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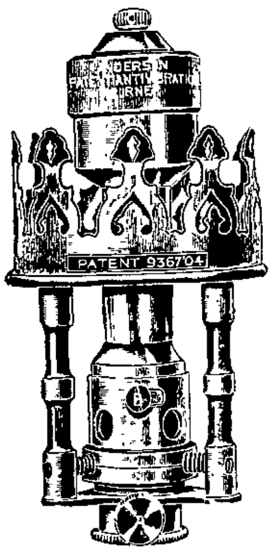

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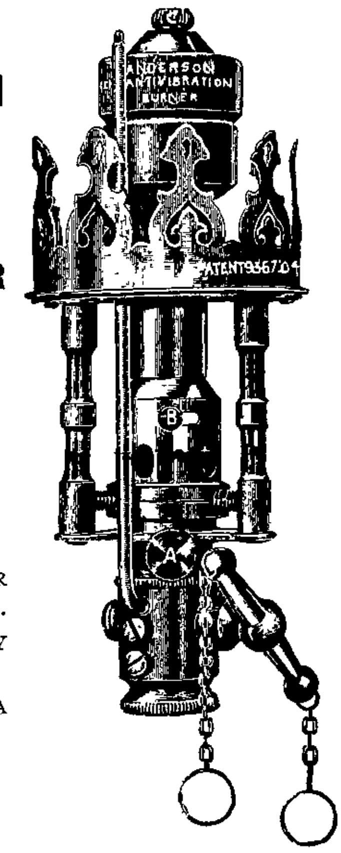

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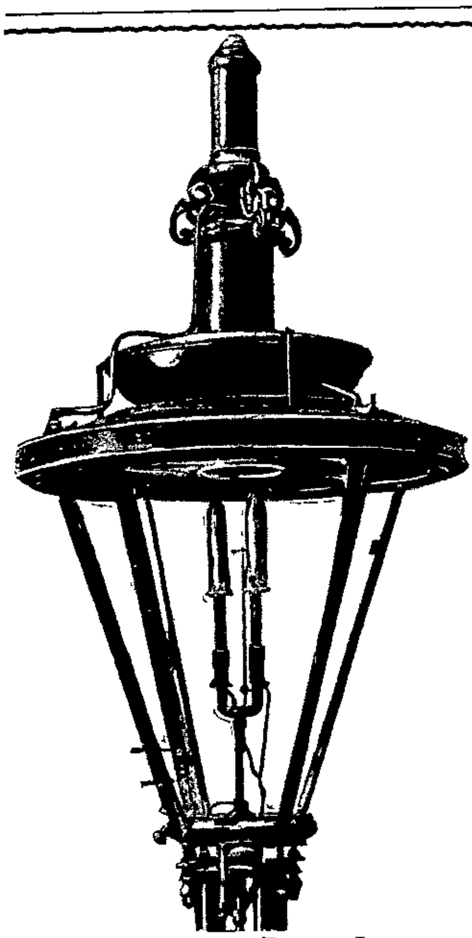
Type of Double Burner Lamp. 1,200 c.p. Consumes 28ft. per hour.

SCOTT SNELL HIGH PRESSURE GAS LAMP

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WE AVOID Expense of Special Service. Increased Leakage Losses. Expenditure for Power. Cost of upkeep of Compressing Plant. Dependence of whole service on working of Power Actuated Pumps, and various minor drawbacks.

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Specification—These Lamps are constructed with detachable reservoirs and cylinders, making any part replaceable in a few minutes. Adjustment is much simplified. Working parts operate on knife edges. Weight considerably reduced. Working parts may be removed and replaced by spare section, and an examination or re-adjustment made at leisure.

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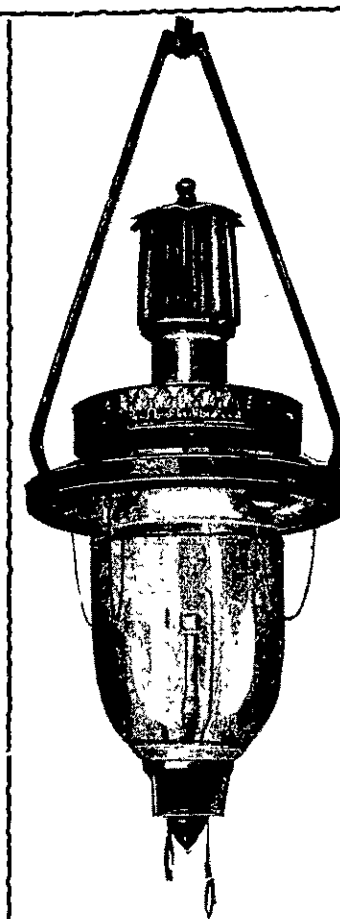
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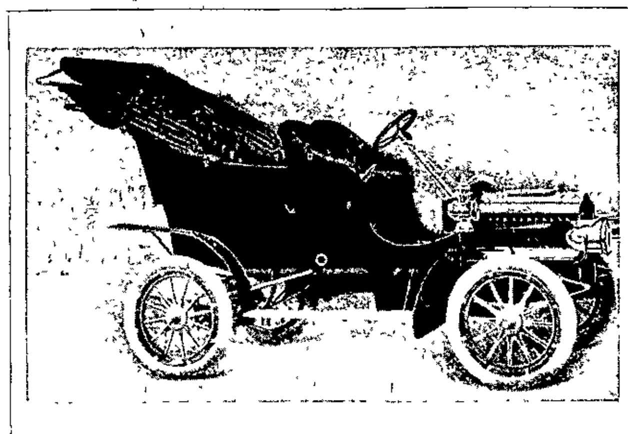

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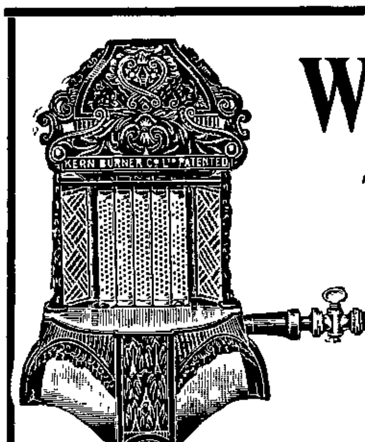

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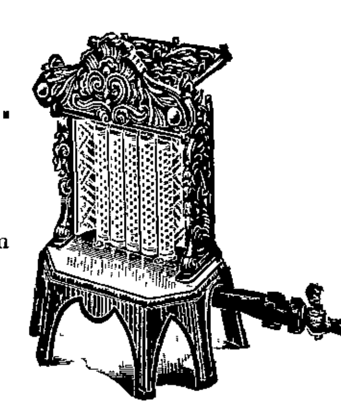

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THE SCIENTIFIC NEW ZEALANDER.

VOL. I.—No. 10. MONTHLY.] WELLINGTON, N.Z., AUGUST 1, 1906. [PRICE: 6d Per Copy; 6/6 Per Annum posted, or in advance 5/-

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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.

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EDITORIAL COMMENT.

New Mail Contract.

