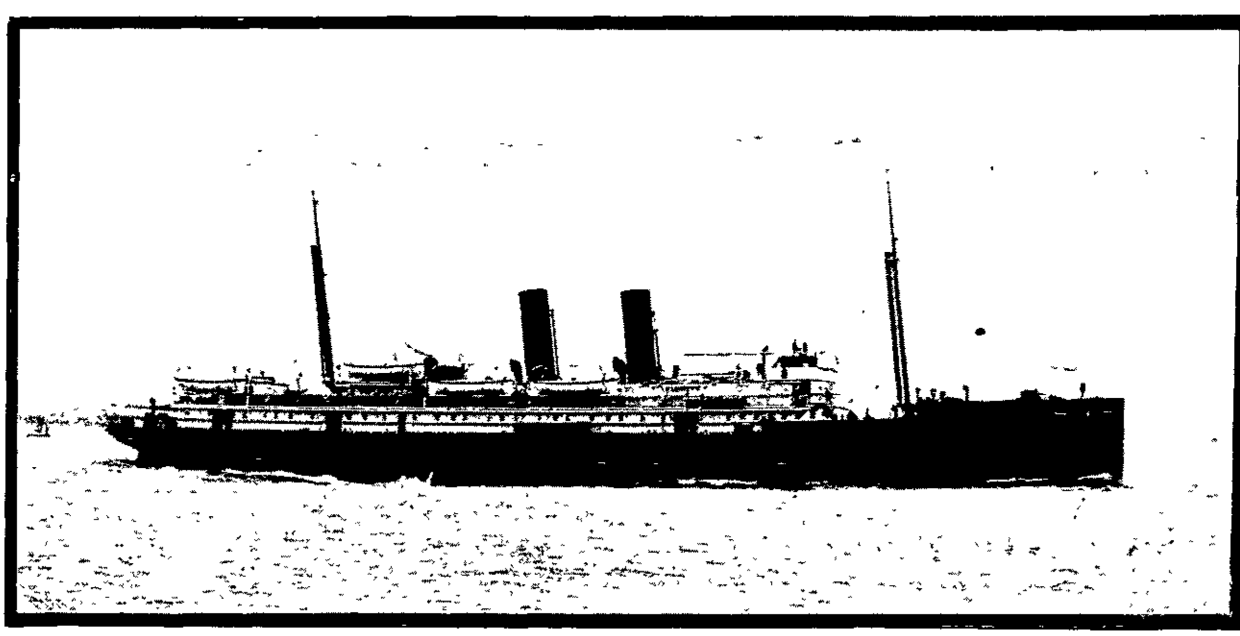
A San Francisco despatch to the "New York Herald" says that Professor Jacques Loeb, of the University of California, whose researches into the subject of the origin of life have attracted wide attention, has succeeded in developing by artificial chemical means eggs of the sea urchin, so that the larvæ produced in the laboratory cannot be distinguished from the living forms produced during the process of natural fertilisation.

The order of events (says the New York correspondent of the "Daily Telegraph") in the process of fertilisation is in both cases the same. Professor Loeb's new method is in every respect a complete imitation of natural fertilisation. In a long account of his method in producing life by artificial means, the professor says that he submits unfertilised eggs to hypertonic sea water for two hours, then uses chemicals. He challenges every investigation.

* * * * *

Applications for space, with full particulars, are invited as early as possible by the authorities of the International Exhibition; and in the allotment of space precedence will be given, as far as possible, to priority of application. No application will be received later than March 31, 1906. Applications for space may be lodged with the Agent-General for New Zealand, Westminster Chambers, 13 Victoria Street, London, E.C., or with the secretary, New Zealand International Exhibition, Christchurch, New Zealand, on the official printed form attached to the prospectus, and notice of the allotment if space is allotted, will be promptly mailed to the applicant. The latest date for receiving applications may be determined earlier if the number of applications promise to exceed the accommodation provided

The ordinary charge for space will be rom 2s. per square foot, the minimum charge being £1 1s., 25 per cent. payable on application, 25 per cent. on allotment, and the balance one month before the opening date of the Exhibition. End spaces will be at special rates.



T.S. "LOONGANA." 2,448 tons gross; 6000 I.H.P. [*Photo lent by U S.S Co.*]

FORWARD.

In the arts and professions there should be no place for crusty conservatism. Their history must be the record of continual progress. Their works should be well in advance of their times, for they are the outward embodiment of a people's finer aspirations, the visible expression of a nation's soul. He who is persuaded that he best serves his profession or art by hugging closely the shores of old custom and out-of-date ideas, will never win anything worth having in the illimitable ocean of discovery and opportunity. The spirit of Columbus or Cook makes for greatness in every path of life. The man who insists on doing only as his grandfather did proclaims himself a mere limpet on the rocks of conservatism. The spirit that leads men to launch boldly out on the untried deep leads also to fortune and to the world's advantage. The successful are those who "trust themselves and dare step out," for whom the rut of antique custom has no fascination. They are successful because they have shaken off the past, subdued the present, and reached forward into the future, into the unexplored regions where are born the newest, noblest, and most beautiful ideals.

THE RHODES SCHOLARSHIP, 1905.

It is interesting to note that the two students who have hitherto been elected to Rhodes Scholarships from New Zealand have both been students of natural science. Mr. Thomson, of Dunedin, last year's successful candidate, had specialised in Geology. This year the choice of the committee of selection fell upon Mr. Robertson, a Victoria College student who is "par excellence" a chemist.

Mr. Philip Wilfred Robertson, M.A., F.C.S., is a native of Auckland, but came to Wellington when ten years of age. He attended the terrace school, and subsequently entered Wellington College, of which institution he was *dux* at the age of sixteen. Although he was head of the sixth form in Latin and Mathematics he had already decided to specialise in science. In the Junior Scholarship examination in 1900 he was head of the colony in chemistry.

In 1901 Mr. Robertson entered the Victoria College, and after working hard for a year at practical chemistry he began to work at original investigation. During the remaining three years at the College he completed six chemical researches—the greater number of which have already appeared in the transactions of the Chemical Society of London.

Though essentially a chemist Mr. Robertson is by no means a one-sided student. He has a good working knowledge of Latin, Greek, French, German and Italian, and he has also studied higher mathematics, and takes a keen interest in Physics and Biology.

In the social life of the Victoria College Mr. Robertson will long be remembered. He played in the tennis and hockey matches, and cheerfully held several of those secretarial offices which entail much work and seldom elicit any thanks.

Mr. Robertson and the Victoria College are to be congratulated upon the decision of the electors, and the time is looked for when Mr. Robertson shall return to New Zealand as professor of chemistry in one of our University Colleges.

In the city of Buenos Aires the ten tramway lines carried during the first six months of 1904 over 72,000 000 passengers, a gain of nearly 7,500,000, or 11½ per cent. over the number of passengers carried during the first six months of 1903.

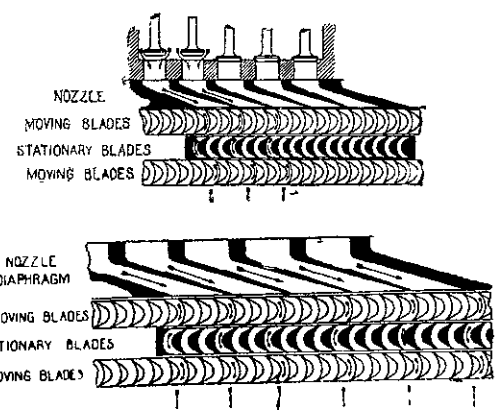
...THE...

CURTIS TURBINE.

By J. R. TEMPLIN.

[*This article was specially written for* PROGRESS *by Mr. Templin, who has until recently represented the General Electric Co. in Christchurch, where his Company has supplied the whole of the electric plant for the new Corporation tramways.*]

THE first steam turbine was probably that built by Heros of Alexandria, in the year 120 B.C. It was then known as a reaction wheel, and worked in much the same way as the latter-day rotating lawn sprinkler. In 1629 one Branca, an Italian, invented an impulse turbine, on the same principle as the impulse water-wheel, in which the water is directed, by means of nozzles, upon a number of vanes mounted on a shaft. Owing to the mechanical difficulties which presented themselves in obtaining suitable materials and tools the Branca machine



SECTION OF CURTIS TURBINE SHOWING NOZZLES AND BLADES.

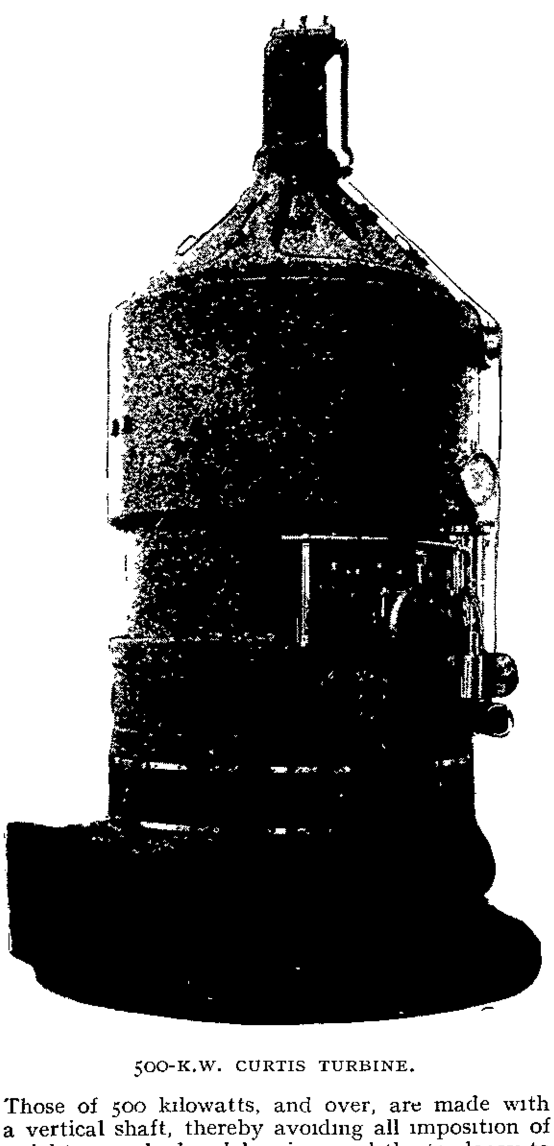
was not developed, and further interest ceased until 1884, in which year a Swede named De Laval perfected the impulse turbine. With improved conditions of manufacture De Laval soon went past the efforts of the earlier experimenters, and gave the world a workable and valuable machine. Steam flowed through a nozzle on to a single vane wheel; and the revolutions per minute went up to as high as twenty thousand.

The invention of the Parsons turbine, which embraced an entirely new principle, was contemporaneous with the De Laval. The Parsons may be termed a reaction-impulse turbine, for instead of steam expanding through nozzles and then impacting its energy to the wheel vanes, the expanding is done in the blades themselves.

The Curtis turbine, which was invented in 1897, differs materially from that of any other type of steam turbine, in that it permits the use of comparatively low rotative speeds without introducing any complicated mechanism. The normal speed is 1800 revolutions per minute; while the guaranteed speed variation is four per cent. no load to full load. However, on small fluctuations of load the variation will not exceed two per cent. The Curtis turbine is designed to work continuously with an overload of twenty-five per cent. and fifty per cent. momentarily. Its efficiency is also demonstrated in its economical consumption of steam per kilowatt*output, for with a full load it requires but 21lbs. of steam per kilowatt hour. This, contrasted with a reciprocating engine's consumption of 20lbs. for each indicated horse power, leaves a great deal to be said in favour of the economy of the later machine. The turbine is divided into stages (1 and 2), in which respect it may be compared to a compound or triple expansion reciprocating engine. Each stage may contain one, two, or more revolving bucket wheels, which utilise the power of the steam after it has been expanded from a set or sets of expansion nozzles. The work is divided between the stages—again similar to a multi-cylinder engine—and thus permits a greater initial velocity of the steam, which renders the action of the steam more efficient and perfect than could be obtained were a lower initial velocity used. By means of this arrangement of working with two stages the energy of the flowing steam is more effectively given up to the revolving parts, as the surface friction caused by the steam moving over the buckets varies as the square of the velocity. The pressure between each stage is so arranged that most efficient results ensue, the required pressures having been obtained after a long and expensive series of experiments. Before proceeding any further it may be well to note the positions of the blades and the nozzles. (Fig. 1).

In other types of steam turbines the steam expands either through a great number of successive rows of buckets, without the use of nozzles, or the expanding steam is used by expanding in nozzles and absorbing the kinetic energy in the one revolving bucket wheel, thus requiring an enormous peripheral speed, and rendering the turbine unpractical for direct driving of electric generators, or for other similar purposes. To give an idea of the enormous velocity of this steam expanding through a diverging nozzle from 150 lbs. boiler pressure to atmospheric pressure, it can be said to have a velocity of nearly 3000 feet per second In order to utilise all the kinetic energy of the steam the peripheral velocity of a turbine having a single bucket wheel would have to be nearly one half of the initial velocity of the steam, or 1500 feet per second, which is over three times the peripheral velocity of the wheels in the Curtis turbine.

The Curtis steam turbine is made in a number of sizes, ranging from $1\frac{1}{4}$ kilowatts to 5000. All of the machines below 500 kilowatts are made with a horizontal shaft, and are direct-current machines.

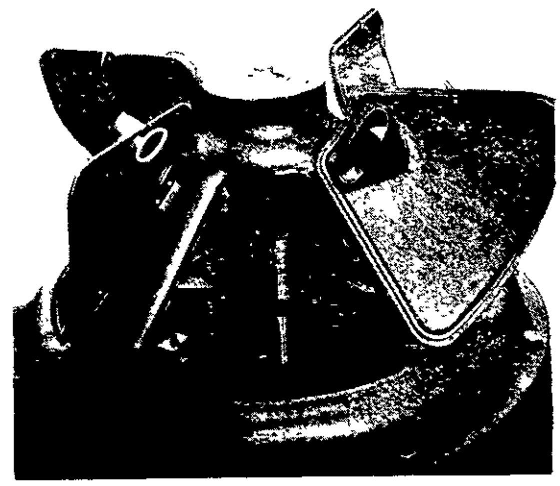


500-K.W. CURTIS TURBINE.

Those of 500 kilowatts, and over, are made with a vertical shaft, thereby avoiding all imposition of weight on cylindrical bearings and the tendency to deflect the shaft, which might be due to unequal expansion—a very important factor in large-sized turbines. The result of this is compactness and simplicity of construction.

* About $1\frac{1}{4}$ indicated horse power.

The vertical shaft is supported on what is called a step-bearing, upon which the whole of the revolving parts are supported, and which maintains the revolving and stationary parts in exact relation to each other continually. This step-bearing consists of two cylindrical, cast-iron discs bearing upon each other, and with a central recess in the bottom part to receive the lubricant which is forced in with sufficient pressure to lift the revolving parts and the top piece of the step. Thus, the whole revolving part turns on a thin film of water, as water is the lubricant used. The water, after passing between the discs, flows upwards and lubricates a guide-bearing which is supported by the same casing, and which helps to align and steady the shaft. The shaft is protected from rusting by a base sleeve which is shrunk over it. After the water passes through this bearing it flows off into the base of the turbine and into the condenser. The sleeve is made of white metal, and can easily be removed in case of necessity. It is therefore clear that the friction must be very slight. For example a 500 kilowatt turbine will revolve four or five hours after the steam is shut off. All of the

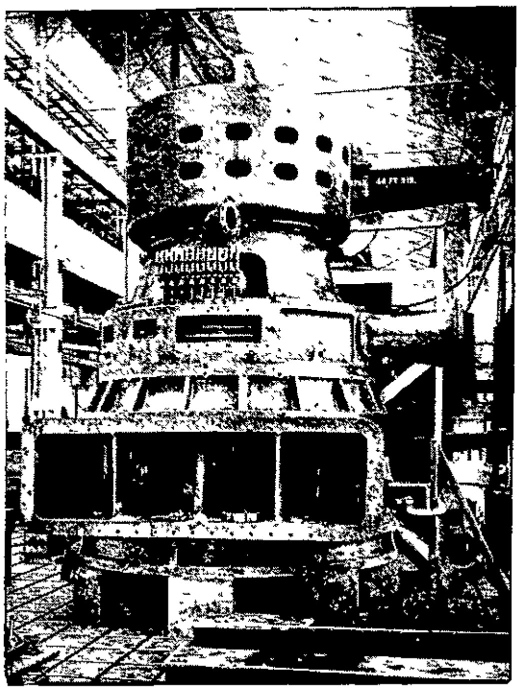


TOP OF CURTIS TURBINE SHOWING COMMUTATOR.

latest designs are, therefore, provided with a brake which bears on the lower surface of a chilled-iron ring carried by the lower wheel. Thus, in case of necessity the machine can be stopped very quickly. Should the water pressure be lost the bearings will score somewhat and slowly wear away; but such a contingency is not likely to prevent the continuance of operation if the pressure is re-established. However, in the event of the bearing becoming much cut it can be taken out and faced off and used again. The failure of the lubricating system is reduced to a minimum, as almost all power houses have a hydraulic accumulator which will keep up the pressure even though the pumps were to stop; and the pumps are duplicated so that should one stop the other would start up. The pressure required to hold up the revolving parts depends upon the size of the turbine, ranging from 185lbs. to 1250lbs. in the case of a 5000 kilowatt machine. The amount of water required by the turbine is regulated by a baffler, which consists of a square-threaded screw, around which the water has to flow, and the longer the thread the less the water flowing. Thus there is a constant relation between the revolving and the stationary parts.

One of the most important features of the Curtis turbine is the method of governing. The machine is governed by changing the number of nozzles in flow; thus the variation of the load affects the efficiency of the machine very little, barring the rotation losses, which are constant with all loads. Thus it is quite apparent that the efficiency of the machine is much higher than if throttling were used. The governor is attached to the top of the shaft. It is a centrifugal governor designed by the General Electric Company. It may be remarked, in passing, that one of the greatest problems of the steam turbine is to obtain a suitable governor for high-speed work. There are plenty of governors for low speed, but when high speed is required none of them will stand the test. The centrifugal governor acts upon levers which operate a drum, and on which there are segments of same number as the valves. These segments, or cams, operate fingers carrying contact points, which close an electro-magnetic circuit controlling a pilot valve, which in turn operates the main valve. The main valve is a balanced valve, having live steam pressure on the top and bottom when it is in the closed position. By the action of the solenoid on the pilot valve the live steam pressure is cut off, and at the same time an exhaust port is opened, which releases the steam on top of the main valve and thus allows the main valve to be opened by the steam pressure under it. As the load varies the number of valves in operation changes. On a regular load one valve will be opening and closing constantly.