DETAILS of the new mail contract, recently ratified by the Commonwealth Government, must be so well known to PROGRESS readers as not to require any expression of detail here. That there has been a considerable amount of political "wire-pulling" (which is apparently inseparable from "good" Government) in the completion of this great contract is beyond question, for in the first place the contractors and suppliers of the new ships have no reputation outside of the building of tramp steamers. A few exceptions may be mentioned in small vessels like the Bombala, Riverina and Westralia—ships well enough known to many New Zealanders—but to compare, in point of capability, a North of England firm like the Laings (which only builds ships, and not the engines) with such Clyde builders as the Fairfield Co., of Govan, and Caird & Co, of Greenock, both of which have supplied the majority of the ships that have made the Australian Mail Line famous for the past twenty years, is not only absurd, but is calculated to prove the means of engendering very serious doubts as to the future efficient carrying-out of the great contract. In extension of our views we only have to quote the remarks made regarding the new contract by Mr. John Paxton, of Sydney, who is one of the best-known authorities on shipping affairs in the colonies. Mr. Paxton is right when he said that "the Commonwealth Government do not seem to realise the tremendous undertaking before them," for the terms of the contract require that vessels are to be employed that would be twice the size of the magnificent ships Mongolia and Marmora, of the P. & O. Co As a matter of fact the total number of steamers afloat at the present time that would approach this size is about four; therefore, any such sum as £400,000, set aside in the contract for the building of each vessel, is totally inadequate. Thus, in order to bring the proposed nine new ships up to the standard of efficiency of the P. & O. Co.'s vessels, it will take a sum in excess of £900,000 over and above the amount that it is proposed to expend on the lot. Mr. Paxton further states that "the precise sum depends upon the fittings and the machinery, and this is the point which the Commonwealth Government have not considered." We cannot but concur with Mr. Paxton in that, although the contract looks genuine on the face of it, there is a feeling that something has not yet been disclosed, not perhaps necessarily on the part of the Commonwealth Government, or actually on the side of the contractors; while the agreement looks uncommonly like one which, to use a shipping term, has been entered into chiefly to "beer" money. In the present instance the contract is so one-sidely in favour of the Commonwealth that the utmost care requires to be taken to safeguard against the possibility of a loophole of escape for the contractors. The mere deposit of £2,500 in cash, and a guarantee of a further sum of £25,000, although representing substantial sums of money, does not by any means indicate the amount of security called for under the agreement, because the option of a ten years' mail contract carrying a subsidy of £125,000 per year for a sum of £27,500 is one which hundreds of investors, in the Old Country and in Australia, would be glad to take an interest in with a view to untimately disposing of the contract at a handsome premium to someone else. Perhaps this is an aspect of the business with which the Commonwealth Government is not particularly familiar, and in any case we cannot do more than come to an opinion that the new contract, if it is really to be an improvement on the old order of things, is highly desirable for the Commonwealth, but need not be considered seriously by New Zealanders, for after the new mail vessels have called at all the chief ports in Australia, with the terminal at Brisbane, we would have nothing to gain on our arrangements with Spreckels and the direct liners. Then again, the opening of the Panama route, in 1914, will prove an event of the greatest significance to this colony. With either Auckland or Wellington as the first or last port of call, we shall have a route but three-quarters of the distance of the present Brindisi itinerary, and indubitably one of the best opportunities for steam communication in the world. We are gratified to learn that the P. & O. Co. is to alternate with the Laing vessels in the new regulations, and, also, that the conditions of the P. & O. Co.'s running are fixed by the Imperial Government, so that that established system of mail transit is not likely to be subjected to the risk that usually characterises the carrying-out of an original and experimental venture of the magnitude of the new Australian Royal Mail Line.

The Exhibition.

SPLENDID progress is being made with the construction of the Exhibition buildings, and everything seems to be well advanced in connection with the arrangements made for accommodating the large number of visitors expected at the opening of the Exhibition in November.

In the latest weekly progress report issued by the Commissioners we observe that the routine work is satisfactorily proceeding, but we particularly note that at a recent meeting of the Agricultural and Pastoral Committee of the Exhibition it was decided that an award of fifty pounds (£50), first, and twenty pounds (£20), second, be given for the best collective exhibit, comprising the best display of wool in grease, representing the principal breeds of sheep in this colony. These prizes to be limited to district displays. Further prizes of twenty pounds (£20), first, and ten pounds (£10), second, will be given to the best individual exhibit of wool, grown and shown by the exhibitor himself. Medals and certificates of exhibits will also be given for all descriptions of cereals. It has been arranged so that next season's wool will be available for the Exhibition to receive wool exhibits up to the 15th. December next. Special applications for space for wool exhibits will be received at any time now, and will probably close about the 1st. of November. Another item of interest is found in the notification that advice has been received from the Hon. the Minister in charge of the Exhibition, authorising the expenditure of five hundred pounds (£500) in connection with the Natural History Committee's request. A meeting of the Committee will shortly be held to make all arrangements in connection with this section.

IMPORTANT ANNOUNCEMENT.

OUR readers throughout Australasia are notified that the first of a series of articles, under the editorship of

FRANK T. BULLEN

will appear in September issue of PROGRESS, on the

PROGRESS OF NEW ZEALAND'S MERCANTILE MARINE.

Mr. Bullen's highly interesting preface will traverse the earliest attempts made by New Zealand to establish a trans-oceanic service, together with reminiscences of our Home shipping.

The U.S.S. Co., Northern S.S. Co., Huddart Parker Co., N.Z. Shipping Co., Shaw, Savill and Albion Co., etc. will assist us with illustrations of some of the earliest and newest vessels trading to the colony.

Order September PROGRESS early.

Paragrams.

Surinham, in Dutch Guiana, has the smallest range of temperature of any place in the world. In summer the average is 78 degrees, and in winter 77½ degrees.

* * * * * *

The total immigrants to Canada during the financial year just ended numbered 175,000—the largest on record, and 20 per cent. in excess of the previous year's total.

* * * * * *

A first-class battleship, which costs over a million to build and fit out, takes upon an average three years to construct, and nearly as long to pull to pieces, after being thirteen years or more in active service.

* * * * * *

Metal does not rust in Lake Titicaca, South America. A chain, an anchor, or any article of iron, if thrown in this lake and allowed to remain for weeks or months, is as bright when taken up as when it came fresh from the foundry.

* * * * * *

The empirics are still curing sea sickness, and the world is still poorly when it ventures on the wave. Those who collect these remedies will be interested to hear of another invention for the purpose. It is a steel cap, heated by electricity, to be applied to the head, and is the invention of a gentleman who bears the appropriate name of Herr Kappmeier, of Alsklosta. The idea is to correct the anæmia of the brain which is assumed to be the cause of sea sickness.

* * * * * *

Recent figures give the June U.S. output of anthracite and coke pig iron at 1,936,000 tons, which is at the rate of 23,232,000 tons a year, and is the highest record for any one month's production. In 1903, the year of the previous maximum output, the anthracite and coke pig iron production for the first three months was 4,453,873 tons, while for the same three months this year it has been 5,309,500 tons. The output for the first three months of 1904 was only 67 per cent. of the current figure.

* * * * * *

It has been shown by recent experiments that the power of germination with plant seeds is not destroyed, but only suspended, by extreme cold. It is impossible to produce any more intense cold than that obtained from liquid air. Seeds of barley, cucumbers, peas, sunflower, and some other plants have been kept in liquid air 110 hours. When taken out and carefully and slowly thawed for fifty hours, and planted, they have sprouted as well as if they had never been frozen. Life had merely been suspended suddenly, locked up within its material investment before there could be a possibility of the least entrance of decomposition.

* * * * * *

The Wellington Harbour Board has accepted the tender of Palmer and Co., of Wellington (representing Rice and Co., of Leeds), at £525, for its new hydraulic accumulator. The amount includes duty. The other tenders which the board considered were from Richardson and Blair (Glenfield and Kennedy, Ltd., Kilmarnock), £542 17s. 6d.; Riley and Holmes (Armstrong, Whitworth, Newcastle-on-Tyne), £585; Greenshields and Co. (Fullerton, Hodgart, and Barclay, Ltd., Paisley), £635. In each of these cases the tenderers included the duty. Informal tenders were sent by A. and T. Burt, Ltd., and the Sydney Hydraulic Engineering Company.

* * * * * *

Two miles from Kamakura, and about 20 from Yokohama, in Japan, on a terrace near the temple, sits the most gigantic idol in the world. It is the brazen image of a deity, and dates from the reign of the Emperor Shomu, who died A.D. 748. The dimensions of the idol are colossal. His height, from the base of the lotus flower upon which he sits, to the top of his head, is 63½ ft. The face is 16 ft. in length and 9½ ft. wide, the eyes are 3 ft. 9 in. from corner to corner, the eyebrows 5½ ft., and the ears 8½ ft. The chest is 20 ft. in depth, and the middle finger is exactly 5 ft. long. The 56 leaves of the lotus throne are each 10 ft. long and 6 ft. wide.

* * * * * *

An interesting subject is the speed of different animals, and recent statistics have been given by an expert who has been making experiments. The Russian wolf-hound's speed, it seems, is 75 ft. a second, while the gazelle attains 80 ft. a second. Aided by its wings, the ostrich is the fastest runner, sometimes making 98 ft. a second, an enormous speed. In measured flights, the Virginia rainpiper has a record of 7500 yds. a minute, and the European swallow has exceeded 8000 yds. The slowest creatures are snails and certain beetles—a healthy snail's speed being 5½ in. an hour. For fractions of a second certain very small creatures have almost incredible speeds, a mouse of the African desert jumping 10 ft. at the rate of 800 ft. a second, while the common flea jumps with an initial velocity of 850 ft., or 10 miles a minute

* * * * * *

The new rail motor car introduced by the London and North-Western Railway to provide an accelerated service on the lines between Walsall and Lichfield, and Walsall and Rugely, is pronounced successful in every way. The vehicle consists of a single long car with seating capacity for about four dozen passengers. The vehicle consists of a single long car with seating for about four dozen passengers. The car is propelled by steam power, and the engine is capable of being regulated from either end, so that the driver has always a clear and uninterrupted view of the signals. The car is divided into two large compartments, one being for smokers, and there is also accommodation for luggage.

* * * * * *

Satisfactory progress has been made with the construction of the immense buildings in Hagley Park, Christchurch, which are to accommodate exhibits and otherwise provide for the innumerable demands made on an International Exhibition. The whole of the ground floor in the main building is about completed, and will be ready for exhibits early in October.

The Machinery Hall is to be finished well within the contract time, if the Railway Department does not delay it in running its line of rails into the large bay set apart for the purpose on the northern side. Two bays of the Machinery Hall have been covered with roofing iron, and a start has been made in placing Stuccolin on the front of the building.

* * * * * *

The splendid revenue received by the State of Victoria for the year ending 30th June, 1906, is the highest reached in its history, making allowance for the share now retained by the Commonwealth. In 1888-9, when the land boom was at its height, the Victorian revenue reached the figure of £8,731,255, and the revenue of the past year, £7,797,626—added to the sum now retained by the Commonwealth to carry out its services, £1,196,439—makes a total of £8,994,065, or £162,810 more than that of the boom year. The lowest revenue since 1888-9 was in 1895-6, when it fell to £6,485,682, and it has since gradually risen, until reaching the magnificent result of the year just closed.

* * * * * *

How many persons (asks a London paper) would not hail with the delight the discovery of a safe, pleasant and easily procurable remedy for indigestion? Such a remedy is recommended in the correspondence columns of the *Lancet* by no less an authority than Dr. Francis T. Bond. "The indigestion must be a very hopeless one," says Dr. Bond, "which will not yield to a diet of a small cup of warm milk to which a teaspoonful of rum has been added, followed by a plain biscuit or two and some very mild cheese, paradoxical as this combination may seem." The marriage of rum and milk, according to the doctor, like all well assorted unions, brings out the good qualities of both parties to the alliance, and, taken wisely and not too well, he is of opinion that they form a happy combination of stimulant and nutriment much superior to many widely advertised pick-me-ups.

* * * * * *

The discovery has been made that the railway tunnel, which has been constructed under the river between New York and Brooklyn, is for 1200 ft. too small to allow of the passage of the trains. The cost of the work has been over £2,000,000. The trouble is attributed partly to cracked steel plates put into the work at an early stage, and partly to inefficient supervision. The prime reason for the trouble undoubtedly is that the top of the steel tube has been crushed in by the pressure of earth and water, causing the sides to bulge out, and in places making the tunnel just one foot too low to accommodate a train. It is not disputed that the most serious blunders have been committed, and it is hardly likely now that the tunnel will be fit for service until 1909. Some experts, indeed, say that a large portion of the bore must be rebuilt.

* * * * * *

There is probably no branch of organised manufacture which demands such precision of workmanship as is required in the production of the best photographic lenses. The bricklayer and the tailor (says *Photography*) are proud of working within an eighth of an inch, the cabinetworker of working to a hundredth, the machinist deals in thousandths, the watchmaker in ten thousandths but the photographic lens maker works in hundred thousandths of an inch every day until he forgets the remarkable character of this performance, for it becomes instinctive. And while this accuracy is necessary fr the production of the best lenses, and any failure to realise it results in a defective instrument, it is likewise true that in the designing of lenses, also in the preparation of the materials, experimental investigation and mathematical reasoning are called for to an extent no less remarkable and rare in manufacturing industries.

* * * * * *

Enquiries made of the N.Z. Department of Labour go to show that at present the man who is practically sure of a job is the experienced navvy who is not afraid of what is colloquially known as "graft" Such a one, it appears, is in request; municipal and public works generally (particularly in Wellington), are providing a wide field of labour for the man with the pick and shovel, and the prospect is that the present state of things is likely to continue. Incidentally it is gathered that the electrical engineer has become somewhat of a drug on the market. Apparently he has gathered in the Old Country that New Zealand is busily engaged in illuminating and propelling itself by means of electricity, and he has come out here to offer his services in the process. Now he finds that he is not in such demand as he thought, and he is looking eagerly for that which he thought would be thrust upon him. It may be added that the man who desires clerical or light employment need not apply.