A very important item in operating a turbine is the balancing of the revolving parts so as to prevent vibration. It is essential that the balance be good in order to prevent undue wear in the bearings; and, in the case of direct-current machines, to facilitate good commutation. The balancing of the turbine it elf is done before the field or armature is put on the discs, or wheels, being provided with holes in which weights can be screwed if necessary. Then the machine is balanced with the field, or armature, in position, the balancing being done in the revolving part of the generator. It may be of interest to some to note that the machine may



2000-K.W. CURTIS TURBINE.

appear perfectly balanced before it reaches the critical speed at which point it changes from its static to its dynamic centre, while after it passes that point the balance may be entirely different.

Thus, in a necessarily restricted space, the writer has endeavoured to explain the principle of the Curtis turbine. Results prove that this machine is not only more economical in the consumption of steam per kilowatt hour than the ordinary reciprocating engine, but that the costs of oil, labour and repairs are all lower in the running of the turbine. The first cost is considerably less than that of the reciprocating engine, and the floor space required for the turbine is also less by nine-tenths.

It is difficult to prophecy the future of the turbine, but it is quite certain that for electrical power work, in all its branches, the machine is a pronounced success.

The annual export per capita in the United States is £4 5 0; in New Zealand it is nearly £20.

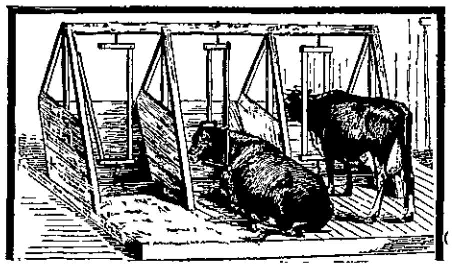
* * * * *

A MOMENTOUS PROBLEM.—Is the development of the human intellect limited? is a question propounded by J.Y.J., of Seymour. In the course of an interesting contribution, which only the many demands on our space debar us from inserting in full, our correspondent avers that so far as that portion of the brain forming the seat of the inventive faculty is concerned there appears no reason why its activities may not increase considerably. Apparently even with the present ratio it seems to be merely the amount of practical knowledge and material available that limits the innumerable combinations it is able to produce.

Machinery and Appliances.

COMFORT FOR CATTLE.

AN improved chain-hanging cattle stanchion, of American origin, is clearly shown in the accompanying illustration. A short chain is used to secure the fastener to the top beam, so that it is suspended one and one-half inches clear of the bottom sill It is also fastened to the bottom sill by a chain of sufficient length to allow it a motion which is free and easy in all directions, as well as in rotation.



AN IMPROVED CHAIN-HANGING CATTLE STANCHION.

This arrangement gives to the cattle freedom, yet security. It keeps them as clean as the rigid stanchion, and yet gives such liberty of action that when standing the head can be turned so as to lap the sides, as when loose; or to rest it on the body when lying down. There is no weight on the neck, no chafing of the head with ropes or chains, and no possibility of cattle getting loose, or of lying in the droppings.

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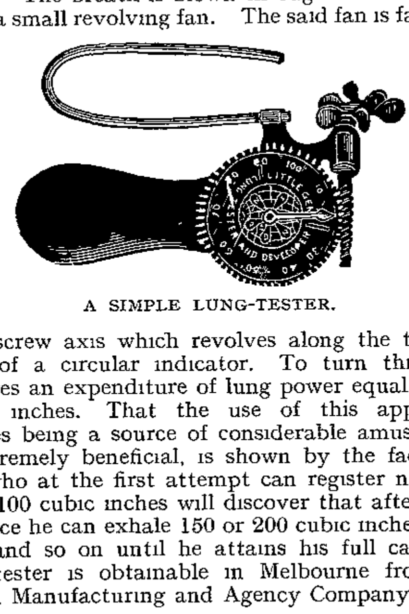
IT is a truism of modern physical culture that perfect health is impossible without deep breathing. The value of the ingenious lung-tester and developer, illustrated herewith, should, therefore, be apparent to all. The breath is blown through a rubber tube on to a small revolving fan. The said fan is fastened



A SIMPLE LUNG-TESTER.

to a screw axis which revolves along the toothed edge of a circular indicator. To turn this once requires an expenditure of lung power equal to 100 cubic inches. That the use of this appliance, besides being a source of considerable amusement, is extremely beneficial, is shown by the fact that one who at the first attempt can register no more than 100 cubic inches will discover that after some practice he can exhale 150 or 200 cubic inches, then 250, and so on until he attains his full capacity. The tester is obtainable in Melbourne from the Union Manufacturing and Agency Company.

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THE prevention of smoke depends upon the application of certain principles governing combustion, which are more of less understood. The application of these principles involves three factors—(1) The device in which the combustion is to take place, including the accessories thereto; (2) the materials to be burned; (3) the method and conditions under which the device and the materials referred to above are manipulated. That which may be the best device in one place may not be the best in another, the prevention of smoke at any particular establishment being a problem depending on the application of general principles.

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THERE is ample room for improvement in the brakes usually employed on road vehicles. Some of the patterns now in use were probably familiar to prehistoric man. An automatic brake has been brought out, principally for heavy vehicles, that promises to be widely adopted. When a vehicle to which the device is attached is decending a gradient, or when the speed of the horse or horses is reduced, the brake acts automatically, by means of the pressure on the breeching in a one-horse vehicle, and the backward pull on the collars when two horses are used. If desired the brake can also be worked by a foot or hand lever, and can be locked on or off when necessary.

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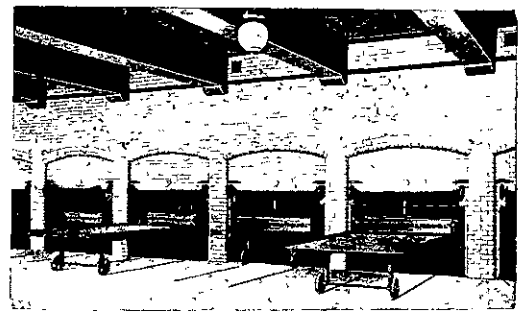
THE latest and most advanced type of any baking oven is represented in the accompanying illustrations. This shows a range of six of "Telescocar" draw-plate ovens erected in the bakery of the Kettering Co-operative Society, Kettering, England, by the engineering firm of Werner, Pfleiderer and Perkins Limited, London, W.C. Actual experience shows that two ovens of this type are capable of a regular output of 120 sacks per week with five men. The sole of the oven is drawn out of the baking chamber



OVENS OF A MODERN BAKERY.

into the bakehouse for setting and drawing each batch, thus ensuring that all the loaves are baked for the same length of time, and are, therefore, uniform in colour, weight and appearance. Undoubted economy is obtained with the continuous working of the oven thus made possible. A complete plant of Messrs. Werner, Pfleiderer and Perkins' ovens and machinery has just been installed in the new bakery of Abel and Co. Limited, of Newton, Sydney. This firm informs us that although not yet actually working all the machinery or ovens, they are in a position to see that the plant is capable of doing all that is claimed for it.

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IN the famous Lebaudy air-ship the principle of the navigable balloon is combined with the use of horizontal and vertical æroplanes. A horizontal æroplane, which is canvas covered, forms a platform suspended from the under surface of the balloon proper. Below this the car is suspended by cables. The maximum girth of the balloon, which in no section is perfectly cylindrical, is 9.8 m., and the total length from end to end 58m. A balloonette is arranged inside the balloon, and is kept inflated by a motor-driven fan in the car. The motor is of 40-h.p., of Daimler type, water-cooled, and the petrol tank is placed under car and motor. Two bladed propellers are used, one on either side of the car, their shafts being driven by bevel gearing from the engine shaft, the speed being from 800 to 1000 r.p m. It is claimed that this air ship will sail closer to the wind than any of its rivals, and also that speeds of 40 hm. per hour in still air have been attained.

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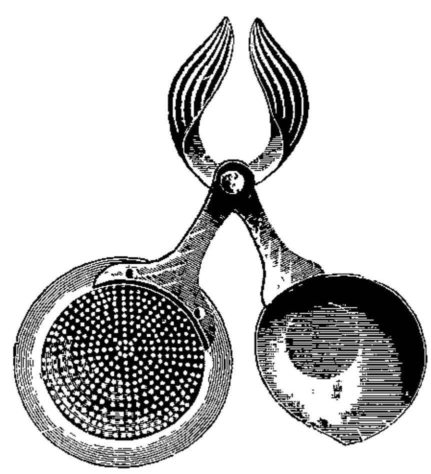
HEREWITH is shown an illustration of a new tea-strainer. The liquid can either be poured direct into the spoon on the left-hand side, when the leaves will remain in the bottom thereof, or it can be poured into the strainer on the right-hand side. If the tea is poured as first described



A NOVEL TEA STRAINER.

the strainer can then be closed over the spoon, and the leaves thus imprisoned prevent any drips or disfigurements of the table cloths. The handle open with a scissor-like action on a slight pressure, and close automatically after use. As to whether this novelty will adapt itself to New Zealand tastes remains to be seen.

Radioactivity.

BY P. W. ROBERTSON, M.A., F.C.S.
(RHODES SCHOLAR.)

PERHAPS no scientific discovery ever aroused such excitement in the minds of men of science, and among people generally, as Radioactivity · for experimental results have been obtained that seem to be contrary to the law of conservation of Energy and the Atomic Hypotheses, which are the very foundation of modern Chemistry and Physics.

Radioactivity may be defined as the spontaneous emission of radiations capable of passing through substances opaque to ordinary light and having the power of discharging electrified bodies. In addition to this they are able to cause fluorescence and fog a photographic plate. This property is possessed by several elements and their compounds, more especially radium, and to a smaller degree by uranium and thorium, all of which elements are characterised by high atomic weights.

The original discovery of Radioactivity was made in the case of the uranium compounds by the French chemist Becquerel, in 1896. Two years later Schmidt and Mme. Curie discovered independently that thorium and its compounds had the power of emitting radiations of a similar nature. Mme. Curie then examined a number of compounds of uranium and found that they all were radioactive. But in the case of certain minerals the activity was greater than that exhibited by an equal amount of pure uranium. The mineral possessing this property in the highest degree was pitchblende, an impure oxide of uranium. Mme. Curie considered that this substance must contain some unknown element considerably more active than uranium itself. The chemical examination of pitchblende resulted in the discovery of two new substances of enormously high activity. One of these separated out with the bismuth, and received the name polonium. The other was found to remain with the barium which was co verted into its chloride. By fractionally crystallising this a great number of times, at last a minute quantity of a substance free from barium was obtained with an activity two million times that of uranium. This proved to be the chloride of a new element to which, in consequence of its characteristic property, Mme. Curie gave the name *radium*.

Radium chloride is slightly luminous in the dark, and its radiations produce intense luminescence on many substances, such as the mineral willemite (zinc silicate). In addition they are capable of exerting a powerful chemical action on many substances. Glass and even quartz is discoloured, yellow phosphorous is converted into the red non-inflammable variety, and iodine is rapidly liberated from iodoform. A solution of radium chloride in water causes decomposition in the same manner as electrolysis with the continuous liberation of oxygen and hydrogen. Radium compounds have a powerful physiological action. Unfertilised ova when acted on by the radiations develop without fertilisation by spermatozoids. The action of the radiations on the human skin is to destroy the epidermal tissues, producing a painful burn which takes a considerable time to heal. In consequence of this property, radium has been successfully employed in curing certain forms of surface cancer, but it has no apparent effect on deep-seated tumours

The most remarkable property of radium was discovered by M. and Mme. Curie, who in 1902 startled the world with the announcement that it maintains itself 5°F. in temperature above the surrounding objects. Thus radium continually emits energy in the form of light and heat.

The latest discovery in connection with radium is due to Ramsay and Soddy, who showed in 1903 that one of the products of the breaking down of the radium atom was helium, that peculiar element whose presence was recognised on the sun before it was known on the earth. This was fully confirmed by the experiments of Himsteat and Meyer in 1904.

The radiations which are emitted by radium are not homogeneous, but consist of three classes of rays. These have been named *Alpha*, *Beta* and *Gamma*, respectively after the three first letters ofthe Greek alphabet.

Alpha-RAYS.—These are characterised by having a feeble power of penetration completely absorbed in a few inches of air. Sir William Crookes showed that phosphorescence of zinc sulphide under the *Alpha*-rays, when examined through a lens, appeared as flashes or scintillations. The instrument known as the spinthariscope simply consists of a magnifying glass focussed on a screen of crystalline zinc sulphide, above which at a distance of about ¼ in. is a pointer holding a minute fragment of some radium preparation.

For a long time the exact nature of the *Alpha*-rays remained unknown, till Professor Rutherford in 1903 showed that they consisted of positively charged particles, since they were deviated in an intense electric field. Professor Rutherford now considers that these *Alpha*-particles are atoms of helium.

Beta-RAYS.—These produce a powerful fluorescence and act strongly on a photographic plate. They appear to be identical with the cathode rays of Crookes, that is they are electrous particles one thousandth of the weight of a hydrogen atom, bearing a negative charge and moving with a velocity almost as great as that of light. In consequence of the fact that they are negatively charged, these *Beta*-particles are deviated in an electric field like the *Alpha*-radiations, but to a greater extent and in the opposite direction.

Gamma-RAYS.—These are characterised by their extraordinary power of penetration, being readily detected after passing through five feet of water. They cause fluorescence and have a photographic action. When heated by the most powerful electric or magnetic fields, they remain undeviated; in this respect they resemble the *X*-rays, though they have a far greater penetrating power. Recent experiments by Rutherford have shown that the *Gamma*-rays are caused by the expulsion of the *Beta*-particle and that the two types of radiation are proportional to each other.

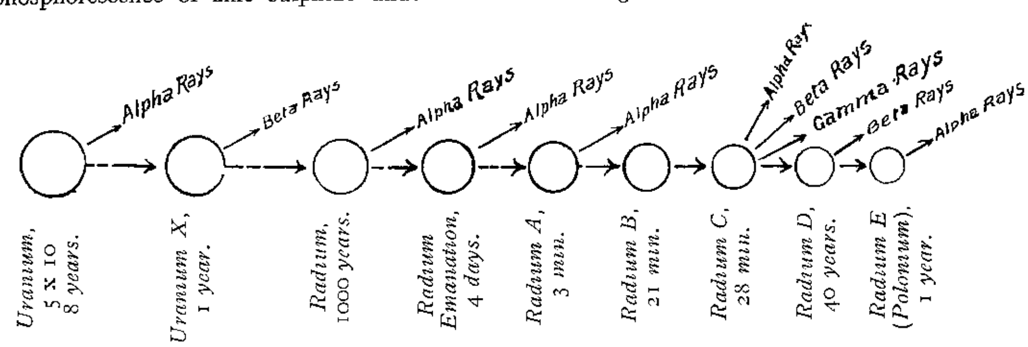
As the radiations are emitted from the radioactive elements fundamental changes occur and new substances are produced. Thus in the case of uranium the first product of the change can be separated by heating a uranium salt with excess of ammonium carbonate, when a slight precipitate is obtained many times more active than the original uranium. This is known as *Uranium-X*, and Becquerel has shown that in a year it loses its power of radiation, whilst the bulk of the uranium regains its original activity.

The first product in the case of radium is a radioactive gas, which has received the name *Radium Emanation*. It has all the properties of a gas, being incapable of penetrating through glass or metals, but readily diffusing through porous substances. It liquefies under the influence of extreme cold. From the fact that it is not altered by such drastic treatment as passing through concentrated sulphuric acid, or passing electric sparks through it when mixed with oxygen, it is considered to be a member of the Argon group of elements. It emits *Alpha*-rays, and in a short time (four days) loses the greater part of its activity and is changed into other transformation products. In consequence of this emanation, radium has the property of imparting Radioactivity to surrounding objects.

Radium appears to be a transformation product of uranium, though the rate of change must be excessively slow. The changes undergone by radium itself are represented by Rutherford as in above diagram.

The times given in each case represent the average length of life, and must be directly proportional to the amount capable of existence at one time. The quantities of uranium, radium and polonium in pitchblende is in the ratio 109 : 103 . 1 , which is practically the same as the ratio of the numbers representing their average life.

Our knowledge of the changes that occur in the case of thorium is almost entirely due to Rutherford and Soddy. They showed that if the thorium hydroxide is precipitated from solution with ammonia, the precipitate no longer gives *Alpha*-rays and the *Beta*-radiation is considerably reduced. On evaporating the solution to dryness an exceedingly minute quantity of a substance was left emitting both *Alpha* and *Beta*-rays. This they called Thorium-*X*. It gradually loses its activity at the same rate at which the thorium freed from Thorium-*X* regains its power of radiation. Thorium-*X* produces an emanation in the same manner as radium, and is also capable of communicating Radioactivity to bodies in its neighbourhood.



All the elements that exhibit Radioactivity possess high atomic weights—uranium 240, thorium 232, radium 225. From this it appears that there is going on in nature a change resulting in the breaking down of elements of high atomic weight. It must be left as a problem of the future to ascertain whether all the known elements are products of a similar change

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A prominent land mark at Petone is the new brick chimney stack of the Wellington Woollen Mills, which is 130ft. high, and is claimed to be the most graceful and best proportioned chimney in the colony. Nearly £28,000 has been spent in buildings and plant within the last two years. This, with the original mill and plant, makes one of the largest and best equipped mills south of the line. Two Lancashire boilers, 30ft. x 8ft. tested to a pressure of 340lb. and to work at a steam pressure of 170lb. to the square inch, have replaced the original five boilers. These new boilers weigh 30 tons each, and are fitted with every up-to-date appliance for economy and safety. The new engine, which replaces the old 240-h p., is of the horizontal tandem Corliss condensing type, fitted with all latest improvements, including an electric stop motion, which can be operated by the youngest employee from any part of the mill, in case of an accident, bringing the engine to a standstill instantly. The fly-wheel is 16ft. in diameter, weighs 16 tons and makes 75 revolutions a minute. The power is transmitted by 14 ¾inch driving ropes.

ELECTRIC TRAMWAYS OF NEW ZEALAND.

No. I. - - - Christchurch.

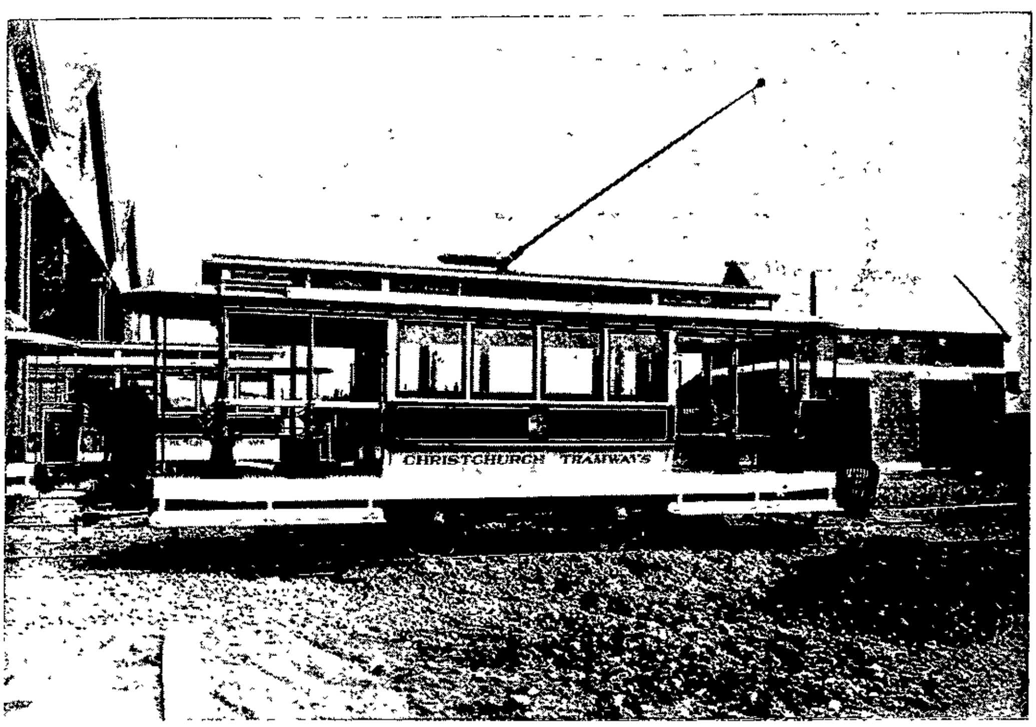
THE Christchurch electric tramway system, which was opened for traffic on 5th June last, has the distinction of being the only one having a 600-volt direct current south of the line; and experts affirm that the general equipment and rolling-stock need not take a single point of superiority from any other system in Australasia. The permanent way and overhead wiring are much the same as those in vogue at the other New Zealand centres, with the exception that the feeder wires are carried along the top of the street poles instead of through conduits. Chief interest, however, lies in the motive power at the central station, and this because of the introduction of the steam turbine.* There are two two-stage, vertical Curtis turbines connected direct to two 600-volt, 500-kilowatt generators, and one set is capable of supplying the whole of the motive power for the service as it is at present—12 miles 21 chains. These turbines condense the exhaust steam in the ordinary way—the condensing outfit being supplied by the Alberger Condenser Co., of New York. The air pump and centrifugal pump in connection with the condenser are both driven by electric motors. The circulating water is cooled by an Alberger cooling-tower, which has sufficient capacity to cool enough water for the whole plant.

The auxiliaries in the engine room, excepting two 6 x 2 x 6 Worthington slow-speed pumps, are electrically driven—the air pump, centrifugal pump and water-cooling fan by motors of 15, 50 and 40-h.p. respectively. The air compressor in basement, which keeps all the electrical machinery clean, is also driven by electricity. A 20-kilowatt marine set, for lighting the station, completes the auxiliaries. In order to conform with Board of Trade regulations the plant is supplied with what are known as boosters—five negative and one positive—which are in reality supplementary dynamos installed for the purpose of re-inforcing the current on long-distance lines. The positive transmits the extra current to lines furthest from the central station, whilst the negatives are used to pull back the current through overhead return, thus minimising against risk of electrolysis which is caused by the current coming back through ground return.

All cables supplied in this installation are lead-covered, in order to ensure perfect insulation and security against fire. The boiler room is replete with the most modern devices for the efficient and economical raising of steam. There are three Babcock and Wilcox water-tube boilers, each capable of evaporating 6000 lb. of water per hour, and working under a pressure of 150 lb. These fine steaming boilers are fitted with B. & W. chain-grate stokers—a contrivance which, slowly moved by a 2-h.p. vertical steam engine, conveys the coal from overhead bins to the furnaces; and the outcome is a considerable lessening of the smoke nuisance on account of the instant consumption of gases before they have time to rise. The main flue passes through an economiser, thereby heating the feed water up to a high temperature. The boilers are fitted with B. & W. superheaters guaranteed to superheat boiler steam to 200°F. There is an injector to each boiler in case of breakdown to feed pumps. Two of Blake's feed pumps complete the boiler room outfit.

The main switchboard is considered to be the finest south of the line, it being of polished slate and surmounted by a clock and ornamental scroll bearing the names of the Christchurch Tramway Board. The panels of the board are thirty-one in number, made up as follows:— ten feeder, two positive booster feeder, four booster motor feeder, one summation, three machine, ten negative booster, and one lighting.

The rolling-stock consists of:— two-deck double-bogie cars *—an improvement on the Wellington two-deckers, which have only four wheels; combination double-bogie cars—with nearly a foot clear space between knees of passengers and back of front seat; and the handy four-wheel box cars—similar to those of Dunedin, with vestibule at either end. There are twenty-seven new cars—twenty-two having been constructed by the John Stevenson Co., of New York, and five by Messrs. Boon & Co., Christchurch; with these are used a dozen converted trailers. Two noticeable features of the new cars are:— (1) the introduction of air brakes, instead of the Westinghouse magnetic brake,† and (2), an American system of cleverly devised life-guards, which are said to be able to pick up any living object from the track, without harm, even though the car be travelling at the rate of twenty miles per hour. The cars are picked out in green and cream, and altogether present an exceedingly smart turnout.



SINGLE-TRUCK COMBINATION CAR.

POWER HOUSE AND CAR SHED.

The gauge is the national gauge of Great Britain as well as the common one in Europe and the most favoured one in America. It was used by the elder Stephenson for the Liverpool and Manchester Railway. It is 4ft 8½in wide, and was formerly known as the narrow gauge. The broad gauge, 7ft wide, which was once adopted on the Great Western Railway, has been discarded and is now almost forgotten. When the whole system has been completed, there will be twenty-nine miles thirty-three chains of single track and two miles thirty-one chains of double track, the latter being used within the city belts. The rails are of steel, and the best hematite ore has been used in their manufacture.

The 92lb. grooved rails will be used on the straight tracks over the whole system, with the exception of about four miles on the Sumner line, where the construction is what is known as the "live track." The exception has been made on account of the line there being laid next to an arm of the Estuary, and the

* The Curtis turbine is described at length in this issue.

* The earning capacity of an ordinary box car on short runs has proved to be twenty per cent. better than a two-decker.

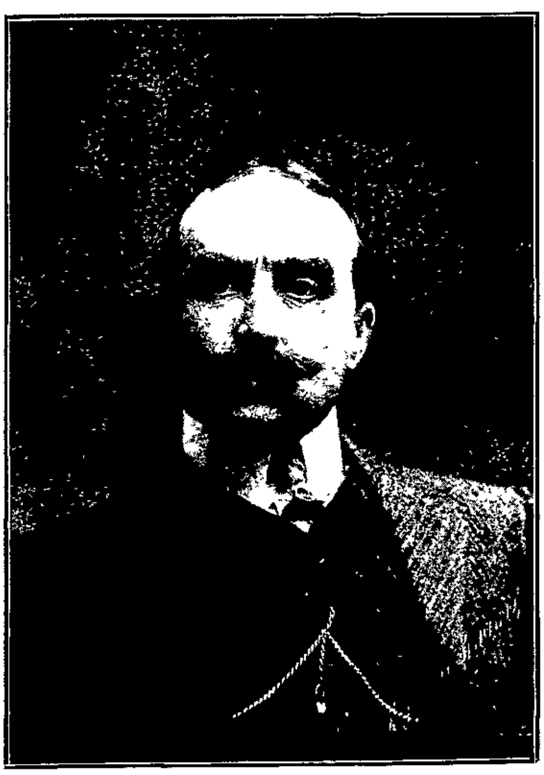
† The Westinghouse magnetic brake will be fully described in next issue.

72lb "T" rails have been adopted for that part of the permanent way. The 95lb. girder rails will be used at all the curves. The rails have been butted together, end to end, with great care, and are double bonded. All the bonds have been manufac-

MR. WM. REECE,
Chairman, Christchurch Tramway Board.

tured with a steel core in the form of a double-headed rivet cast into a copper terminal. They are known as the General Electric Company's ribbon bond.

The running of the whole system is controlled by the Christchurch Tramway Board, of which Mr. William Reece is chairman, and Mr. G. G. Stead deputy-chairman. Mr. F. C. Chamberlain, on



MR. F. C. CHAMBERLAIN,
Engineer, Christchurch Tramway Board.

whom the constructional responsibility has rested, retains the position of Engineer-in-chief to the Board; and Mr. J. R. Templin, of the General Electric Co., has successfully undertaken the task of installing the electrical plant on behalf of that company. The cost of this system when completed is estimated at £10,000 per mile, and £300,000 was voted for the installation.

THE average attendance during the year at all the schools throughout the colony, which in 1903 showed a falling-off of 664, rose to 116,506 in 1904, an increase for the year of 3459. This is a greater increase than has been shown in any one year since 1894. The increase above the attendance during 1902 (113,711), the highest recorded previously, was 2795.

..Legal..

CONTRACTORS' LIENS ON LAND.

BY H. F. VON HAAST, M.A., L.L.B.

PART I.

RECENT decisions of the Supreme Court on the interpretation of "The Contractors' and Workmen's Lien Act, 1892," have somewhat upset the preconceived notions of laymen as to the protection afforded them by that Statute. A short statement of the existing position of the law may perhaps give readers of PROGRESS a clearer idea of their rights and remedies under the Act, and the course to pursue if they wish to take advantage of it. The Act gives three remedies to contractors, sub-contractors and workmen for work done by them under a contract, (the term work including the supply of materials), viz —

(1) A lien upon land upon which any work is done.
(2) A lien upon a chattel upon which any work is done.
(3) A charge in favour of sub-contractors and workmen upon moneys payable under the original contract or any sub-contract.

This article is confined to liens upon land and liens in favour of contractors. As the work most commonly done upon land in respect of which liens are claimed is the erection of buildings, that will be for simplicity's sake the only kind of work hereafter referred to.

Prior to the act of 1892 a contractor, merchant or workman, whose materials or labour were expended in the construction of a building, had no security over the land on which it was erected. His remedy for non-payment was a personal one only against his employer. The contractor could sue the employer in a civil action for the amount due, and having obtained judgment, could then exercise such powers of distress, execution, judgment summons or bankruptcy as the law gives all creditors.

In 1892 the Legislature passed "The Contractors'-Workmen's Liens Act," based on the bill introduced into the Queensland Parliament, and prepared by Sir Samuel Griffiths, who took his bill from an Ontario Act, which in turn seems to have been copied from one of the many Lien Acts in the United States. In that country these liens are known as Mechanics' Liens. Each State has its own law on the subject with its own peculiarities, and there has been a great mass of conflicting decisions upon almost every point that could possibly arise. The New Zealand Act was passed to give protection against dishonest or insolvent employers and contractors. If employers and contractors were both solvent and honest no remedy would be needed, for all those employed on the contract would be paid in full. The intention of the Legislature was to give those whose materials or labours went into a building, some security over the land on which it was erected—in other words, the land, to the extent to which it had increased in value by the materials and labour bestowed upon it, should be burdened by a charge in favour of those who had increased its value.

The Statute, after some complicated definitions, enacts that contractors, sub-contractors and workmen (which terms inculde merchants supplying materials) have a lien on the interest of the employer in the land on which their work was done for the contract price of that work. If the owner of the land is not himself the employer he is subject to a lien only to the extent to which he has consented in writing. Section 6 prescribes that if a mortgage be duly registered against the land before a lien, it shall have priority over the other unless the mortgagee be a party to the contract. Other sections provide that, in order that a lien may not be extinguished, the lienor must do three things: —

(1) Within 30 days after the completion of his work serve a notice in a prescribed form claiming a lien.
(2) Within 60 days after such completion issue a summons in the Magistrates, District or Supreme Court, according to the amount involved.
(3) Within 30 days after such completion register the lein in the Deeds Register office or Land Transfer office (according as the land is under one or the other system) by registering a copy of the statement of claim and affidavit verifying it certified as correct by the proper officer of the Court in which such claim is filed.

Until recently contractors have been under the impression that as long as they followed the procedure prescribed as above their lien over the land was safe and could not be defeated. Section 29, however, takes away with one hand what the Legislature has given with the other. That section states that if the claim of lien is not registered within 30 days after the completion of the work, the lien shall be extinguished, apparently contemplating the existence of a lien which is to be snuffed out by non-registration. The section, however, concludes: "Until registration, the land shall not be affected by lien or claim of lien." The construction recently placed on these words goes far to render nugatory, so far as land is concerned, the protection that the Act purports to give. *En passant*, one of the inconsistencies of the Act may be pointed out: although one section gives the contractor 30 days for his notice, and 60 days for his summons, section 29 makes it necessary to issue the summons within 30 days and to register within that time a copy of the statement of claim with the summons.

Recent decisions have laid down the following rules:— The lien is created, not by notice or by registration, but by the Statute; but until it is finally enforced is a mere floating or inchoate charge. It is unaffected by the bankruptcy of the owner of the land, and notice of claim of lien and proceedings to enforce it are effectual, even though given or taken after such bankruptcy. Until the lien is registered, however, the contractor has no real security over the land for his debt. At any moment his claim may be defeated by the prior registration of a transfer of or other dealing with the land upon which he is claiming the lien. The Act applies to all lands, but for simplicity's sake only land under the Land Transfer Act will be referred to. It is immaterial whether the transfer or dealing be by the way of gift or for full consideration, innocent or fraudulent, or whether the transferee had or had not notice of the contractors claim of lien. The mere registration of the transfer gives the transferee absolute priority over the lienor, although the lienor had no suspicion that any change of ownership was taking place, and although the transferee knew that the contractor was being deprived of his claim of lien. If the transfer is registered before the lien, the latter, though registered within the time prescribed by the Act, has ceased to float. It is drowned, and no diligence on the part of the contractor can resuscitate it. Further, if the owner transfers the land when the building on it has only just begun and the contractor, knowing nothing of the transfer and having no reason to suspect a change of ownership, continues to supply material, he has no remedy against the land or against the transferee, not even in respect of the materials supplied since the transfers, and not even although the transferee in his transfer stipulated that the transferor should complete the building. For the transferee, although the owner, has not consented in writing to the lien and has been held not to be within the definition of employer. Contractors may declare with Mr. Bumble that "the law is a hass," but such is the law until it is altered by the Legislature or reversed by a higher Court.

This interpretation opens the door to all kinds of frauds—transfers by husbands to wives or friends, bogus mortgages, and a hundred and one devices which can readily be called to mind to defeat contractors' liens. It makes the Act a snare instead of a shield for contractors who are induced to give credit to impecunious speculators, relying on the protection which they suppose the Act affords them. Until the law is altered, therefore, merchants, if they have any doubt as to the honesty or solvency of the builder whom they supply with materials, or of his employer, should either take a mortgage over the land of the builder, if he is building on his own land, for the value of all materials to be supplied for the job; or whenever they supply materials to a substantial amount should give the required notice, issue a summons and register it against the land without delay. In the latter case quite a number of summonses might have to be issued in the course of the erection of a building, a procedure which would mean increased expenditure and worry to the builder and owners and would injure their credits, and doubtless after the registration of one lien prompt recourse to another merchant not quite so keen to protect himself according to the requisites of the law. The law may in theory require the registration of a series of liens during the construction of a building, but in practice such a course will be found quite out of the question by business men.

(To be continued).

The Liquefaction of Gases.

—By—
PROFESSOR EASTERFIELD,
(Victoria College)
Wellington.

In many cases the historical method of treatment leads most easily to a clear understanding of the subject under consideration; this is certainly the case with the subject of gas liquefaction.

Northmore, of London, liquefied chlorine gas in the year 1805 by compressing the gas by means of a brass syringe. Eighteen years later Michael Faraday rediscovered the fact that gases could be liquefied by pressure, and the apparatus he employed was so simple that it is worth describing.

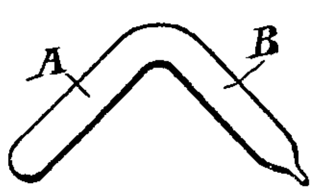


FIGURE 1.

In the limb, A, of a bent glass tube was placed some substance which would give off the desired gas on warming. The end of limb, B, was then hermetically sealed before the blowpipe. Upon heating the limb, A, so that gas was evolved, great pressure was developed within the apparatus, and some of the gas was liquefied and collected in the cold limb, B.

With this simple apparatus Faraday demonstrated that pressure alone would liquefy sulphuretted hydrogen, cyanogen, carbonic anhydride, chlorine, sulphurous acid, ammonia and laughing gas. The last five gases are liquefied by pressure on a commercial scale at the present day. The ascertained pressures in Faraday's tubes were as high as sixty atmospheres, and explosions were not unfrequent.

Faraday quickly recognised that cold was just as great a factor as pressure in producing liquefaction, and aided the process by surrounding the limb, B, of his tube with ice, ice and salt, or some other convenient freezing mixture. In his later experiments he compressed the gases by means of powerful compression pumps, and cooled the compressed gases by a mixture of solid carbonic anhydride and ether. He was unable to liquefy oxygen; and this gas, together with hydrogen, nitrogen, and a few others, resisted all attempts at liquefaction for many years. They were therefore classed together as permanent gases. Faraday believed that the failure to liquefy these gases was due to his inability to obtain sufficiently low temperatures, rather than an inability to generate high pressures. This view was confirmed by Natterer, who failed to liquefy the "permanent" gases at pressures of two thousand atmospheres.

A most interesting observation had been made in 1822 by Cagniard de la Tour, viz — that if a sealed tube partly filled with water be slowly heated to a temperature of 360° C, the tube appears to be perfectly empty owing to continuity between the liquid and gaseous states. Thomas Andrews, of Belfast, showed in 1869 that there must be such a "critical" temperature for each liquid, and that above the "critical" temperature no amount of pressure could cause liquefaction. From this time onwards, therefore, experimenters directed their attention mainly to the procuring of low temperatures.