* * * * * *

The success of rail-motor services on many hitherto unremunerative railway branch lines has brought to the front the possibility of re-opening abandoned lines to be worked on the new method. The Great Western Railway have been asked to establish a motor service on the Whimsey branch, between Mitcheldean Road station and Cinderford. The Whimsey line was constructed some years ago by a company, which, finding they had not enough capital to work it successfully, sold it to the Great Western Railway in expectation that they would work it, but they decided to keep it closed. The Great Western Railway have replied to the petitioners that they are afraid that the possibility of getting a reasonable return for such service is not such as would justify the heavy capital expense that would be involved, and as the population served only numbers about 9,000 people, the caution of the railway in the matter appears perfectly justifiable.

* * * * * *

Some interesting statements have been made by a medical man in Hong Kong in respect to Chinese surgery. Alluding to a distinction between internal and external medicine, the external medicine being what we call surgery, he referred to the fact that several hundred years before the birth of Christ there was an eminent Chinese surgeon who believed in extensive operations and amputations, but he was almost alone, as no one else ever attempted even to cut off a finger. Describing the chief aims of the native doctor in surgery at the present time, he said that they are skilled in the use of the needle and counter irritation, the latter including what is ordinarily termed massage, and burning of the flesh. He had himself seen children treated by this burning process for diseases of the stomach. Commenting on the deplorable ignorance of anatomy among the Chinese, he affirmed that they have an idea that the heart and the stomach are connected, and that the epigastrium is the seat of thought. They also imagine that the gall bladder is the seat of boldness, and that all schemes originate from it.

* * * * * *

The Central Council of the Employers' Federations of Australia has discovered a peculiar situation in regard to the registration of workers' trade marks—that is, the union label under the Trade Marks Act. The Minister for Customs has received a letter from the council, in which it is stated that a serious situation has arisen. The council intended opposing the registration of any such label on constitutional grounds, and sought legal advice on the matter. The council had learned that this proposed objection had been provided against, applications for such registration being kept secret, instead of being gazetted in same way as applications for ordinary trade marks have to be. In the case of application for registration of a regular trade mark it has to be announced in the *Gazette*, and any opponent of an applicant may oppose the granting of it. Under the new Act, all that an applicant for a trade union mark need do is to file an application, which is examined and entered upon a special register without gazetting. The council's adviser, writing on the subject to the Minister, asks—"If a trade mark can be registered by stealth may it not be tainted with suspicion?"

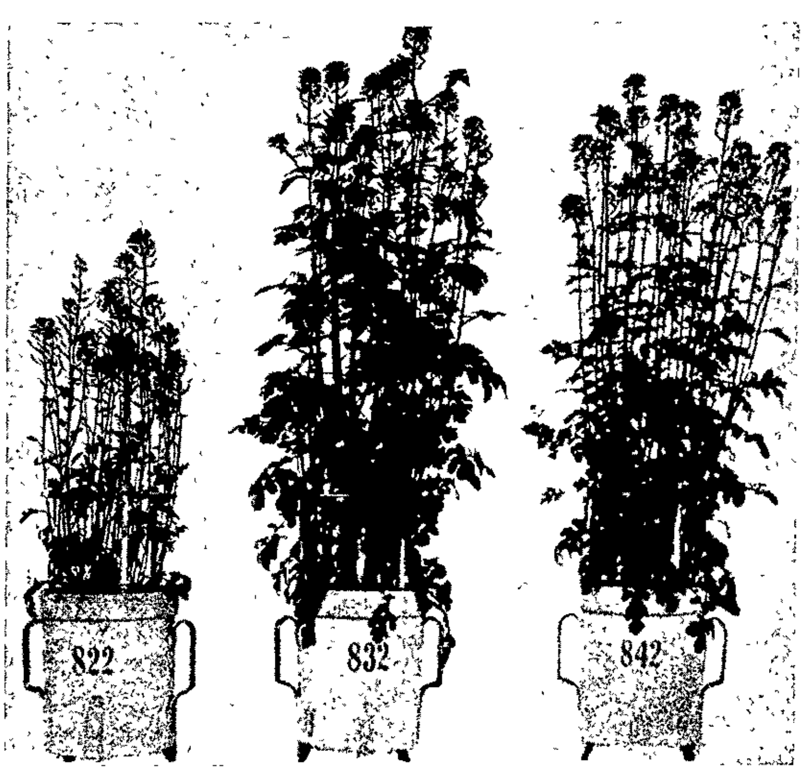
Chemistry and the World's Food.

By ROBERT KENNEDY DUNCAN.

PROFESSOR ADOLPH FRANK,
THE DISCOVERER OF CALCIUM CYANAMIDE.

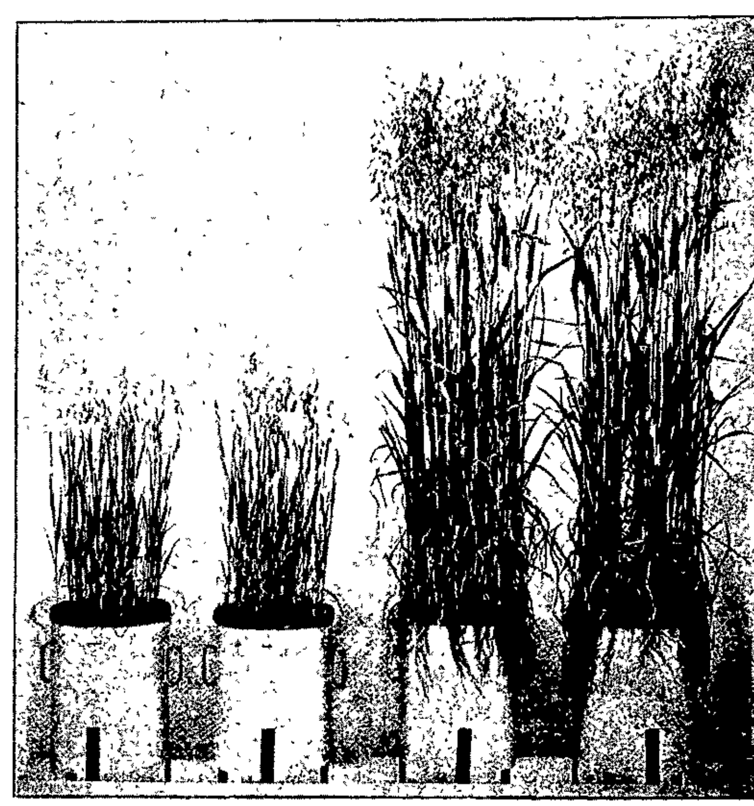
The Fixation of Nitrogen.

THE romantic deportment of the nitrogen atom is fascinatingly interesting to the student of chemistry. Wherever he looks he sees that the living, moving, doing thing in the world is nitrogen; it is at once the most restless and the most powerful of the elements. When nitrogen enters into a collocation of atoms we invariably expect the collocation to do something active, whether good or ill; for the nitrogen compounds have properties and qualities they are never inert



A. B C.

AN EXPERIMENT WITH MUSTARD.
(A) WITHOUT FERTILISER; (B) FERTILISED WITH AMMONIUM SULPHATE; (C) FERTILISED WITH KALKSTICKSTOFF.