At the meeting of the French Academy on December 24th, 1877, it was announced that Pictet of Geneva had liquefied oxygen, by surrounding a tube of highly compressed oxygen with a bath of liquid carbonic anhydride, the temperature of which was kept at − 140° C by means of rapid evaporation. At the same meeting it was stated that Cailletet, of Paris, had liquefied oxygen by allowing the highly compressed gas to suddenly expand. For great heat is developed when a gas is compressed, and conversely a fall of temperature occurs if a compressed gas be allowed to expand.

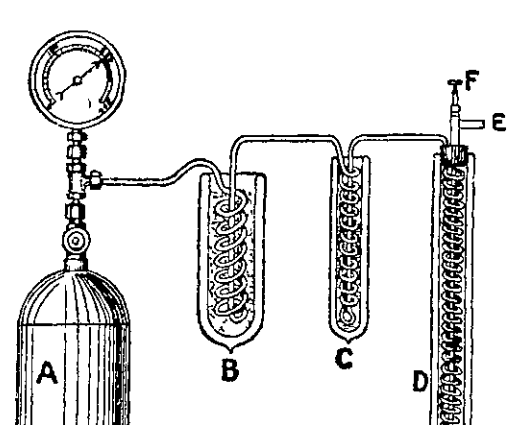
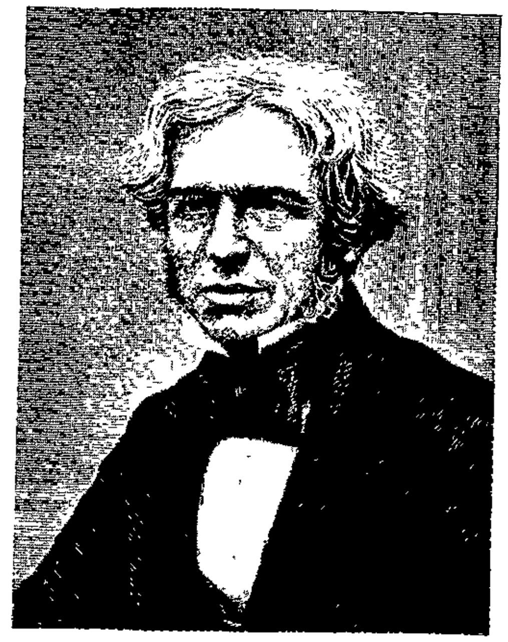


FIGURE 2.

Perhaps the most notable experiments upon gas liquefaction in recent years are those of Dewar, carried out in the Royal Institution in Faraday's old laboratory (see fig. 2) By allowing compressed hydrogen to expand through a fine nozzle, G, at the end of a long spiral tube, around which the expanded gas was allowed to circulate, and thus employing the principle of "reversed currents," Dewar has succeeded in liquefying hydrogen, a task which had defied the labours of all previous investigators. By boiling hydrogen under reduced pressure in one of his well-known vacuum vessels the temperature fell so low that the hydrogen froze to a solid mass, the temperature of which was only 13° above the absolute zero. At these low temperatures india rubber becomes as brittle as glass, lead as elastic as steel, most chemical reactions cease, and eggshells acquire the property known as phosphorescence—truly a wonderful change in the properties of matter.

It is not improbable that many of Faraday's contemporaries wondered that a man of his abilities should devote much time and labour to such a non-utilitarian subject as gas-liquefaction. Neither he, nor the men of his time can have forseen that, based upon his discoveries, a system of freezing machines would be constructed without which the frozen meat industry could never have originated. They could not have anticipated that by the partial liquefaction of air the oxygen would be separated from the nitrogen, and become an every-day article of commerce. In this respect, however, the liquefaction of gases is only an example of the fact which is now realised by thinking men, and must sooner or later be recognised by our educational authorities, viz:— that the scientific toy of to-day is the power giving machine of to-morrow.

Scientific researches, however abstruse and apparently useless, have an immense technological importance, and a still higher educational value; and no system of education can be considered sound which does not regard the development of the spirit of original investigation as one of its highest ideals.



Michael Faraday.

The Straker Steam Wagon.

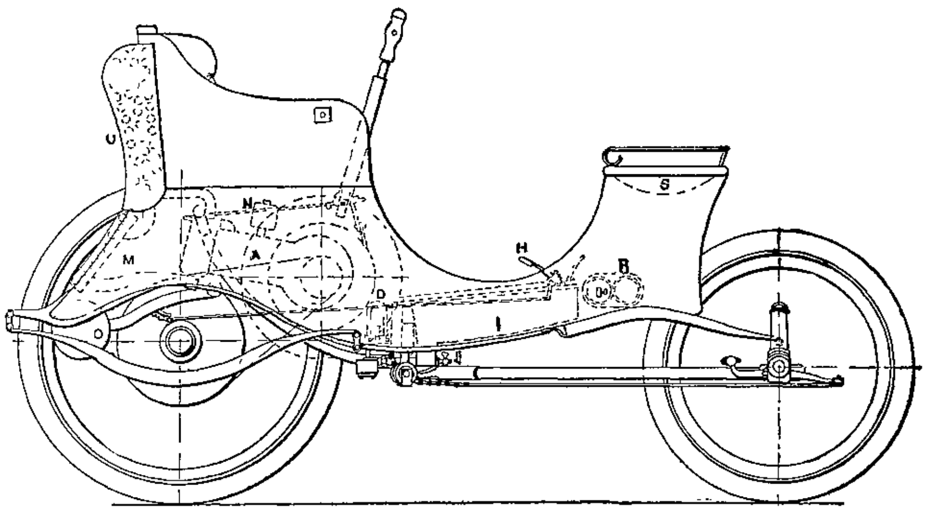
The progress made during the last few years in the Old World has not been long in extending itself to these shores, and from the success attained by the Straker 5-ton tipping wagon, imported at the beginning of the year by the Auckland City Council, it is evident that this mode of traction for cartage of road metal and heavy goods will be adopted by all progressive councils, contractors and carriers in the near future. A machine that is successful in negotiating the very steep grades in and around Auckland cannot fail to be successful in any other part of the colony, and the following report on the working of the Auckland Straker will prove of interest. The amount carried per day has varied somewhat according to distance, but as an instance this wagon has taken 6 loads of 5 yards each to Ponsonby, 2½ miles each way, and 6 loads of 5 yards each to Cox's Creek, about 3½ miles each way. The cost of running, taking the average during the three months, works out at 2d. per ton per mile, reckoned on the following basis of weekly expenses.—

	£	s.	d.
Fuel consumption ..	1	5	0
Lubricating oil		6	0
Wages	3	0	0
Repairs, so far, have only been of a very trifling nature, but would be amply carried out at 10/- per week		10	0
Depreciation @ 15% ..	2	2	0
Interest on Capital @ 5%		14	0
	7	17	0

From the above figures it will be seen that this wagon, costing under £8 per week, including all working expenses, depreciation and interest, is doing the work of six two-horse carts, the cost of which would be £6 per day or £36 per week; so that a saving is made of £28 per week, or over £1,400 per year. In other words the wagon will be paid for and a saving of £500 made in the first year's working. The chief features of the Straker machine are its water-tube boiler with its 474 tubes, enabling steam to be made very rapidly; and the wonderful pair of 45-h p. compound engines with their patent reversing gear; but the whole of the mechanism in this machine is up-to-date, and is carried out in a workmanlike manner.

The "Journal du Petrole" states that water only quickens the flame of petroleum or of gasoline.

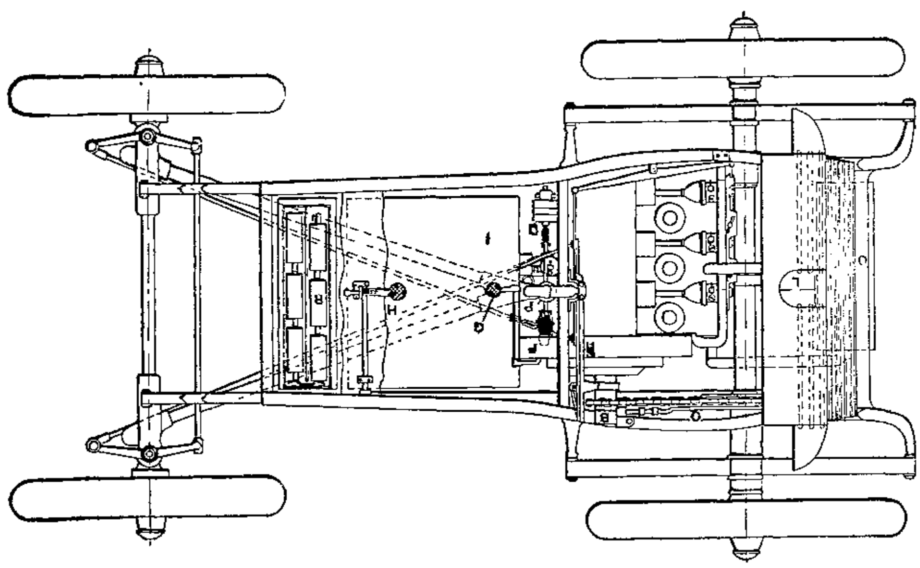
MOTORS and MOTORING.



ELEVATION OF THE DURYEA MECHANISM.

The Duryea Mechanism.

The Duryea carriage is a typical American run-about of the multicylinder type, that possesses numerous remarkable records for reliability, speed and rapid hill-climbing powers. The Duryea system consists, primarily, of triple cylinders, with a two-speed and reverse planetary transmission gear on the motor shaft, connected by a short chain to a large sprocket on a live rear axle. The plan and elevation shows the motor, with cylinders inclined, placed under the operator's seat at the right side of the vehicle, while the driving chain and its sprockets are on the left side of the vehicle, inside the bearings on which the springs rest. The motor, A, is supported by an angle-iron framework, and the shaft extension which carries the transmission gear is provided with a bearing, B. By withdrawing two bolts the entire transmission gear can be taken out in less than fifteen minutes. A distance rod, C, from the end bearing to the rear axle takes the pull of the chain in a direct manner. The magneto, D, has a long shaft, having a flexible joint near the magneto and a pulley, E, with governor, arranged to engage the

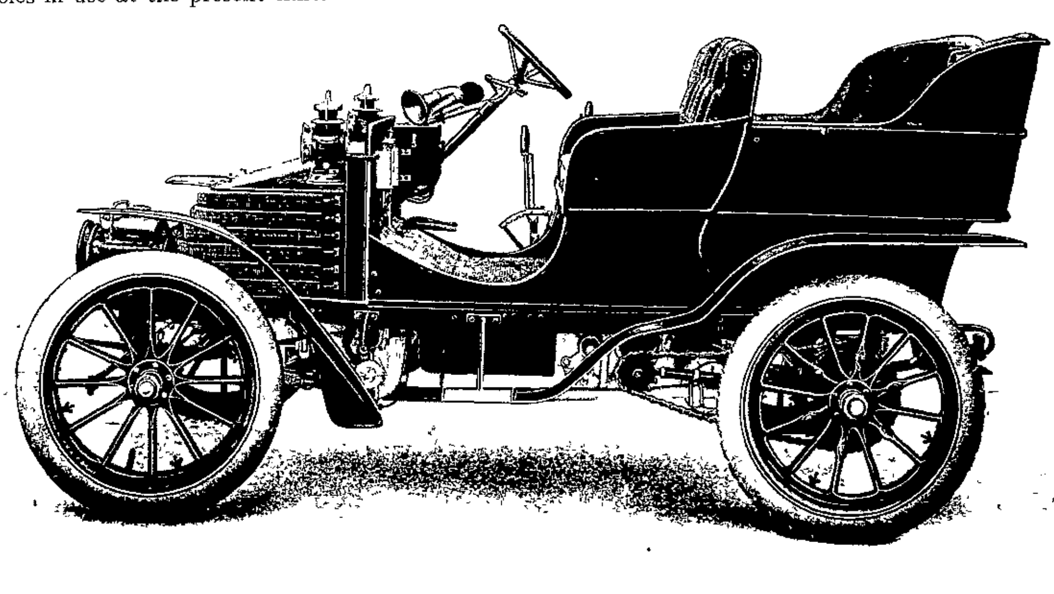


PLAN OF DURYEA MECHANISM.

face of the flywheel. This pulley is of such size that the magneto turns fast enough to ignite when the motor is pushed over a compression quickly, and the governor prevents excessive speeds doing damage to the magneto. From the magneto one wire is grounded on the framing, while the other is carried either to the coil or to the switch, if batteries are provided. This switch is a threeway affair, to which one wire from the magneto and one from the battery are attached, while the third wires goes to the coil. A spring keeps the switch constantly on the magneto except when the button is pushed to connect the battery instead. By this arrangement the battery is used for starting only, and is not liable to be damaged by unintentional use or by forgetting the switch. The push button is placed on the side of the seat in a handy position for the left hand, while the right uses the starting crank, or for the right hand in case it is needed when driving. From the coil a bare wire leads to the three spark plugs on top of the engine. A light push on the button disconnects the magneto without connecting the battery, and leaves unburned charges in the engine ready for easy starting by turning over one compression slowly. A lever, F, sets the high clutch and the low clutch, both clutches being free when the lever is in middle position. A reverse pedal, G, at the centre of the vehicle, easily reached by the heel of the operator, gives a reverse motion. In the large sprocket an expanding band brake is located, from which a connecting rod passes forward to a lever projecting below the floor. The pivot of this lever passes to the centre of the vehicle, where a toe lever, H, is mounted upon it. Under the floor hangs the gasoline tank. At the rear of the tank is a well, provided with a pet cock, J, permitting either gasoline or water to be drawn off—a valuable precaution when one gets water with gasoline. The water tank, U, is carried at the back of the seat. It has 150 air tubes into which a current of air from each side is deflected by wings; the heated air passing out at a central opening, L. The water passes to a tubular panel M, closing the rear of the vehicle, thence forward to the bottom of the water jacket, thence upward and back to the tank by the expansive effect of the heat. If desired, pump and radiator are supplied. The tubular panel, M, is provided with flexible hose connections, and is held in position by hooks. Three oil cups, N, of 100-mile capacity, and with large filling openings, are provided on top of the cylinders, the only oil cups except on the magneto and wheels. These cups feed by gravity when the engine is running. At the extreme rear of the vehicle, with openings slightly below horizontal, is a cylindrical muffler, O Mounted on this is a superheating chamber to receive any escaping steam from a vent pipe passing downwards through the water tank. In front of the fuel tank is a battery case, R, consisting of a tin box lined with insulating material, in which six dry cells are placed.

Wolseley 12-15-H.P. Tonneau.

This car is shown fitted with the type of body most generally used, and is one of the most popular motor vehicles in use at the present time.



WOLSELEY 12-15-H.P. TONNEAU.

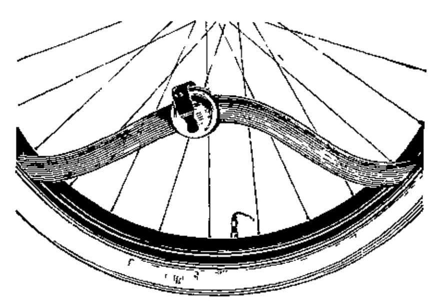
Since its introduction, this car has always been conspicuous for its consistent reliability and hill-climbing qualities. It is purposely constructed as simply as possible, without sacrifice of efficiency, so that it is possible for the owner to quickly learn how to drive and attend to what adjustments may be needed from time to time.

In public reliability trials and hill-climbing competitions during the past three years, Wolseley cars have created a remarkable record, having secured eleven gold medals and two silver medals in open competition with every well-known make of car

The chassis is so arranged that all mechanism lies below the frame, which makes it possible for any type of body to be fitted.

Novel Tyre Repairer.

FOR repairing cycle and motor tyres a novel device has been introduced. It is known as a puncture closer, and consists mainly of two small circular wooden discs, together with a metal clip for holding them in position on the tyres. The patch is affixed in the usual way with solution, but instead of being



PUNCTURE CLOSER IN POSITION.

pressed down by the fingers, it is covered with the discs, which are secured in position by the clip. Not only is a pe fect and exceptionally clean repair made by this method, with a minimum of trouble, time, and inconvenience, but the patch and the tyre are thoroughly welded and made as one.

THE........ HARVESTER COMBINE,

A Menace to New Zealand.

BY PHIL. GODFREY.

[THESE ARTICLES, WHICH HAVE BEEN SPECIALLY WRITTEN FOR "PROGRESS", WILL DEAL WITH THE LATEST ROCKEFELLER COUP, THE INTERNATIONAL HARVESTER COMPANY OF AMERICA, AS IT AFFECTS THE MANUFACTURE OF AGRICULTURAL IMPLEMENTS IN NEW ZEALAND; AND IT WILL BE SHOWN WHY THE GOVERNMENT SHOULD LEGISLATE FOR THE PROTECTION OF NEW ZEALAND'S THREATENED INDUSTRY, WHILE NOT OVERLOOKING THE NECESSITY OF FAIR TREATMENT FOR THE FARMER.]

1—THE HARVESTER COMBINE.

FOR the past two years American and British newspapers have devoted considerable space to the condemnation of Rockefeller and his myrmidons, all apparently without aught but moral avail; for the ramifications of the multi-millionaire's organisations have not only become general throughout every commercial country in the world, but they have encroached on home industries to an extent hitherto undreamed of. Especially is this so regarding our own colonies; and it is gratifying to know that the manufacturers of New Zealand are already working for legislative measures that shall minimise the national evil before it becomes out of hand and oppressive.

The International Harvester Company of America was established in 1902 by the amalgamation of the McCormick, Milwaukee, Plano, Champion, Deering, and Osborne Companies, with the avowed intention of capturing the world's trade in agricultural implements, and of wiping out all opposition, however small. Behind the enormous combined capital of these firms "stood the serried millions and perfect organisation" of Rockefeller's Standard Oil Trust. To-day this combine, with its railways, its steamships, its bank allies, its control of more than one-half of the patents on labour-saving devices connected with harvesting machinery, and its ninety-per-cent share of the world's output in such machinery, is managing an annual export trade of £6,000,000; is doing a yearly domestic business of £20,000,000; is killing competition; is stifling invention; is pressing to absolute monopoly; and is paying dividends of over forty per cent.

In the year of its flotation the Combine extended its tentacles to Australia, and the ingenuous—nay, they might be termed philanthropic—methods adopted to secure the bulk of the agricultural implement industry in the Commonwealth have already resulted in the seizure of the reaper-and-binder business, one-third of the stripper-harvesters, nine-tenths of the drills, fifty per cent of the stump-jumping ploughs, and the whole of the cultivators. In most of these implements it is stated by a good authority that the Americans have "filched the principles and evaded the patents" of the colonial manufacturer and inventor.

The stripper-harvester is a machine of Australian invention and exploitation, yet the Trust calmly usurps prior right of proprietorship and lays hold of it to the extent foregiven. So far as drills go the position is obviously worse; they are easy enough to make, but the pressure of the Combine has led manufacturers in Victoria to abandon this branch of the trade, so that the plant is lying idle and men who should be engaged on it are swelling the army of the unemployed in Melbourne. In regard to cultivators the firms who used to manufacture them have turned importers owing to the hopelessness of competing with Rockefeller & Co. The stump-jumping plough was another exclusively Australian invention "designed by Australians to enable farmers to cultivate ground that had been prepared at a cost of about 10/- per acre by burning off, whereas cultivation by the ordinary plough would have required a preliminary grubbing at a cost of from £4 to £6 per acre. The stump-jumping plough enabled the stump to be left to rot in the ground, and this invention has brought much land, that otherwise could not have been touched, under cultivation." Originally Australia manufactured all these machines, but now she has been forced to be content with half the turnover.

Receiving every inducement from local governments to stifle local industry—free, or almost free, import and the tax on raw material—the great Trust is working now for the ultimate control of Australasian markets. The home manufacturer is hopelessly outwitted in any attempt at competition. The much-vaunted theory of safety by reason of our isolation, and the consequent high freights ruling on the imported article, is dissipated by the fact that Rockefeller owns or controls nearly all the steamers trading between the States and Australasia, and that by these ships he delivers harvesting machinery at any big port in Australia for 15/- per ton cubic measurement. To be quite laconic it should be stated that it actually costs 25/- more to send a harvester from Melbourne to Sydney than to bring the Trust's machine all the way from New York.

This iniquitous cutting in freights and Government sanction of trust methods would be mitigated were agricultural implements manufactured in the colonies by the Combine, but not a shilling is turned to benefit prime local manufacturing industry. True, the Combine officials declare that their total cash expenditure for the last fiscal year in Australia was in excess of £140,000, out of which more than £80,000 was paid to employees; but what a paltry sum is this compared to the royalties and the amount of wages which would circulate in the Commonwealth consequent upon the manufacture of the bulk of agricultural machinery locally, and what an absurdly low figure £140,000 is when regarded as one year's contribution to the Combine's "Local Industries Annihilation Fund"—the fund so cunningly directed against home manufacturing enterprise as to cause it to languish within a few years of the Combine's first operations.

We will now proceed to examine the official statements of the Harvester Combine in Australia—statements which for apparent generosity and brotherly regard for the farmer cannot find their equals in contemporary business records. In fact these statements will show that there is still such a thing as sentiment in business, and that the American, first to extol the "hard-nut" policy in his own country, is prepared to weep with joy on finding that the antipodean partiality to sentiment is just the thing to help sales.

STATEMENT 1:—

The International Harvester Company is justly proud of the fact that it was among the first to recognise that while it is impossible for the farmer to compete with the world without a full equipment of the latest labour-saving machinery, yet at the same time it was in many instances equally impossible for farmers to raise a sufficient amount of money to pay for this equipment in cash, and with this fact in view was the pioneer in the introduction of credit sales whereby many a struggling farmer has, without paying a penny down, been supplied with an outfit of agricultural machinery to the cost of about £200 or £300, thus enabling him to invest his available money at the beginning of the season in seed, fertiliser, and so forth, and not requiring him to make any payment on his machinery until after the proceeds of his crop have been received. Even then the payment in many cases has been only a small one, the majority of the purchase price being divided up over two or three crops, thus permitting the machines to earn a large portion or all of their cost before they are finally paid for."

STATEMENT 2:—

"In addition to its direct expenditure of £80,000 in wages paid out last year in Australia, 90% of which was handed to Australians, the company also purchased many thousand of pounds worth of Australian-made goods which indirectly represented a large addition to the above contribution to the prosperity of Australia."

STATEMENT 3:—

"Another very practical instance of this company's enterprise and of the benefit conferred thereby to Australian farmers occurred during the twine shortage in the harvest of 1903, when it imported from America 1,000,000lb. of binder twine, a large proportion of which came by mail steamer, and thus provided twine for the binding of over 300,000 acres of crop that would otherwise have been lost.

"It may be worthy of note that, although the farmers were begging for twine at any price, and though this twine costs considerably more to land than was usually the case, it was sold at the same price as other twine of a similar quality, although from the fact that the farmers absolutely had to have twine, the company could just as well have got 50 per cent more for it, had they tried to do so"

STATEMENT 4:—

"It will also be of particular interest to farmers to learn that this company is now carrying on its books an indebtedness from the farmers of Australia to the sum of nearly £200,000, thus using a portion of its large capital in the building up of Australian agricultural enterprise

This is a very large proportion of the entire credit extended by implement manufacturers and importers to the farmers of Australasia, and it is therefore obvious that were this large credit to be withdrawn, the immediate effect must be the shortening of terms, the cramping of agricultural credit, and consequent hardships of farmers generally. Thousands of pounds of the indebtedness referred to has matured, but has been extended to suit the necessity of the debtors."

These are the planks in the Australian platform of the great Harvester Combine—the Combine which has so far successfully exploited the agricultural communities of the United States that it now controls "over nine-tenths of the implement trade, and by methods of extortion, constriction and law-breaking, so dominates the market situation as to compel what opposit on is struggling against it to do business at a loss." These are the lamblike sentiments of the Combine which strove for the conquest of the £20,000,000 spent annually by the farmers of the United States for tools, implements and machinery, and to turn them to its own profitable use; the Combine which is now, in the third year if its existence, reaping from that £20,000,000 a yearly profit of £8,000,000, eighty per cent of which may be counted as "mere rapine attained by methods that would shame a footpad, and are wholly criminal in the eyes of the law."*

Will New Zealand prove immune from the ravages of such a concern?

We have the authority of that able exposer of Harvester Combine methods, Mr. Arthur Henry Lewis, for stating that "if the Combine were limited to lawful methods and were confined in their money-hunting to what honest rules are set forth in the statutes, harm would not arise." In Germany such limitations are indirectly placed upon German Trusts, and, according to Privy Councillor Goldberger, the imperial commission set up last year to investigate home trusts failed to reveal that any of them were guilty of practices necessitating either government regulation or restriction. Yet it is plain that the government does exercise an indirect, though none the less potent, influence to keep the trusts in their operations within the sphere of legitimate business.

"The investigation developed the fact", said Goldberger, "that the industrial organisations of Germany are successful because they pursue a policy of moderate prices and aim to improve the conditions of labour." But he should have added that they were able to do so because under German laws their capitalisation cannot exceed the actual cash value of their holdings, and prices are based upon the actual cost of production, with a profit equivalent to the wear and tear of the plant and with insurance and a fair rate of interest upon the money invested added. Those features are wholly lacking in the trust system of the United States, as exemplified in the Harvester Combine, where a profit must be earned upon a vast amount of "watered"† stock, the extension of which has been marked by rising prices and increased estrangement of capital and labour.

With the facts before us it is easy to conclude that while the mobile and unerring operations of the International Harvester Company of America are in their infancy in New Zealand there is an opportunity for the Government of the Colony to pass regulative measures; but if the Combine once gets a foothold as in Australia, it will be at the expense of one of our most promising manufacturing industries, and to the ultimate extortion of prices from the farmer that shall prove ruinous to the country. *(To be continued).*

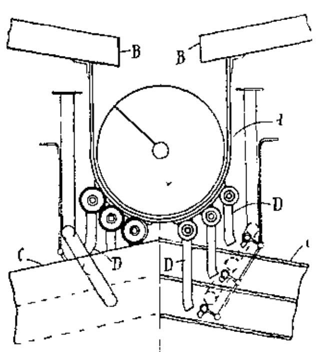
* Arthur Henry Lewis, in April "Cosmopolitan"

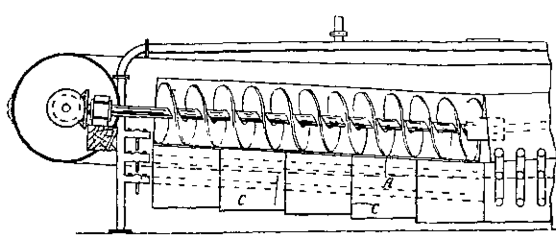
† A term applied to securities whose nominal amount has been increased without any corresponding payment in cash.

Inventions.

A New Gold-Saving Apparatus.

It is a fact well known amongst dredging men that in spite of the utmost care upon the part of dredgemasters a very large percentage of alluvial gold escapes in the treatment of the wash. A great many contrivances have been invented with the object of preventing this very serious loss, but none of them so far appear to have come up to the full expectations of their inventors. A new apparatus, which is certainly worthy of a trial, is the joint production of Messrs. Brittin, Magnus and Le Cren. As shown in our illustration the apparatus com-

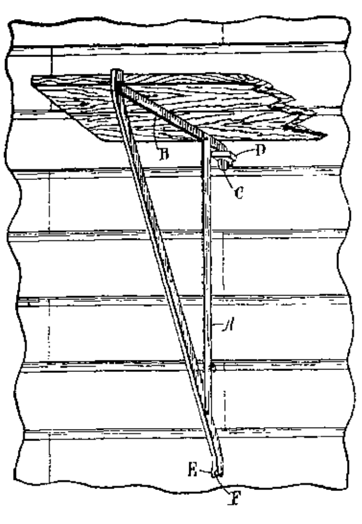




prises a trough, A, into which is delivered the fine material brought up by the dredge buckets, the separation of the fine from the coarse material being effected by a shaking riddle, B, which is inclined towards the trough. Within the trough is a constantly revolving archimedean screw which constantly agitates and moves the fine material from one end of the trough towards the other. Upon each side of the trough are the inclined saving tables, C. fitted with the usual gold-saving plush or the like. Nozzles, D, from the trough deliver the fine material upon the upper ends of the tables. The nozzles are adjustable to regulate the quantity of material delivered, and a very large spread of saving surface is obtained by superposing the tables. Dr. F. G. M. Brittin, Papanui, Christchurch, is the inventor of this apparatus.

The Safety Scaffold Bracket.

A scaffold bracket which is coming very largely into use throughout New Zealand is the invention of Mr. G. E. Humphries, builder, of Wellington. It is particularly useful for fixing weatherboarding, for cleaning and painting the walls of wooden buildings, and for use in fixing gutters etc., as it can



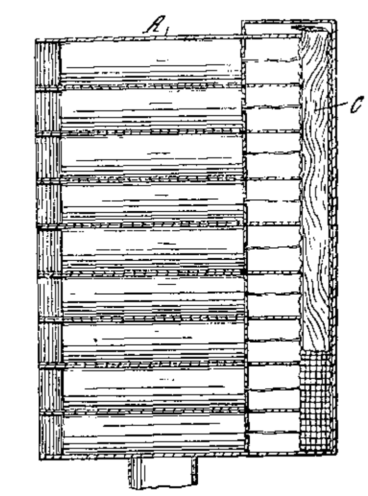
be attached to and removed from a wall with great ease and dispatch, and leaves the whole surface of the wall available for painting. The device comprises a rectangular frame, A, of angle and bar iron. The upper horizontal member, B, which supports the platform, has a square hook, C, which fits into a similarly shaped hole in the end of a coach screw, D, which is screwed into the stud of the building. The bottom of the bracket has a claw, E, which fits over a spike, F, which is driven into the building to give additional support. All that is needed in fixing this bracket is an auger and a claw hammer. That it fills a long-felt want is evidenced by the fact that, although it was only placed on the market four months ago, there are already over one thousand in daily use by up-to-date builders in the Wellington province.

Combination Boot.

THE lace boot is considered to present the neatest appearance to the eye of fashion; but upon the other hand the button form of fastening appears to offer a considerable advantage in saving of time. The combined lace and button boot shown in our illustration is the invention of Mr. J. H. Jackson, who hopes to induce some firm of wholesale manufacturers to place it upon the market.

A Friend to the Orchardist.

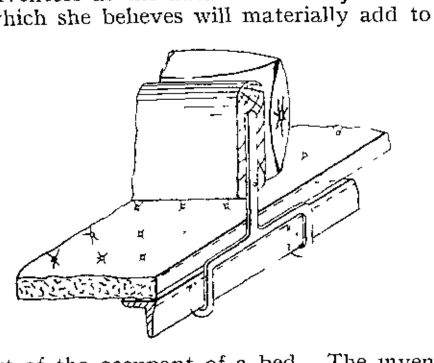
THE ubiquitous blackbird and starling evince such determination to share the fruits of the orchardist's labour, that the ancient scarecrow has long been abandoned as an effective deterrent. A bird-scaring device invented by Mr. Harold Irwin appears likely to have considerable effect



upon the nerves of the predatory enemies of the fruit grower. It consists of a frame, A, in which are placed a number of roman candles, B, which are arranged one above the other and charged so that each candle gives a succession of reports when ignited from one end. The ignition is effected by a slow burning taper wick, C, which extends down one side of the frame. Mr. Irwin has patented his invention in New Zealand and abroad.

Bed Foot-Rest and Warmer.

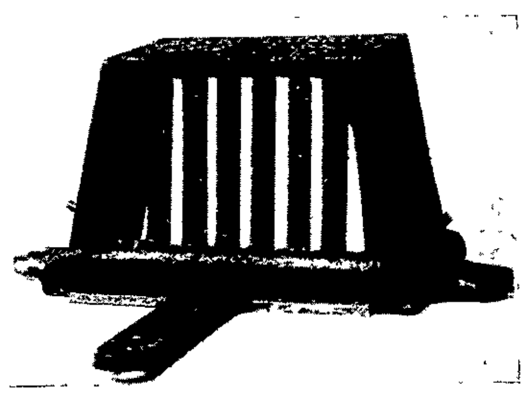
MISS Flora McPhee has entered the ranks of lady inventors as the author of an adjustable foot rest, which she believes will materially add to the



comfort of the occupant of a bed. The invention consists of a "Pillow block," which extends across the bed and is made to slide so that it may be adjusted to any position to suit the comfort of the user. It is possible to make the pillow block in the form of a receptacle for hot water, which can be poured in through a plug at the top and withdrawn through a tap at the side. The invention in its ordinary form is said to be a great addition to comfort; while if constructed as a foot warmer it should be particularly useful for sick persons.

Household Fuel Economiser.

The lady inventor is not very much in evidence in New Zealand, but so far when she has tried her prentice hand she has usually been successful. Miss B. J. Mouat, who resides in Dunedin, has devised a contrivance which effects considerable economy in the fuel consumption of ordinary household grates. The device consists of what



may be termed an iron "Air Box," which is placed within the fire where it takes space which would otherwise be occupied by fuel. Air passes from the bottom of the grate through the apertures upon all sides of the box and materially assists in the perfect combustion of the fuel, there being a noticeable reduction in the amount of smoke from grates in which the invention is used. Beneath the grate is a damper which can be moved out or in to regulate the amount of air passing to the air box.

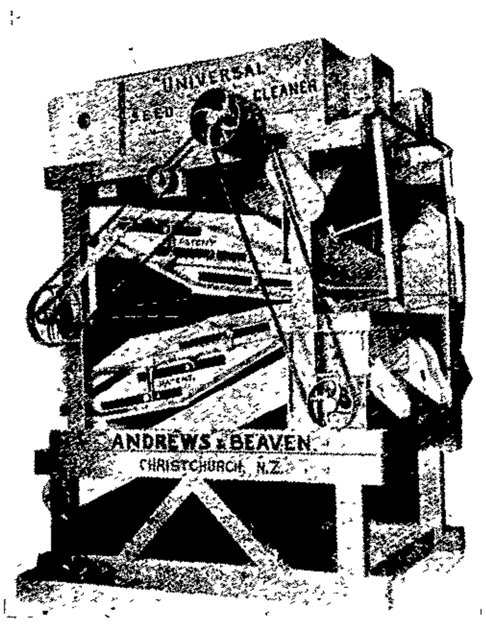
Worry.

ONE definition of worry is that state of mind that enables one to see difficulties ahead and to prepare to meet them. This is quite different from the fretfulness that leads to continual complaining over trifles that cannot be helped. A person who never worries but takes things as they come never amounts to very much. Just drifting along, shirking responsibilities, having sublime faith that "things will come out all right" means freedom from worry, but it also means a double burden placed upon someone else. This unwillingness to face difficulties leads to irreparable loss in many ways. We put off doing things until it is too late; we fail to prepare to meet forthcoming obligations in money matters until our chances for doing so are past, and sacrifices must be made that otherwise would have been unnecessary. Details in every-day matters are neglected, the habit to shirk becomes fixed, the character is weakened and the result is a wasted life. Love of ease is not compatible with success and it becomes necessary to choose between the two. If we want to make life worth while we should have some object to work for and with strong determination to win we should do our best to overcome all obstacles. Sometimes we shall fail, but strength comes with every struggle, courage with every effort and success must come at last. Look at things squarely, leave nothing undone as being "not worth while." It is the small things, the mastering of details rather than the doing of great things that combine to make success. Don't be afraid of worry; it acts as a spur to force one on, it keeps one alive to possible and real difficulties and to be alert means to be prepared.—ELLA L. LAYSON. *in the Agricultural Epitomist.*

* * * * *

WOOD PRESERVATIVE.—Coal tar is an excellent preservative for wood. For fence posts a thick coating should be applied after the bark is removed. Dipping the posts in a vessel of hot tar is much better than applying with a brush. For cleaning the hands from the tar any common oil is good; kerosene may be used afterwards.

RUST-PREVENTING COMPOSITION.—A good mixture which will prevent the rusting of machinery can be made by dissolving 1 oz. of camphor in 1 lb. of melted lard. When the impurities have been skimmed, black-lead may be added to give the whole an iron colour. After cleaning the machinery carefully and smearing it with the compound it can be left indefinitely, or if wiped off after twenty-four hours will obviate rust for some time. When removed, the metal should be polished with soft cloth.



THE "UNIVERSAL" SEED CLEANER.