A. B.

DEMONSTRATION WITH OATS.
(A) WITHOUT FERTILISER; (B) FERTILISED WITH AMMONIUM SULPHATE.

So it is that, entering into combination with a few other atoms, it will yield us the most delicate and delicious of perfumes, while it is equally ready to join forces with others to produce substances whose smell of utter vileness has the psychological effect of causing the experimenter to "wish he was dead." In the aniline dyes it enhances our clothing with a thousand beautiful colours, and in still another thousand forms it enters the chambers of the sick in the healing guise of all the synthetic medicines. It lurks in prussic acid, the ptomaines, and a host of deadliest poisons; it drives our bullets in the form of gunpowder; it explodes our mines as dynamite and guncotton; it dissolves our metals as nitric acid; it extracts our gold as cyanide; and in an infinity of ways it menaces or ministers to mankind. Nitrogen-containing substances, then, are active substances, and their activity seems to be due to a certain "temperamental nervousness" of the nitrogen atom which sends it flying on the slightest pretext from one atomic community to another. On this account we call nitrogen a "labile" element.

But it is only when we consider nitrogen in its relation to life that we see how truly momentous is this fact of its lability. We have been accustomed in the past to ascribe to carbon the role of life element paramount, but the more the question is studied, the more does it appear evident that the carbon constituent of the body is the mere brick and mortar of it, good enough to constitute its physical substratum, and good enough, too, to burn as fats and carbohydrates to maintain its fires, but that the working, building, "vital" thing, the thing that is the moving-spring of protoplasm and that brings about the continuous adjustment of internal to external conditions that we call life, is the versatile, restless nitrogen.

It looks as though the living being constituted a vast unstable plasma in which the nitrogen atom, with oxygen on the one hand and carbon or hydrogen on the other, very much as it is in nitro-glycerine, swings the atoms of the living body through all the multiplex atomic relations of growth and decay. The lability of living substance is the lability of the nitrogen atom, and we may say, with much more propriety than "Ohne Phosphor kein Gedanke," "Ohne Stickstoff kein Leben"—no life without nitrogen.

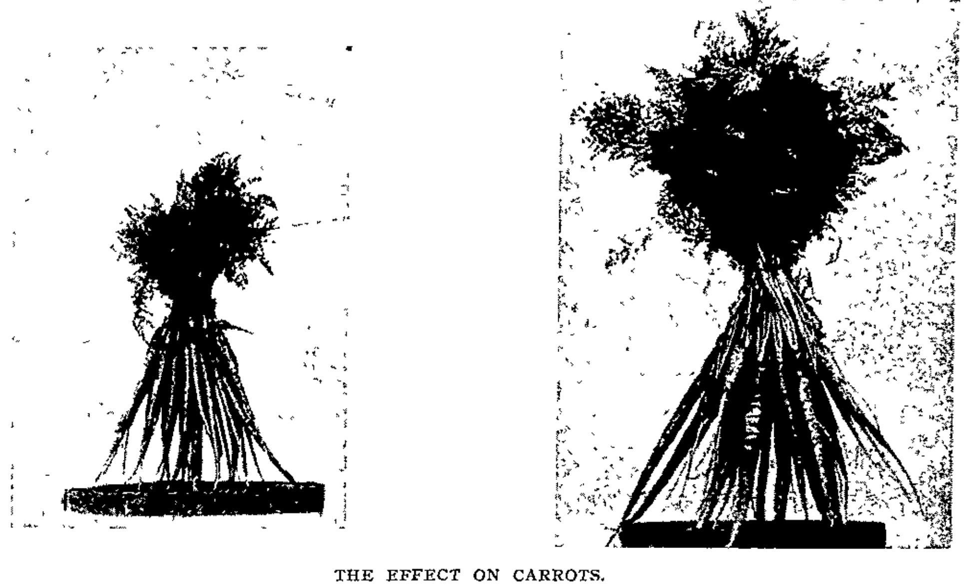
And yet—and this is a most interesting thing—this nitrogen, which when combined with elements of another kind is so energetic and so useful, is, in its care-free, solitary condition, a stubborn lazy, inert gas. In this the elemental conditions it is one of the most abundant and pervading bodies on the face of the earth. It constitutes four-fifths of the air that blows in our faces, and so much of it there is that every square yard of earth's surface has pressing down upon it nearly seven tons of atmospheric nitrogen.

Chemically speaking, it is all but unalterable, though the "all but" is vastly important to us.

One or two metals, such as calcium and magnesium and a few compounds of metals, may be made to unite with it. We find, too, that certain organisms, bacteria—"nitrifying microbes" they are called—have within their little bodies laboratories for attaching nitrogen to other elements, though the mechanism of this action no man understands.

Still, again, we find that the lightning flash will cause the nitrogen and oxygen of the air to combine in the path of its streak to form nitrous acid, or that it will cause the nitrogen and water vapour to react to form ammonia. Outside, however, of the minute quantities which are extracted from the air in these various ways, the whole great ocean of atmospheric nitrogen under which we live and move maintains, in a chemical sense, a listless, useless lethargy.

Now, nitrogen which is united with other elements (it matters very little which) and which is so temperamentally nervous and active and useful we call "fixed" nitrogen, while the nitrogen which exists in the elemental lethargic condition of the nitrogen of the air we call "free" nitrogen, and the object of this paper is to present the various modern attempts to solve the problem of transforming



THE EFFECT ON CARROTS.
GROWN WITHOUT FERTILISER. FERTILISED WITH KALKSTICKSTOFF.

in large quantities the free and useless nitrogen into the fixed and useful kind. This problem is of immense importance to the whole world—to every race, to every human being—for as a matter of hard, cruel fact we either must solve this problem or starve. This statement is a most unlikeable one, for it is sensational and alarmist, but how true, it is easy to show.

The invaluable "fixed" nitrogen which we have within us, and which we are continuously using up, we must continually restore. In order to do this we eat it. We eat it in the form of animal food or of certain plant products, such as wheaten bread. But plants and animals, too, depend upon the soil for every trace of the nitrogen they contain, and the soil in its turn has won it from the reluctant air through the slow accumulations of the washing rain, from the lightnings of a million storms, or through slow transformations by billions of nitrifying organisms through what, so far as we are concerned, is infinite time. Not only so, but the valuable nitrogen-containing substances we employ in our civilisation are in the same parlous position of depending upon the soil. Every cannon-shot disperses in an instant the fixed nitrogen which it required millions of microbes centuries to accumulate. We filch this nitrogen from the soil immensely faster than it is restored by natural processes, and the land grows sick and barren and refuses to grow our crops. Everybody knows what we must do to cure the land; we must use manure or fertiliser. In other words, we must mix with the soil substances containing fixed nitrogen which the plant may utilise in building up what we must and will have—bread and meat, to say nothing of other substances such as gunpowder and dyes and medicines. In the olden time natural manure was sufficient to meet the demands of sparse populations accustomed to poor food and little of it; but in these days of rapidly multiplying civilised man, who requires more food and better food, particularly wheaten bread, the natural manure of the world is a mere drop in the bucket of his wants; and this would be true even if he could utilise the fixed nitrogen of the sewage and drainage of his towns, which, it is horrifying to learn, England alone hurries down her water-courses to the sea to the value of £16,000,000 a year.