This machine is called the "Universal," because in it the makers have attempted to supply a machine that will effectually clean the greater number of the grains and seeds grown in New Zealand and Australia. There are a few weed seeds which necessitate exceptional treatment, such as hair grass and tares, inasmuch that special jump, or cellular, machines have to be used on them; but the "Universal" will clean all the usual grass seeds and grain, and make a high-class sample free from impurities.

The machine under notice has a hopper which is fitted with a regulator for accurately determining the quantity of seed to be fed to the separators, and a mechanical feeder for equally distributing the seed across the whole width of the machine, and to feed the light and rough seed equally throughout the cleaning operation. One large powerful exhaust fan in the centre of the machine draws off all dust and light impurities; the dust is blown away and other matter taken to the side of the machine by a conveyor, and there bagged to be subsequently re-treated if it is found to contain material, such as clover pods, which makes it worth while. The proportion of impurities drawn off from the sample is regulated by a slide, in the leg down which seed is fed into the machine; this is a great improvement on the valve hitherto used, as it enables a much more delicate adjustment to be made. The volume of air passing into the fan is always the same, and no check in the delivery pocket is experienced. The seed then passes to the top riddle frame which holds three riddles, over each of which the seed passes in succession, leaving behind it all impurities larger than seed. From thence the seed passes to the lower riddle frame, also fitted with three riddles, which can be utilised to take out material larger than the seed, or screens can be fitted for taking out smaller impurities. Brushes travel backwards and forwards, beneath each riddle keeping the meshes free, and enabling them to always do full duty. The arrangement of the three sieves one under the other separates the seed from the foreign substance so effectually that there is less recleaning with this machine than any other.

A hummeller-and-polisher of the most ingenious construction is used upon the machine, this rubs off all husk from fog or suckling clover, capsules from red clover, white coats from wheat etc., and generally brightens all kinds of seed and grain and puts that polish on red or white clover which users like to see.

A double elevator is utilised to deliver the seed to hummeller, and waste from lower riddles is raised sufficiently high to be delivered into bags.

A second aspirator upon the outside of the machine extracts all dust, husks etc. removed by the hummeller, and draws off the amount of seconds required to make the sample up to required weight.

All spindles are large, and run in wide brass bearings. The machine is so accurately balanced that no vibration is thrown on the building in which it may be placed.

The machine is very complete and is capable of turning out the very highest grade of clean seed up to any merchants standard, and will add to the good reputation Messrs. Andrews & Beaven's seed cleaners enjoy both in New Zealand and Australia.

NOTICE TO ADVERTISERS.

Change Advertisements for next issue should reach "Progress" Office not later than the 10th inst, otherwise they will have to be held over.

Look for the Maker's Name or Trademark.

In all lines of merchandise, goods which have become well and favourably known are often imitated and sold to the consumer with the assurance that they are "just as good" as the articles which bear the maker's name or trademark, while as a matter of fact such goods are often "seconds" or goods of an inferior quality, for which reason the maker will not show the name or trademark under which he has built up a valued reputation for quality. Manufacturers usually make several grades of goods and are careful that their best grades shall bear their name or trademark to advertise the excellence of their products, and it follows that they are not only willing but anxious to replace any article so guaranteed to have been made by them and which may prove defective in any way. This is especially true with articles usually sold by hardware stores. It is a common practice with manufacturers of these lines to dispose of their inferior grades under what is known to the trade as "special brands" and also to furnish such goods to buyers of large quantities, marked with the buyer's "private brand" needless to add that private brand goods, bought from whichever manufacturer will make the lowest price on a season's quantity, carry no assurance of quality and it behoves the consumer who desires quality and manufacturer's guarantee to see that goods bear maker's name or trademark.

Value of Advertisement.

There was an influential gathering of City men at Anderton's Hotel recently, when Sir William Treloar, on behalf of a large number of friends, presented Mr. W. G. Thame, the late advertising manager of the *Standard*, with a handsome testimonial as a mark of their esteem.

Sir William Treloar, in offering the tokens to Mr. Thame, whose birthday it was, mentioned that he had known the recipient of their good wishes for very many years. That gentleman used to induce him to spend a good deal of money in advertising, and he felt it difficult to dissociate him from the occupation their guest had so ably followed. He (Sir William) had been looking up some old newspapers, and found that forty-one years ago his father had a shop on Ludgate Hill which the Chatham Railway Company acquired when they put a bridge across that thoroughfare. His father brought an action for compensation, and in his evidence he said a good many things about advertising which were interesting. He gave it as his opinion that advertising in a certain number of years repaid to the extent of 10 or 15 per cent. Advertising was a science which it was necessary to study, and although it would not return profits for some time it soon did so. His father also told the judge that he had had a gentleman in his shop who carried a newspaper seven years old, and pointed out that a considerable purchase resulted from the perusal of an advertisment published seven years before it reached the eye of his customer. Some years back Sir William Treloar said his income-tax assessment was doubled. He appealed and found the commissioners not very wide awake. It was not so now—he spoke as an income-tax commissioner. (Laughter) Asked why they overcharged him, one of the commissioners produced three copies of a paper in which he had a whole-page advertisment, and said: "It is impossible to spend a lot of money like that unless you have a large income." He laughingly replied, "It shows you know nothing about it. These advertisments are flags of distress which I show when I want business."

The experience of Sir William Treloar is that of every other liberal advertiser, whatever goods he advertises. The "flag of distress" is rarely run up in vain. As Gladstone said, advertising is to business what steam is to an engine the great propelling power. The mistake so often made by advertisers is to cut down their advertising expenses when trade is a bit dull. A wiser course would be the allocation of a larger sum for the purpose of advertising at such times. It is precisely the right thing to do to advertise in slack times, and it is equally far-seeing to advertise when things are brisk. The "flag of distress" should be kept flying all the time.

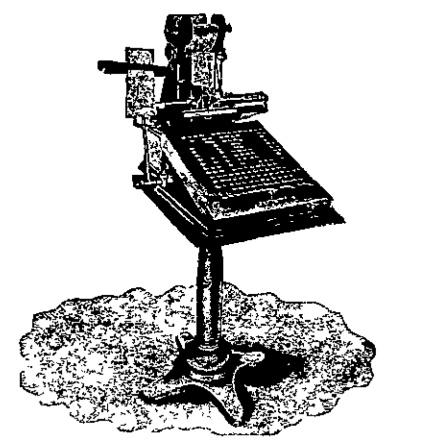
What is claimed to be the largest centrifugal pump ever built has been produced at the Byron Jackson Machine Works, of San Francisco. It consists of a high head centrifugal pump of the five-step series type, operating under a maximum pressure of 250 lbs. per square inch, which is equivalent to a total 1 ft of 580 ft. Its capacity under normal condition is 9,000 gallons of water per minute, and it is driven by four 400-h.p. turbine water-wheels.

A WONDERFUL MACHINE.

THE LANSTON MONOTYPE.

SETS THE TYPE FOR PROGRESS.

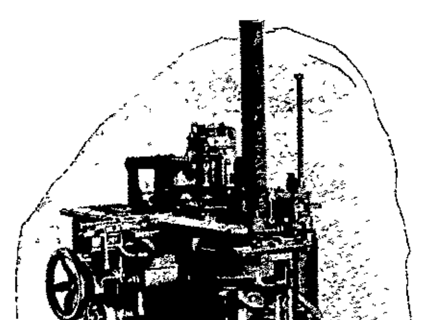
The accompanying illustrations show the keyboard and caster of the wonderful typesetting machine which has been specially installed for setting the "solid" matter of Progress. The Lanston Monotype deserves to be recorded as one of the most remarkable and epoch-making inventions of modern times. Imagine an over-grown typewriter carrying no fewer than 257 keys; these keys, instead of being connected to levers as in a typewriter, are simply caps to small brass rods,



THE KEYBOARD.

called plungers, which are held up to the highest point of pressure by compressed air. When depressed they let air through holes which only coincide when in that position. The compressed air forces up punches which perforate holes in a strip of paper. When complete this paper looks somewhat like the music strips on mechanical pianos and organs. The strip is placed in a second machine which may be in another part of the premises, and which casts the type. Every time a hole in the paper strip coincides with another hole in the machine a type is cast, with molten metal, pumped into a matrix; and this type is cooled, trimmed and set in position for forming the words which are being set. As many as 13,000 letters an hour have been set in this way, though in practice it is not run at such a high speed, the saving over hand-set composition being quite appreciable enough when run in a normal way.

The mechanism by which the humanlike movements are accomplished is naturally a marvellous example of mechanical skill and accuracy, which never fails to excite the wonder of the onlooker. It would be impossible in this necessarily brief and intentionally non-technical article to describe



THE CASTER.

even cursorily the various features of the machine, and we must, therefore, leave our readers to take for granted the ingenuity of its mechanism.

It is capable of dealing with any class of composition, from poetry to railway timetables, and any size and style of face from Pearl to English.

The Lanston Monotype is, indeed, the greatest mechanical boon ever presented to the printer. It is rapidly changing the whole life and aspect of our printing offices, and undoubtedly it is a machine which must immensely influence the future of letterpress printing.

Colour Photography.

Readers of the daily newspapers are familiar with the paragraph which periodically appears, informing them that the problem of how to duplicate the colours of nature by photography has at last been solved. The few, however, who have studied the subject, and know its difficulties, do not easily accept such bare statements, and it may truly be said that the public see little or nothing of its results from such proposed methods. An opportunity of seeing something tangible was, however, recently afforded to visitors to the photographic exhibition lately held under the auspices of the Victorian Amateur Photographic Society. In a lecturette Mr. J. Patterson (of Messrs. Patterson, Shugg & Co.) described a process of photography in natural colours, and demonstrated the success of the method by about a score of examples, which were projected upon the lantern screen by means of the ordinary limelight apparatus. The process by which these slides (which contain in themselves all the colours of the originals), were produced, is based on the well-known three-colour theory, which shows that white light is really equivalent to a mixture of three colours only, combined together—viz., red, green, and violet rays—and that all colours whatsoever can be compounded from these three in various proportions. Three negatives are made on colour sensitive plates. The first is taken through a red glass or filter, which allows only the red rays to act; the second through a green, and the third through a violet filter. By this means is obtained the value or amount of the fundamental colours reflected from the original. Three positives from these are made on gelatine films, which on development are caused to absorb respectively the three complimentary or pigment primary colours—blue, pink, and yellow. The superposition of these three films shows by transmitted light all the colours of the original. The examples shown include a number of natural flower studies, in which the brilliancy and fidelity of colouring were remarkable. Three slides of views in the Botanic Gardens were also wonderfully realistic in their representation of the natural colours. The process amply demonstrates the possibility of duplicating the colours of nature by purely photographic means.

Machinery and Appliances.

A new type of helmet experimented with by the Fire Brigade authorities of Manchester, England, is decidedly interesting. The equipment includes incandescent electric lamps, while an air current is directed upon the eyes and nostrils to protect them from smoke. A telephone apparatus is also provided, so that a fireman, when he enters a building, can always maintain communication with the force outside, and, if necessary, summon assistance. The helmet is specially designed to facilitate the penetration of dense masses of smoke.

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Owing to the rapid destruction of the world's great forests, the preservation of timber from insects and decay is becoming a question of vital importance. Many efforts have been made to perfect a process for this purpose. One of the most successful is adopted by the Ayer & Lord Tie Co., of Chicago. The timber is placed in airtight cylinders, where it is first subjected to steam under pressure to remove all air from the pores of the wood, after which the air and steam are exhausted by a Deane wet vacuum pump. When all the vapours and gases have been removed, creosote is admitted into the tank, and forced into the wood by a pressure pump of the Deane duplex type. A Clayton air compressor is next used to force air into the tank, displacing the creosote, and returning it to an elevated storage reservoir.

Automatic Weighing.

The average housekeeper when making her weekly purchases of tea, starch, and sugar is rarely troubled as to how these and similar articles are weighed into packages. This, however, is a problem of considerable importance to the merchant, and when tea and other household commodities in bulk can be automatically weighed into separate packages of definite quantities at the rate of 7200 and upwards per day, it is scarcely surprising that machinery is favoured in place of manual labour. An electric weight repeater, not only accomplishes this achievement, but also does the work without waste, leak, or stoppage. The material is directed into a bag or package, and the machine, once set, requires no special knowledge to work efficiently. An instantaneous electric cut-off to feed is provided, which is stated to be more certain than the slower means hitherto employed. Another advantage is that it can be used as a meter (with electrical portable register) either to or from mill rolls, bins or ship's hold, and thus used deal with 4000 bushels per hour. It can also discharge quantities of 4¼ bushels direct into bags at the rate of at least 900 per hour.

In May, 1903, five crates of coal, each holding two tons, were sunk in Portsmouth Harbour, and a similar quantity was placed at a coaling point in small heaps, covered with tarpaulins. Six months ago some of the submerged coal was raised and burnt, in conjunction with the same amount of that which had been kept on land. The results showed that the submerged coal had the greater calorific qualities. Further experiments on these lines are now being conducted.

CLEAN, LEGITIMATE ADVERTISING.

Great care is taken in admitting to the columns of PROGRESS none but reliable and clean advertisements of legitimate advertisers, who do just what they advertise; and we believe that there are no advertisers represented in our columns to-day that our readers need have any hesitancy in patronising. We carefully investigate the standing and reliability of advertisers before accepting their business, but the most careful publisher will at times be imposed upon by unscrupulous persons. Should any of our readers at any time be deceived by an advertisement appearing in our columns, we shall deem it a very great favour if they will notify us promptly, and thereby enable us to make a full and careful investigation, and thus protect our readers from fraudulent advertisements stealing into our columns. We would advise our readers when writing advertisers to mention PROGRESS as it will ensure good service and prompt attention.

Progress Business Directory.

NOVEMBER 1st, 1905.

PERPETUAL MOTION:

The Inventors' Paradox.

By H. H. Rayward, M.E., Medallist, Techl Assocn , London

The seeker after perpetual motion has to the superficial observer apparently been engaged in as fruitless a task as the ancient alchemist, progenitor of the modern chemist who spent years of patient research for the elusive "philospher's stone" From time to time the solution of the problem has been boldly announced but no inventor has yet produced the desired result although unwearying toil and experimental research have, as in the case of the alchemists, led to other discoveries in the realm of physics which have proved of inestimable value to science and the industrial arts.

It is a settled principle in mechanics that perpetual motion, in its purely theoretical sense, can never be attained for the reason that it is impossible for a machine to exist in which the element of friction, involving wear and eventual destruction, is lacking Recent discoveries, however, appear to indicate that the great objective of so many earnest investigators may, in its practical sense, shortly be arrived at. The discovery of radium, for instance, has brought into the calculation a new element, a natural store-house of energy, which, from a human standpoint, is inexhaustible, and which one day may be utilised for practical purposes.

Experiments have already been made by scientists in the utilisation of radium for motive purposes, and amongst other experimental contrivances a radium clock has been constructed (by Mr. Harrison Martindale, of England) which, it is said, will keep in motion for an indefinitely long period. The apparatus is also interesting as exhibiting the dissipation of the negatively charged alpha and beta rays of radium. A minute quantity of radium supported in an exhausted glass vessel by a quartz rod, is placed in a small tube. An electroscope, formed of two long leaves or strips of silver, is attached to the lower end of the tube. A charge of electricty in which there are no beta rays is transmitted through the activity of the radium into the leaves. Thereby the latter expand until they touch the sides of the vessel, which are connected to earth by wires, these wires instantly conduct the electric charge and the leaves fall together Until the radium is exhausted, which, it is estimated, will not be for thirty-thousand years this simple operation will be repeated every two minutes. This may be one of the first faltering steps upon the part of practical experiment leading ultimately to the employment of the new element for motive purposes

Study of the efforts of inventors in connection with perpetual motion is not only interesting, but has an instructive influence, many mechanical problems being involved, the examination of which is most beneficial in broadening the views and enlightening the mind of the student. The reasons of failure of the various contrivances which are briefly described in these articles will be at once apparent to many readers who possess mechanical knowledge, but upon the other hand a few of the propositions look so feasible that skilled mechanical engineers may be momentarily at a loss to explain why the "wheels won't go round" interminably.

The illustrations are reproduced from the not-over-clear drawings filed with the applications for the several patents; but it has been necessary to much abbreviate the somewhat verbose descriptions of the inventions which were given by the patentees.

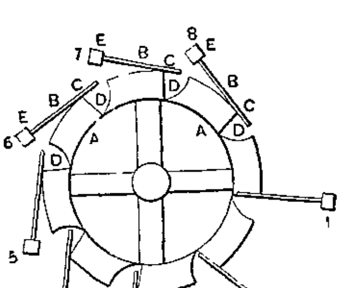


FIG. 1.

Figure 1 shows apparatus invented by the Marquis of Worcester towards the end of last century, and a forerunner of hundreds of motors which depend, for their alleged ability to "mote," upon the assumption that it is possible to arrange a number of equal weights upon the periphery of a revolvable wheel in such manner that the weights upon one side of the axle are a ways either more numerous, or, are further from the axle, than those upon the other side. The revolvable wheel, A, had the arms, B, pivoted at equal distances apart upon its circumferential periphery. Weights, E, were carried one at the end of each arm, and as the wheel revolved the arms turned upon their pivots under the influence of gravity, and the weights were thrown away from the centre of the wheel upon one side, and, fell towards the centre upon the other side. In Figure 2 the endless chain, A

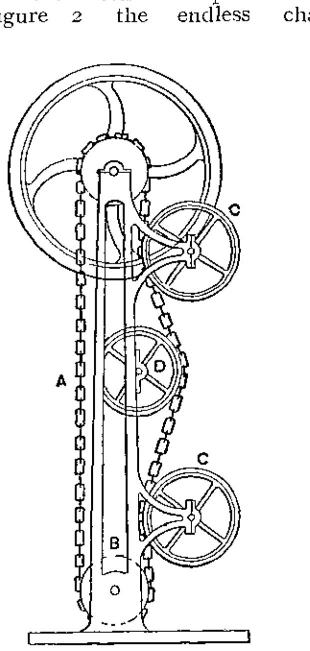


FIG. 2.

connected the chain wheels at the top and bottom of the frame, B. The idle wheel midway between the two wheels pushed the chain laterally so that there was always a greater length, and consequently greater weight, of chain upon one side of the wheels than upon the other side. The large wheel at the top of the frame was provided to convey the perpetual power which was expected to, but alas did not, eventuate.

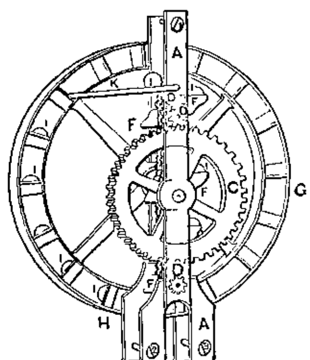


FIG. 3.

In Figure 3 the wheel G, which was fixed upon an axle journalled in the uprights A, had a number of cups around its circumference, and the aim of the inventor was to arrange matters so that while some of the cups upon one side of the wheel each carried a weight, in the form of a ball the cups upon the other side of the wheel were empty The ball weights, I, were raised to near the top of the wheel, each in one of the buckets, F, fixed upon an endless chain; as each bucket reached the top of its path the ball rolled from it down a shute, K, into one of the wheel cups; when the balls arrived, during the revolution of the wheel at the bottom of the apparatus, they rolled from the cups into the buckets, to be raised to the top of the apparatus for repetition of the operation. The endless chain was driven by the revolution of cup-wheel, G, through the medium of a spur wheel upon its axle which geared with pinions, D, upon the axles of the chain sprockets.

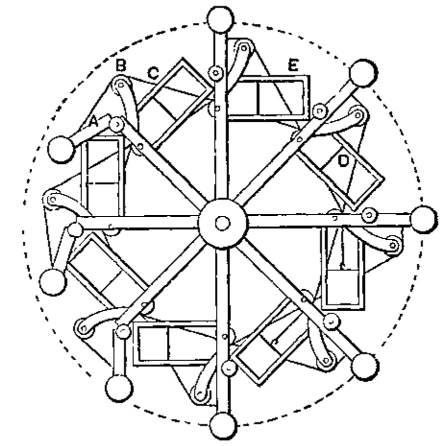


FIG. 4.

Figure 4 illustrates apparatus patented by Ferguson in 1770. A number of radial arms fixed to a revolvable boss have each a jointed end, A, which is weighted, and also a guide frame, E, in which slides a weight, D, As each arm reaches a horizontal position the weight, within its frame, slides down, and by means of a cord, C, which passes over a guide pulley, B, straightens out the jointed end, A, of one of the arms which is then vertical. Upon the upward travel (left hand) of each arm the weight to which it is connected falls back and the weighted end, A, being released from the pull of the cord turns upon its joint and falls nearer to the centre of the wheel. Thus the weights upon one side of the boss are farther from the axis than the weights upon the other side.

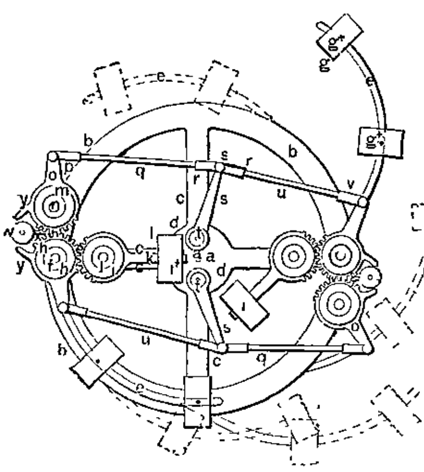


FIG. 5.

Figure 5 shows one only of a series of wheels which were all mounted upon the same axle, A. Each wheel had two curved arms, E, pivoted opposite one to the other upon the rim, and each arm carried two fixed weights, G, a boss, H, at the pivoted end of each arm had a number of teeth gearing with similar teeth upon the pivoted boss of a lever, C, carrying a weight, I. The weights I, caused the lever, E, upon the right hand side of the wheel to project outwardly while the similar lever upon the other side was drawn in by the other weight, I, thus causing a preponderance of weight upon one side of the wheel. The curved arms were connected by a system of rods, W, Q, pivoted to levers S, T, and levers, O, having toothed bosses in gear with the teeth upon the bosses of the arms,

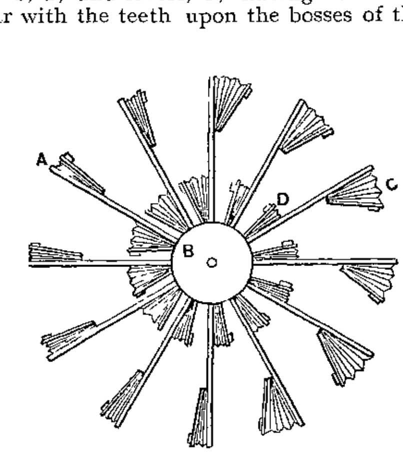


FIG. 6.

Figure 6 shows apparatus depending for its effect upon the automatic transfer of water from the periphery to near the axle of a wheel. The arms, A, project radially from the boss, B, which is mounted upon an axle, and each arm has a water bellows pump, C, upon its outer end A, and a similar bellows, D, near its juncture with the boss, the bellows being in communication through the arm, which is tubular. The outer bellows has a weight which causes it to expand when the arm reaches a vertical position, whereby water is drawn through the arm from the inner bellows, D, and remains in the outer bellows until the arm reaches a vertical position at the bottom of its travel, when the bellows collapses, under operation of the weight, and transfers the water to the inner bellows.

It is obvious that if the apparatus worked as the inventor intended, the water upon one side of the wheel would be farther away from the axis than the water upon the other side, and consequently the wheel should have revolved perpetually ,but it did not.

(To be continued).

NOTES ON EARTHQUAKES AND THEIR RELATION TO BUILDING CONSTRUCTION IN NEW ZEALAND.

By F. de J. Clere, F.R.I.B.A

FIRST PAPER.

As Great Britain and most of her dependencies have almost always been free from serious earthquakes, it would appear that there is not much literature on Seismological subjects in our language ; and though these islands of New Zealand have, from time to time, been visited by severe shocks, it has only been within the last few years that their effect on high buildings has been noted.

The first severe shock experienced by the writer was in the winter of 1880, when the Manawatu, Rangitikei and neighbouring districts were badly shaken. On that occasion the tops of chimneys were thrown down, being, as is generally the case, broken off immediately above the roof line. The rotary motion generally experienced was very noticeable ; bottles and other articles, in many cases, completing a half circle in their movements during the shock.

It should, however, be remarked that most of the chimneys that fell were built of the very poorest mortar, and that those which were well constructed generally escaped with but very slight damage.

During the construction of the New Zealand Government Life Insurance buildings, in which the writer was specially interested, several bad shocks occurred, in one case the vibration being almost sufficient to throw down the workmen who were on the higher scaffolds, but, owing no doubt to the work being "green" and therefore more elastic than when set, no damage was done. Stones lying ready to be laid were twisted out of position ; but, as far as could be seen, the walls were in no case cracked. Some five or six years ago the swing of the large slated roof over the main tower moved portions of the Oamaru stone immediately below it. On this occasion the authorities caused the upper part of the brickwork to be embraced with iron straps, and this appears to have prevented further damage in that direction.

It was, however, left for the earthquake of the 9th August, 1904, to show the questionable nature of Oamaru stone as a building material. Its shearing strength is very slight, especially after being subjected for some years to the decaying influence of the acids in the air of Wellington. As the gables rocked, the edges gave way and portions fell. It is plain, too, that the adhesion of the stone with imported Portland cement is not good ; and in future building the greatest care should be exercised in "tailing-in" stones to the brick backing, and in other ways preventing the stones moving in their joints.

As the experience in building earthquake-proof buildings in New Zealand is still comparatively small, it may not be out of place to study the building laws and regulations that have been drawn up in other cities, with a view to strengthening edifices to withstand shocks ; and with this idea I propose noting points taken from other regulations which may be applicable to New Zealand ; but, before doing so, it may be well to preface these notes by the following quotations culled from Milne's writings on the subject.

"Near to an earthquake origin, a disturbance travels quickly, but, as it radiates, its velocity apparently decreases."

"In the Tokio earthquake of September 5th, 1886, earth particles described paths which were nearly circular, and there were many which were elliptical. At other times it describes paths which are spiral or like a figure 8. The elliptical paths are, however, the most usual, and in the case of shocks the major axis of such ellipses indicates the direction from which the earthquake originates."

"Generally in all large earthquakes the destruction has been greatest on soft ground."

"After a severe earthquake it has been observed that many bodies (like obelisks, grave stones, chimneys, etc.) have been more or less rotated."

"The upper portions of the buildings suffer greater motion than their lower parts."

"The pushing out of facing stones and brickwork from the walls of buildings with an internal framing may be taken as an illustration of non-synchronism in vibration period."

"Portions of a building which are not likely to synchronise in their vibrational periods ought either to be strongly tied together or else, by means of joints internally left during the construction, to be completely separated from each other"

"In Yokohama experience has taught almost every householder to make his chimneys short, thick and without heavy ornamental copings."

"Two points of ground, only a few feet apart, may not synchronise in their motions."

Mr. Mallet, in his description of the great Neapolitan earthquake of 1857 shows that if we have a rectangular building the walls at right angles to the shock will be more likely to be damaged than those which are parallel to it.

"One conclusion which may be drawn from observations of cracks in walls is that a cracked building at the time of an earthquake shews a certain amount of flexibility. Whether a building which has been designed with cracks or joints between those parts which are likely to have different periods of vibration would be more stable as far as earthquake shakings are concerned, is a matter to be decided by experiment. Certainly some of the cracks which have been examined indicate that if they had not existed the strain upon the portion of the building where they occur would have been extremely great."

"Rigidity favours the transmission of momentum ; and with rigid walls we are likely to have ornaments, coping stones and the comparatively freer portions forming the upper parts of a building displaced ; whilst with flexible walls, absorbing momentum, in the friction of their various parts, such disturbances would not be so likely."

Within three-quarters of a mile of Professor Milne's house in Tokio there is a piece of ground which has so great a reputation for the shakings it receives that he was told its marketable value had been considerably depreciated, and that it was, at the time of his writing, untenanted.

"One writer gives an example taken from the records of the Syrian earthquakes of 1837, where not only neighbouring villages suffered differently, but even neighbouring houses. In one case a house was entirely destroyed whilst in the next house nothing was felt."

Many of Professor Milne's remarks have relation to the geographical nature of sites, but these have no practical use with regard to New Zealand.

The following notes are taken from the Spanish building regulations for Manila, which were drawn up in consequence of the earthquakes of 18th and 20th July, 1880

"The height of stone walls of public buildings must be in accordance with their use and disposition, but in private buildings they must be limited to a height corresponding to the ground plan of such buildings, but they can also have a basement in addition."

"The length of stone walls cannot be more than double their height without their being supported by cross walls or strenghtened by exterior or interior buttresses."

"The thickness of stone walls must be at least one-fifth of their height. In this thickness is not included the stone facings or brick linings of walls, which are not of the same construction throughout, The thickness of transverse walls can be reduced a little according to the span of the floors which they support, but it must be never less than one-eighth of the height."

"Stone walls which present the greatest number of joints and the greatest homogeneousness are those which best resist earthquakes"

"Posts must be neither built into nor touch the walls ; the necessary space being left in order that they may not injure the stone walls during earthquakes."

"The separation between masonry and timber must not be less than about four-fifths of an inch"

"Though not forbidden mixed construction must, as far as possible, be avoided, as the different elasticity of the materials, of which such is composed produces great derangementof the different parts."

"For the covering of iron or wooden framework blocks or cement of artificial stone is recommended."

It would appear from different remarks scattered through the building regulations, and a report of the consulting committee of public works of the Philippine islands, that the site of Manila consists chiefly of mud. Generally, it seems to be considered that water-soaked foundations are particularly bad ones ; and for this reason, no doubt buildings on the Wellington reclaimed land suffered so much more than those which were built elsewhere.

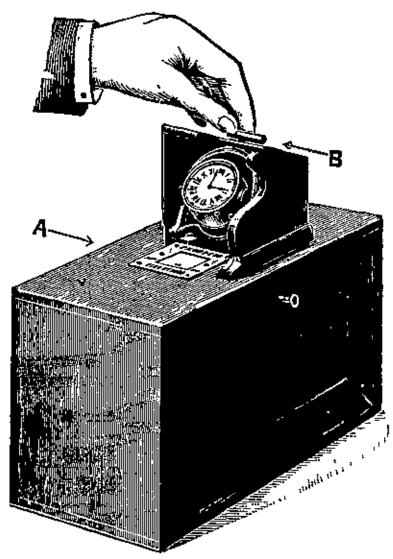
The Committee above mentioned recommended iron construction protected by concrete or brickwork. Considerable emphasis is given to the necessity of having very good foundations, as it has to be borne in mind that foundations have to give unity to the building, and have to resist the action of earth movement over the whole of the building."

The commonly used arrangement of letting wall posts into walls is considered as vicious.

(To be continued.)

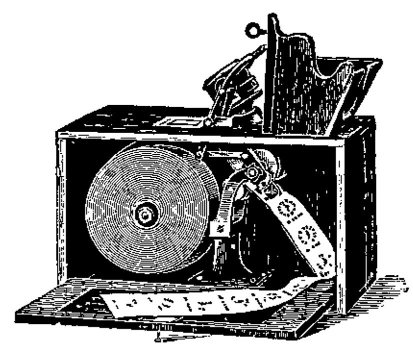
TIME RECORDING CLOCK.

Mr. Herbert H. Thompson, 132 Cambridge-street, Birmingham, England, is the inventor of this clever contrivance. The employee writes either his name, initials, or number on a paper ribbon (A) with a pencil, and then pulls down a lever (B). Th s movement impresses the time on the paper



OUTSIDE VIEW, SHOWING PAPER RIBBON AND TIME RECORDING CLOCK.

immediately above the signature. As the lever moves back to its normal position it carries the record inside the box, where it is automatically rewound, and being under lock and key cannot be withdrawn or tampered with. The capacity of the machine is only limited by the length of the paper roll, and about 5000 records can be made before this requires renewal ; the portion containing the records

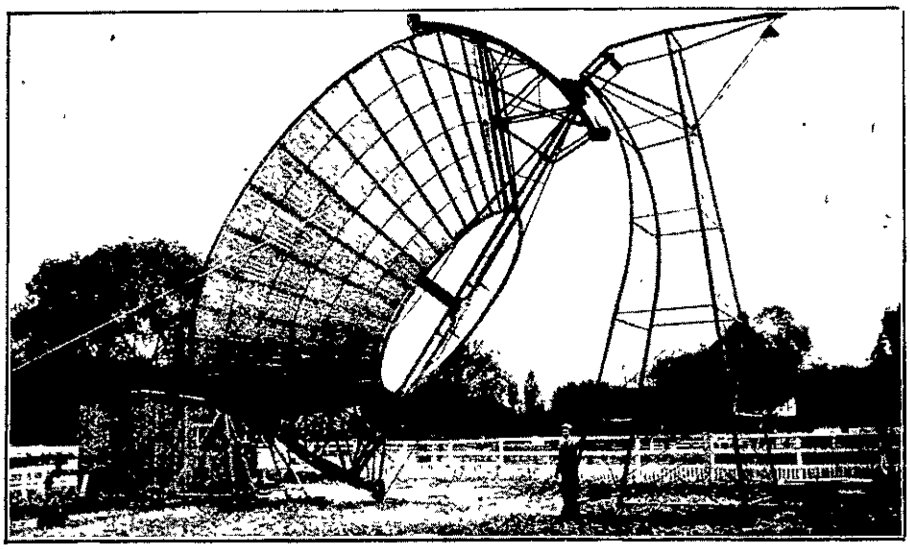


VIEW SHOWING CLEAR PAPER ROLL, AND USED PORTION WITH RECORDS.

can, however, be torn off for booking when wanted. If desired the ribbon can be thrown out of gear and the machine used as a time stamp for stamping messages, letters, orders, etc. It can also be employed as a watchman's tell-tale. The lightness and portability of the machine make it well adapted for checking the time of workmen engaged away from the works.

For the extermination of the rabbit in Australia an ingenious scheme is proposed by Mr. Wm. Rodier, Tambua Station, Cobar, N S.W. Mr. Rodier urges pastoralists and farmers to abandon spring traps and poison carts in favour of devices for catching the pestiferous bunny alive. When caught, the females are to be killed, and the males liberated. The reason for freeing the males is that, when they outnumber the females, they will kill their young. Others, it is said, will be so persecuted that they will not breed, and in time the bucks will worry the remaining does to death. Thus it is proposed to get rid of the breeders, and in time the males will die off by old age and their natural enemies.

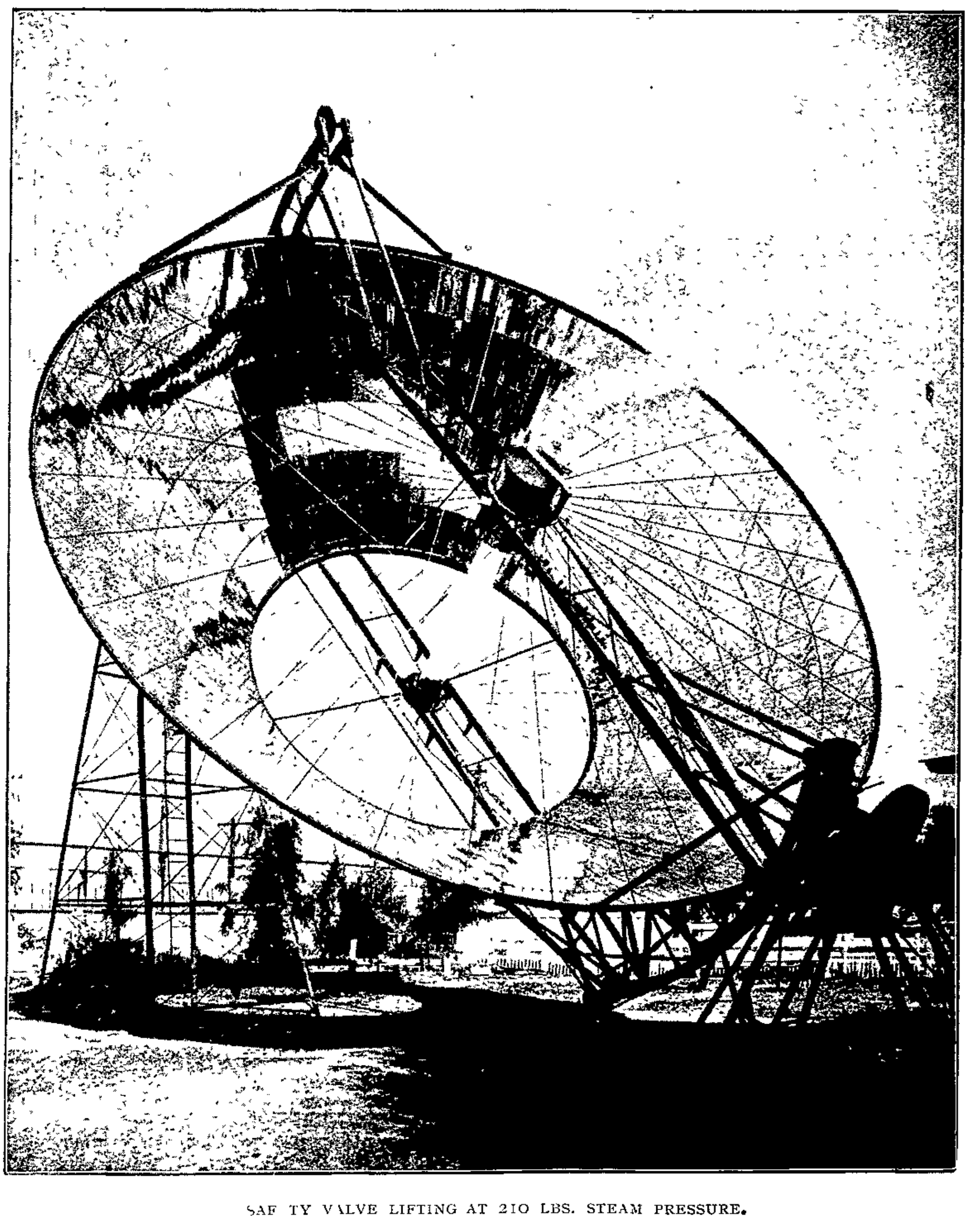
Utilisation of Solar Energy.