As a matter of fact we were long ago forced to the employment of three other fertilisers. The first of these was Peruvian guano. This substance was produced from the excrements and remains of sea-birds deposited in a very arid region. It contained fixed nitrogen in the form of about twenty per cent. of ammonia. We say the first "was" guano, for while in 1856 the year's sale amounted to 50,000 tons, to-day it is practically nothing at all. We have eaten it up.

The second fertiliser is ammonium sulphate. This is obtained as a by-product in the distillation of coal-tar in the manufacture of coke. In 1900 the world's production of ammonium sulphate was 500,000 tons, worth some £4,000,000. But this amount is a fixed quantity; we may have so much and no more from our coal-tar distilleries, and large as the amount seems, it is inadequate to supply the one-hundredth of the imperious and increasing demands of our Mother Earth.

There is actually but one substance, the third, possible of being used on a world-wide scale as a nitrogenous manure. This is nitrate of soda, or, as it is called Chili saltpetre. It occurs native over a narrow band of land between the Andes and the coast hills, a rainless district, where for countless ages the continuous fixation of atmospheric nitrogen by the soil, its conversion into nitrate by nitrifying organisms, its combination with soda, and the crystallisation of the nitrate have been steadily proceeding against the time when, as now, earth's increasing family would insistently demand it for bread. In order to drive home to the reader the validity of the statement we are about to make, let us examine the pay roll of the years. The Chili saltpetre beds yielded in 1860, 68,500 tons; in 1870, 182,000 tons, in 1880, 225 000 tons; in 1890, 1,025,000 tons; in 1900, 1,453,000 tons; and since 1900 every year has added 50,000 tons to the demand of the year before.

The amount yielded in 1900—1,453,000 tons—was sold for £5,000,000, one-quarter of it passing into the thousands of nitrogen compounds used in our civilisation, and the other three-quarters into food through its fertilising action in agriculture.

European and American agriculture and a hundred varied kinds of industry are thus wholly and implicitly dependent upon a tiny little strip of land in a South American republic, and upon the grace of the "Nitre Kings" who own it; and were the little republic to close her gates of export, hungry months and insurrections would follow as infallibly as the night the day. This is, of course, embarrassing and highly significant of the inter-depending conditions of our civilisation; but when we begin to estimate the amount of nitre taken out and the amount still remaining in the beds, and compare this amount with the crescendo ratio of the world's demand, we are more than philosophically interested—we are practically frightened. We see that what has happened to guano will inevitably happen to saltpetre. It is a matter of plain, hard cold-drawn fact, as everybody now knows who knows anything about the Chili saltpetre beds and the needs of agriculture, that these saltpetre beds will not last longer than twenty years, if present conditions continue. About the year 1925, then, there will be no more nitre; and a year or two after that, or before it, famine will stalk on the lands of civilised men. This is acknowledgedly true if present conditions continue.

But the phrase, "if present conditions continue", contains the crux of the whole matter. Why should they continue? We have in the enveloping air an immense and inexhaustible supply of nitrogen—33,880 tons of it upon every acre of land. This is "free" nitrogen and the world demands it "fixed." If man must fix the wandering air into his own bodily substance and into substances that are the implements of his advancement, he will so fix it, and within the quarter of a century which is his margin. Let us see how far we have progressed. In attacking this problem, man of necessity and convenience imitated nature. If the cosmic processes were too slow, it was for man to hasten them.

If there exist certain little organisms capable of fixing atmospheric nitrogen, why not favour them, breed them, multiply them to our needs? It was discovered by Hellriegel that certain leguminous plants, such as clover, beans, and peas, have near the base of their stalks little nodosities, little pimples, which turned out to be veritable colonies or cities of nitrifying microbes. These interesting microbes on every pea plant, for mere board wages, work full time in turning over the useless atmospheric nitrogen to the plant in a

NITROGEN-INOCULATION EXPERIMENTS IN NEW ZEALAND.

BROAD BEANS SHOWING DEVELOPMENT OF NODULES ON THE ROOTS, DUE TO INOCULATION OF THE SEED.

BROAD BEANS (UNINOCULATED) SHOWING COMPARATIVE ABSENCE OF NODULES.

fixed and useful form. Furthermore, it was discovered that soil inoculated with such microbes would grow these plants even when innocent of any trace of manurial nitrogen. The deduction is obvious. Why should we not blossom the desert with clover or peas, and thereafter plough the plants into the ground to afford manure for a succeeding crop of wheat.

In 1896 Nobbe and Hiltner produced this microbe in a commercial portable form under the name of "Nitragin." The experiment failed, as nearly all first experiments fail. The bacteria died, and, as it subsequently appeared, probably for want of suitable food, and possibly, too, from injuries suffered by secretions from the seed itself in the early stages of germination.

But to know the cause of failure was to succeed. They now supply this necessary nourishment in in the form of grape sugar and peptones added to the water in which they are distributed for spreading upon the soil. Their measure of success has been so great that we find to-day several manufacturers perfecting the method and establishing their processes for the wholesale production of nitrifying microbes. Another method has been ascribed to Professor G. Moore, of the United States Department of Agriculture. He has sent out to the farmers of the country the dried germs packed in cotton. With them go two packages containing the food upon which they are to multiply when placed in water—one containing granulated sugar, potassium phosphate, and magnesium sulphate, and the other ammonium phosphate.

The microbes when placed in the solution of these substances multiply with prodigious rapidity and serve to inoculate either the seed or the soil.

But there are many other nitrifying microbes besides those concerned with leguminous plants—dozens of tribes and hundreds of species, and investigation is to-day feverishly busy with them. We have every reason to believe that by multiplying nitrifying organisms alone, we should be able, in some measure at least, to restore to the soil the fertilising nitrogen which in the past we have wilfully and extravagantly wasted.

We have said that the lightning bolt burns the air in its path into oxides of nitrogen which, when washed by the rain into the soil, quickly become fixed into nitrates. We have learned to harness the lightning and why should we not, therefore, imitate nature in this respect as well, and utilise the combining efficiency of the electric spark, and burn the air to make our daily bread?

Over a hundred years ago the masterly Cavendish showed that with the tiny electric sparks at his command this could actually be accomplished, and afterwards, by this very method, Lord Rayleigh burned the air to obtain the interesting argon hidden within it. In the powerful heat of the electric arc there is a combustible gas, and the only reason that this gas, when once ignited, has not spread through the surrounding atmosphere and deluged the world in a sea of nitric acid is the peculiar fact that its ignition point is above the temperature of its flame. It is not hot enough to set fire to the adjacent mixture.

(*To be continued.*)

Architecture and Building.

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

PROVINCIAL NOTES.

A substantial Nurse's Home has just been completed in Gisborne. Architect, A. Natusch.