PREPARING FOR THE DAY'S WORK.

FOR centuries man has striven to devise a means of utilising the heat of the sun for the production of power. From this source the quantity of energy derivable is shown to be equal to 1-h p. for about 4 square feet of receiving area. In 1670 Vilette melted silver and copper by focussing the sun's rays with a mirror. Fifty years ago a solar motor operated a printing press in Paris, and James Ericsson, of Monitor fame, is the inventor of a wonderful engine, shown in the accompanying illustrations, which has been improved and rendered more workable than at the time of its appearance in 1868. It is no exaggeration to state that this sun motor, which is in successful operation at Pasadena, California, marks an era in the world's mechanical history. By the illustrations it will be seen that the engine may be likened to an enormous open umbrella, with a part of the top cut off; or to another familiar object—a billiard-table lamp-shade. The interior forms a huge reflector, in which are 1,800 glass mirrors, each about 3-in. wide and 2-in. long; and these reflectors catch the sunshine and reflect it upon a long, slim boiler, set in the centre like the handle of an umbrella. The reflecting surface, however, must be first set at an angle to catch the rays; therefore the whole engine is mounted on a tall iron framework, like that set up for windmills, and under the bottom is an equatorial mounting, something like that used with leviathan telescopes. The solar motor is automatically balanced, the weight resting on roller bearings, so that only a few pounds of hand pressure are required to turn it in any way that may be desired. When the operator wishes to get up steam he turns a crank and swings the reflector into focus, guided by an indicator. When the focus is once obtained, the great umbrella, like a sunflower, automatically keeps its shining face towards the sun, a common clock regulating its movements. The motor works a fifteen horse-power engine employed in pumping water. In that land of almost perpetual sunshine, which was selected as the best place for its first practical trial, the reflector is focussed daily soon after the sun has risen. At first the morning dew is seen slowly to ascend from the gigantic mouth. Then the bright glasses glitter in the sun, and the heat lines begin to quiver inside the circle, the greatest commotion taking place round and about the long black water-tube boiler, which, as the intensity of the focussed rays increases, begins to glisten, so that in any photograph taken of the machine the boiler is shown almost as pure white. Within an hour of the time of turning the crank and getting the focus—provided that no clouds intervene to throw shadows into the reflector—there is a jet of steam from the safety-valve. The engineer opens the regulator, there is a succession of hisses from the umbrella handle, and the high-pressure steam is being conducted in pipes to a compound engine operating a centrifugal pump. The sun, in fact, is drawing water at the rate of 1,400 gallons a minute. This is wonderful enough in all conscience, but the ingenuity of the mechanism does not end here. The fact has already been mentioned that the reflector automatically keeps pace with the passage of the sun across the firmament but there are other labour-saving devices to be recorded The machine oils itself; the supply of water for the boiler is regulated automatically—as is also the steam pressure, which reaches its maximum with a pressure of 210-lb. per square inch—and there can be no explosion. Therefore, once started, the solar motor runs all day without any attention whatever Then when the sun sinks so low that there is no more heat, it will stop, rest over night, and all that is needed to start it when the radiant energy again asserts itself is the twist of a couple of handles It should be added that the reflector seldom requires cleaning, and this, indeed, is practically the only manual work to be done in connection with the machine. This solar engine was made in Boston, and its successful operation is the outcome of ten year's experimenting.

The utilisation of solar energy is not, however, confined to the Ericsson method, for a communication has been received from an American engineer, Mr. H. E. Willsie, 180 Broadway, New York, in which he claims to have invented, and perfected beyond the ordinary experimental stage an entirely new method of producing power from solar heat in continuous commercial quantities. A Willsie plant, it is said, will not only run night and day as steadily as a steam-power plant, but also do the same work in furnishing power for electric lighting, ice-making machinery, city waterworks, irrigation, &c. Hitherto solar motors have stopped at night and when the sun was clouded The new system, says Mr. Willsie, will run a week or more without sunshine, and the cost of storage installation be extremely small. It should last fifty years, and is practical and efficient. With this method it is claimed that a 500, or even a 1000-h.p. plant may be installed with but little more trouble than a steam plant and with nearly as much certainty of the result.



SAFETY VALVE LIFTING AT 210 LBS. STEAM PRESSURE.

The "Gardner" Oil Engine.

THE "Gardner" British-made Oil Engine, as illustrated on the cover of this issue, is the result of many years' experience and close study of internal combustion engines. There are said to be over 5,000 now at work, varying from ½ b.h.p. to 60 b.h.p.

In 1891 1600 persons owned eighteen million acres of land in New Zealand; one fertile tract, aggregating 250,000 acres, then carried only sixty-five people. In many of the resumed estates, under the closer settlement scheme, the returns have proved to be fourteen times greater than those formerly produced under land monopoly.

Applications for Patents.

The following list of applications for Patents filed in New Zealand during the month of September has been specially prepared for PROGRESS.

19974—1st—Dil, W. J., Dunedin: Bicycle roller brake.
19975—1st—Grainger, A. M. Weed-cutting plough
19976—1st—Kennedy, W., Sutton Plough-lifting attachment.
19977—4th—Tippett, E., Normanby Cream-separator.
19978—1st—Davidson W, Paparoa Brake for cart, &c.
19979—5th—McKim, F G London Pneumatic tyre.
19980—4th—Smith S Christchurch Sandal
19981—6th—Henry, J & Gabites A G, St. Albans N Z., Pocket flask and heater
19982—6th—Madder, W., New Plymouth Vote-recorder.
19983—6th—Reid, A., ,Whangamomona Hooks for reins, traces etc.
19984—5th—Martyn, D. W., Christchurch Saucepan.
19985—6th—Beale, O. C. & Vader, C. J, Annandale N. S. W.: Piano door.
19986—6th—Pollard, E. T. & Behrmann, E. L., London. Cigarette machine.
19987—6th—Pieper, H. Liege, Belgium. Electric-machine governor.
19988—6th—Macdougal, J., Melbourne and Southouse, M., Sydney Manufacture of pulp holloware, &c.
19989—6th—Dewar, J. N., Leonora, Western Australia: Ore-feeder for battery.
19990—5th—Charleston, D., Melbourne Puncture-sealing compound.
19991—7th—Hoskins, G. & C. Ltd., Sydney: Joint for locking-bar pipes (C. J. Hoskins).
19992—7th—Hooker, J. T., Hokitika Luncheon-can.
19993—2nd—Wilson, R., Dunedin: Street-cleaning machine.
19994—8th—Davis, J. W., Auckland: Exposure and focus distributor.
19995—8th—Sibley, R. H. & Brown, A., Auckland Game.
19996—8th—Griffiths, G., Birchfield Forming bearing of wheels.
19997—8th—Troup, J., Christchurch Bag-printing machine.
19998—4th—Branton, T., Blenheim Flax-tailing appliance
19999—5thGrainger, A. M., Oamaru: Bird-trap.
20000—6th—Sinclair, M. Dunedin Drainpipe
20001—7th—Cook, W. E., Christchurch Venetian blind cord grip
20002—9th—Humphries, G E, Wellington Scaffolding bracket
20003—6th—Love, J. H, Auckland Protector for dress.
20004—6th—Oxley, H. H., Auckland Reversible brush.
20005—9th—Ford, A. S, Coromandel Ejecting liquid from one receptacle to another
20006—9th—Fletcher J W Jun, Wellington Clothes dryer
20007—5th—Jaggs, W. J, Auckland Laundry-iron.
20008—6th—McPhedran D T, Timaru Maul-ring fastener
20009—6th—McLean, J. E, Dunedin Garment match-striker.
20010—6th—Paik, J. R, Wellington Brooch-pin catch (W. H Fahey).
20011—6th—Roberts, J. H., Waipiata Swingle-tree and equalising-bar connection
20012—6th—Roberts, J. H., Waipiata. Plough-chain connecting-hook.
20013—7th—Mason, J., Brydon T., & Armstrong, G. Dunedin Rope-block lifting-tackle.
20014—9th—Kempthorne, Prosser & Co.'s N.Z Drug Company, Dunedin Culinary-essence manufacture
20015—11th—Fowler, J. W., Whangarei Heads: Exit-door.
20016—11th—Karl, V., Rotorua: Weed-eradicator.
20017—11th—Shelton, F. J., Wellington: Valve.
20018—11th—Gordon, F. E. A. & Hepworth, E., Palmerston North: Washing-fluid.
20019—12th—Pintsch's Patent Lighting Company, Ltd., London Inverted incandescent gas-lamp (J. Pintsch)
20020—12th—Mitchell, E H. J., Triavunna, Tasmania, and Mellor B F, Moonee Ponds, Vict. Plough.
20021—12th—Bawden J. M Traralgon Victoria Egg-boiling cruet-stand
20022—12th—Louat, P T Waihi Slimes-treatment.
20023—12th—Hughes, W. E. Wellington Steam-distribution for locomotive (H Lentz and C. Bellens)
20024—12th—Bishop, R C, Christchurch Gas-heated boiler.
20025—12th—Murphy, J and Harper, C, Fordell Vehicle-shafts.
20026—13th—Cornwall H. G., Wellington Envelope and sheet of paper.
20027—13th—Worthington Henry R., New York Centrifugal turbine pumps (F Ray)
20028—13th—Hoppe, M A, Wellington Muscle-developer for fingers
20029—13th—Noedle R C Woodville Clothes-prop.
20030—13th—White R H and Pritchard G T, Wanganui Sash-fastener
20031—14th—Scarr J S Hobart Tasmania Vermin-trap.
20032—14th—Scarr, J S, Hobart, Tasmania Portable-bed
20033—14th—Worthington, Henry R New York Centrifugal turbine pumps (F. Ray)
20034—14th—Perrott, T H Broken Hill New South Wales Lubricator.
20035—14th—Smith, F W., Rangiwahia Fruit-gatherer.
20036—14th—Hatmaker, J R, Paris Milk food.
20037—14th—Hatmaker J R, Paris Milk food
20038—14th—Andreas, E P Leura, New South Wales Ascetylene generator.
20039—14th—Falls, A L., Cambridge Slasher-handle fastener
20040—9th—Macalister, J. Invercargill Manure feed.
20041—12th—Hatcher, E J. and Henry C., Dunedin Steam cooker
20042—15th—Alley, C J., Faindon, New Zealand Chimney and crozing machine.
20043—15th—Parrish, E. J., Sydney Window-sash sustainer.
20044—16th—Craig, C., Marton Sighting apparatus for lifting rails
20045—13th—McCole, A., Onehunga Sock or stocking.
20046—18th—Mallabar, H. J., Liverpool, England Printing and developing photographs.
20047—14th—Blackburn, F. and Robertson, J., Auckland Non-refillable bottle.
20048—14th—Harvey, W., Auckland Pressure-block for cheese-press.
20049—14th—Johnston A, Devonport, and Jenkins, C, Ponsonby Scrubber and Mop.
20050—14th—McNab, T, Lawrence Ball socket-joint for gas-hanging
20051—18th—Lucy, G. W., Capetown Aerial roundabout.
20052—18th—Wilson, A B, Brisbane, Queensland Rotary engine
20053—18th—Jackson J. D., Prahran, Victoria Spark-arrester
20054—18th—Jackson J D, Prahran, Victoria Water-heater
20055—18th—Haughton, R S, Wellington Emptying kerosene-tin
20056—15th—Cox J and Johansen, V, Auckland Cycle-valve connection
20057—19th—Green, A E Dannevirke Horse-coupling
20058—19th—Kelly R D Wellington Letter-envelope, &c
20059—19th—McCallum, J Blenheim Bale-band fastener
20060—20th—Cotton, F, Hornsby, New South Wales Refuse-furnace
20061—20th—Stebbing H Auckland Post and letter cards
20062—20th—Baty, T B, Greymouth Steam-engine
20063—20th—Shelton F J, Wellington Gas-heated laundry-iron
20064—21st—O'Keefe P H, Grafton, N S.W Salting or corning meat
20065—21st—MacIntosh W P, Annandale, N.S. W. Tobacco lighter
20066—21st—Paull, J, Wyndham N S W Gate opener.
20067—21st—Hughes, W. E, (Lentz, H, Berlin and Bellens, C, Neuilly, Sur-Sein) Steam distributor for locomotive.
20068—21st—Sharpe, J. ,Glebe, N.S.W Wire suspender for bottles
20069—21st—Bruer, J J., Adelaide, S.A. Piano.
20070—21st—Anderson, F. H, Auburn, Victoria. Wilson, H., St. Kilda, Victoria, and Rigby, E. J., Malvern, Victoria Steel bar manufacture.
20071—21st—Bissaker, C H., Cootamundra, N.S. W Ascetylene generator.
20072—21st—Ellis, J C. Melbourne, Victoria Watch and clock regulating tag.
20073—21st—Jones, H. H., Wellington. Boot polish.
20074—21st—Dixon, F. A., Albany, N.S.W. Eaves, gutter fascias.
20075—20th—Collier, G., Christchurch Damper for register grates.
20076—21st—Grofski, J. A., Christchurch Hydraulic ram.
20077—21st—Head, J. A., and Leach, G. D. L., Lyttleton: Burglar alarm.
20078—22nd—Clegg, A. J., Hawera: Indicating closing and sorting mails.
20079—22nd—Johnson, A., Picton. Game.
20080—22nd—International Cigar Machinery Co., New York; Tyberg, O., Point Loma.; Luckett, W. S., New York; Lake, L., Brooklyn; Knight, H., Jersey City, Hetherington, F., San Juan, Porto Rico Cigar Machinery.
20081—22nd—Houghton, E. M., Detroit, U.S.A: Blackleg vaccine
20082—13th—Millar, R., Outram: Sprayer.
20083—20th—Irwin, E. A., Timaru Paper stand and cutter.
20084—22nd—Gale, J., Timaru. Key for securing pins of traction engine.
20085—20th—Hall, I. H., Invercargill. Hair pin.
20086—21st—Smith, C. B., Dunedin Sphere forming machine
20087—25th—Hudson, R, Wellington: Walls, Partitions, &c.
20088—25th—Bayley, R., New Plymouth: Boot sole attachment
20089—20th—Builton-Bennett, R. J., and Shadgett, W, Penrose Electric belt.
20090—25th—Ham, H., Fielding Flax stripper frame.
20091—22nd—Kinnimont, A., Gisborne Slaughter-man's tree.
20092—26th—Cowern, F. J., Kaponga Mailbag fastener
20093—26th—Baskiville, A. H., Wellington Braces
20094—26th—Crump, J. B., Ballarat, Victoria. Potato planting attachment to plough.
20095—26th—Hughes, W. E., Wellington; and Levinge, H. M, Okato: Candle or lamp holder.
20096—23rd—Thurgan, E. W., Auckland: Buckle, detaching tongue from strap.
20097—27th—Olsen, F, Wellington: Attaching trace speller to trace.
20098—27th—Nicholson, J., Sydney: Separation of gold
20099—27th—Nicholson, Sydney Saving gold.
30000—27th—Miller, A., Dunedin Surgical appliance.
30001—27th—Palmer, F. H., Wellington: Boat keel.
30002—27th—Whelar, T. J., Hawthorne, Victoria: Label and address holder.
30003—27th—Ford, A. C., Christchurch: Oil drum or can.
30004—27th—Scott, G., Halswell. Injecting into cow's udder.
30005—28th—Aspinall, H. W., and Rigby, E. J., Melbourne Supplying water to rock drill.
30006—28th—Hughes, W. E., Wellington; Hinds, H. H; Lewis, G. J., Sydney; Grass, H., Broadford, Victoria Laying poison by hand
30007—28th—Regenerated Cold Air Co., Boston, U.S.A. Treating air.
30008—28th—Lamkin, C. J., Ngahauranga, and Croll, C H G, and Mitchell, A. S., Wellington: Producer gas generator.
30009—28th—Ashton, W. T., Makotuku Planing machine
30010—28th—Kitchen, T., Sydney: Overdoor.
30011—29th—Orr, L. A., Hukanui. Cycle drawing gear
30012—23rd—Rash, C., Invercargill, and Cameron, E A. Travelling race for sheep.
30013—30th—Lowe, G. I., Palmerston North: Bicycle pump.
30014—30th—Mail J S; Stanton, W. J.; Storrie, P H, Wellington Folding chain.
30015—25th—Allan, A. I. W., and McCullough, W Thames Gold-saving table.
30016—28th—Connell, J., Timaru. Hill climbing attachment to foot
30017—30th—Hall, R E., Port Levey, N.Z.. Gate fastener
30018—30th—Ellen, J, Staveley: Feeding bottle protector
30019—30th—Charlton, J. R., Christchurch Preventing horse from kicking.

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 main building of the Christchurch International Exhibition is to be of two stories and 850 feet long by 90 feet wide, and the facade fronting the river 34 feet high with a central feature and two towers 120 feet high