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A residence has been erected in Feilding for Mr. Norman Gorton. Architect, C. Tilleard Natusch.

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A large building is being erected as soapworks, at Belfast, for Mr. Walcote Wood. Architect, F. J. Barlow; contractors, Soanes Bros.

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A residence in Hanson street, Wellington, for Mr. P. Wills, is in course of completion. Architect, J. Charlesworth; contractor, Richard White, Petone.

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The contract price for the erection of additions to "Rototawai," Featherston, is about £2,000. Architect, John S. Swan; contractor, W. Benton, Featherston.

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A four-storied brick and cement warehouse has just been erected in Lichfield street, Christchurch, for Messrs. Reynolds & Kinvig. Architect, F. J. Barlow; contractor, H. J. Otley.

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The Education Board, Wellington, have let a contract to Humphries Bros. for an Industrial School at Levin. The contract price of this building is £827. Architects, T. Turnbull & Son.

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A residence at the corner of Hill street and Golder's Hill is in course of erection for Mrs. F. Riddiford. The contract price of this building is £2,300. Architect, J. Charlesworth; contractor, A. J. Rand.

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A two-storied brick and cement shop is being erected in Colombo street, Sydenham, for Mr. W. Claxton. Architect, G. Gregory; contractors, Inglis & McLeod.

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Extensive additions and alterations are being carried out at the Poverty Bay Turf Club's course at a cost of £3,000. Architect, A. Natusch, contractors, Mackrell & Colley.

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A one-storied building, intended for two shops and to be known as Hulston's Buildings, is in course of erection in Madras street, Christchurch. Architect, G. Gregory; contractor, Jas. Greig.

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A picturesque residence of 14 rooms with a full complement of all up-to-date conveniences is being erected in Fitzherbert street, Palmerston North, for Mr. W. Hankins. Architect, C. Tilleard Natusch.

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Three workers' cottages are in course of erection for the New Zealand Government at Petone. The contract price for each of these cottages is £364 6s. 8d. Architect, J. Charlesworth; contractor, W. J. Barrie.

A very up-to-date residence is in course of completion for Captain Grey at Kelburne. The contract price of this building is about £1,300. Architect, James Bennie; contractors, Heaton & Jones.

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A two-storied brick shop and showrooms, with reinforced concrete foundations and concrete bands, is being erected next to the Masonic hotel, Gisborne. Architect, A. Natusch; contractors, Mackrell & Colley.

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The old White Swan hotel, in Tuam street, Christchurch, is being replaced by a modern two-storied building of brick with cement front. The contract price of this building is about £3,500. Architects, S. & A. Luttrell; contractor, C. H. Cox.

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The Waverley private hotel in Marion street, Wellington, has just been completed to the order of Messrs. Broadbent & Haworth, at a cost of about £2,000. The building has two floors and is built of brick and stucco. Architect, James Bennie; contractor, W. G. Rowntree.

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A two-storied brick and stone building, with an elaborately designed front, is being erected in Worcester street, Christchurch, for the Dunlop Tyre Co. It is understood that the front will be carved by H. Wilson, stone and wood carver, Christchurch. Architect, F. J. Barlow; contractors, Moore Bros.

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A contract has been signed for the erection of a four-floor brick and concrete warehouse in Victoria street, Wellington, for Messrs. Sargood, Son & Ewen. The architects estimate of £3,000 was the contract sum, and the building is expected to be completed about Christmas time. Architect, John S. Swan; contractor, John Wood.

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The new brick Sunday school designed by Mr. Clere and erected by Mr. George Garner for St. Thomas's parish, Wellington South, was formally dedicated recently by the Bishop of Wellington in the presence of a large congregation. The building has been designed to meet the double purpose of a Sunday school and parish hall. There are several class rooms and library, with a kitchen and other conveniences. The hall and gallery are capable of seating between five hundred and six hundred people.

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A two-storied building in brick and stucco is being erected in Queen street, Masterton, for J. L. Murray Esq. This is to be called the "Exchange Buildings," and the ground floor consists of three large shops with ante-shops, 9 ft. main entrance corridor, tea room of up-to-date dimensions, and three very large sample rooms. The first floor has a series of offices, strong-rooms, photo studio, and a very large meeting-room, etc., etc. The contract price for this building is about £8,000. Architect, James Bennie; contractor, John Hunter.

A substantial up-to-date brick building called the Denbigh hotel, of over 70 rooms, is being erected in Feilding. Architect, C. Tilleard Natusch; contractor, W. Wilkinson.

A new residence for Mr. Frank Moores, near Kai Iwi, Wanganui, is drawing rapidly towards completion. This residence has a frontage of 156 ft. with a fine 90 ft. colonnade of Ionic columns and entablature. It is built on the crest of a hill upon very solid concrete foundations, and contains a spacious and well-lighted billiard room. Architect, C. Tilleard Natusch.

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Good progress is being made with the Police Station additions in Hereford street, Christchurch. These consist of a substantial brick and stone building, to replace the old rooms erected in the early provincial days and which are now in a dilapidated and damaged condition. In the new building the ground floor will be occupied as offices, mess room, recreation room, etc., while the upstairs portion will form the single constables' quarters, and provide bed accommodation for thirty-six men. This, our correspondent states, will meet all emergencies and prove a great saving to the Department. Contractors, Hansford & Hughes.

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Messrs. Sanders Bros. have just completed the purchase, at £3,550, of one of the few remaining large blocks of vacant land in the centre of Wellington city. The land in question is in Ingestre street, and contains half an acre of level ground, being 132 ft. by 165 ft. It is the intention of the firm to erect thereon an up-to-date building-construction plant and joinery factory, the firm's present premises in Little Taranaki street having proved to be totally inadequate. The firm also recognises the importance of preparing for the advent of steel buildings, which mode of erection must be adopted if high buildings are required.

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Sourensen, the Danish builder of windmills, recently discovered, through accident, a form of windmill which tests show to develop more power than any other form heretofore tested. He had been running an old mill bearing ten wooden vanes. In a storm, four of these vanes were carried away, when, to the wonder of its proprietor, the old mill worked better than before. Inspired by this demonstration, he made some further experiments, and perfected a wind motor of conical form, having six vanes, the ends of which curved toward the summit of the cone. Prof. P. LaCour, who has established, by authority of the Danish Government, an observatory for the study of wind power, showed that the new conical aeromotor developed more power by nearly five per cent. than that of the "Ventocrat" type, whose surface is seven times as great; and thirty-one per cent. more than the "Rose of the Winds" type, with a surface three times as great; and twenty-nine per cent. more than that of the old Sourensen type. It is predicted that the discovery of this new form of wind engine will go far towards making wind power, which is now largely lost, available for general use.

Town Hall, Wellington.

The excellent picture, which we print on this month's cover, depicts the Wellington Town Hall, New Zealand's finest municipal building.

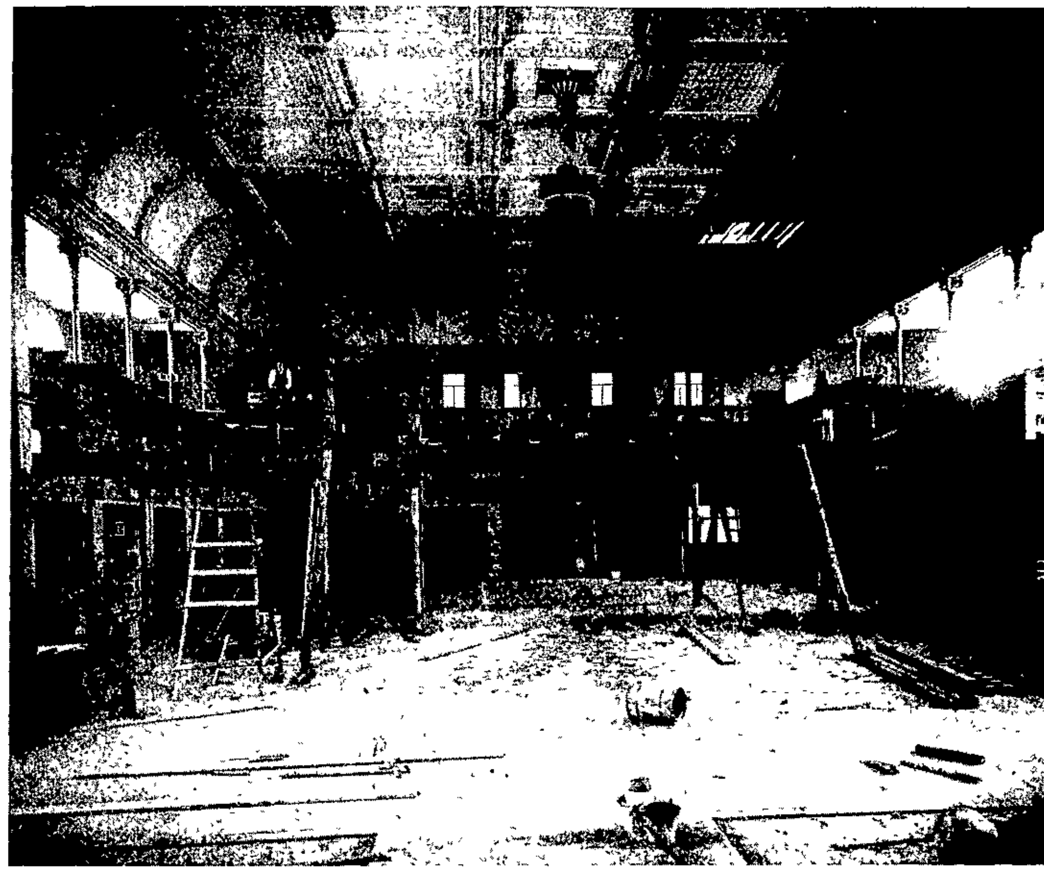
The architecture is Italian Renaissance and Corinthian, and the effect of these styles is imposing when viewed from an outside vantage point. Looking towards the building from the north the beholder is first impressed with the handsome main portico supported on its graceful Corinthian columns, and surmounted by the clock tower—209 ft. from ground to flagstaff truck. But the symmetrical proportions of the huge building are evident on all sides, while the embellishments on the pediments and superstructure generally form quite a feature in the external scheme. These are appropriately confined to allegorical groups and the civic symbolism of the city.

Entering the building at the main entrance in Cuba street, the visitor is at once delighted with the chasteness of pure white wall and ceiling; and, passing into the Great Hall—one of the largest in the Southern Hemisphere—he is fascinated by the sheer bigness of things. This chamber is 150 ft. long, 75 ft. wide, and 48 ft. high. It accommodates, without overcrowding, 3,000 people, and possesses acoustic properties of the first order. A continuous gallery, 10 ft. from the ground floor, encircles the hall, and seats quite half the fore-mentioned number. The colouring of ceiling and gallery balustrade constitutes, perhaps, an unnecessary expenditure, but, nevertheless, remains as pleasing to the eye as the artistic application of harmonious tints can procure. The organ, built by Norman & Beard, London, is one of the finest in the Australasian colonies, and cost upwards of £6,000. The design of the instrument is such as to enhance the architectural effect of the Great Hall.

Passing upstairs to the first floor, the visitor next inspects the Small Hall, 62 by 46 by 30 ft., an admirable little chamber for the average concert, and capable of seating 500 people. Herein are permanenly fixed a sloping stage, with a couple of contiguous ante-rooms, and modern devices for ensuring requisite warmth and ventilation. On this floor are also the Council Chamber and Mayor's Offices, besides the host of smaller rooms used in direct connection with the Council's work. In the Council Chamber a horseshoe table has been adopted in place of the inconvenient, oblong one of old. This idea brings about a considerable saving of time in despatching the business of the Council.

The provisions for escape in event of fire are quite commensurate with the detail bestowed upon the eye-pleasing qualities of the Town Hall. The building is fireproof and the exits are considered perfectly adequate in event of panic. The body of the Great Hall and the gallery have six egresses, all opening on to the main 10 ft. corridors to fire escapes. Of the latter there are two—one leading from the Great Hall into Mercer-street yard, the other into an interior area. Cloak rooms and conveniences for performers and public abound. Electricity is used for the lighting, and a system of ventilation is installed which militates against oppressiveness when the halls are crowded.

The contractors were Patterson, Martin and Hunter, and the price to date is close on £60,000, architect, J. Charlesworth; clerk of works, J. Short. Among the sub-contractors were the following:—furnishings, H. Feilder; ironwork, Crabtree & Sons (200 tons of steel girders and ironwork for balustrades); plumbing and heating, G. Snadden; plastering and tiling, T. Foley & Sons; painting, Jackson & Co.; electrical work, J. Dawson; zinc (Wunderlich), Briscoe & Co.; linoleums, etc., Kirkcaldie & Stains.



THE CANTERBURY HALL IN COURSE OF ALTERATION; WHEN FINISHED THE HALL WILL SEAT 250 IN ORCHESTRAL STALLS, 600 IN STALLS, 400 IN PIT, 350 IN DRESS CIRCLE—TOTAL, 1600.
[*Clarkson & Ballantyne, Architects.*

Principles of Ventilation.

By Alfred L. Hubbard, M.E.

The problem of maintaining air of a certain standard of purity in various buildings occupied is one of supreme importance, and stands in very close relation to the problem of heating.

The introduction of pure air can be done properly only in connection with some system of heating; and no system of heating is complete without a supply of pure air, depending in amount upon the kind of building and the purpose for which it is used.

Composition of the Atmosphere.

Atmospheric air is not a simple substance, but a mechanical mixture Oxygen and nitrogen, the principal constituents, are present in very nearly the proportion of one part of oxygen to four parts of nitrogen by weight. Carbonic-acid gas, the product of all combustion, exists in the proportion of 3 to 5 parts in 10,000 in the open country. The quantity of water present, in the form of vapour, varies greatly with the temperature, and the exposure of the air to open bodies of water. In addition to the above, there are generally present in variable but exceedingly small quantities, ammonia, sulphuretted hydrogen, sulphuric, sulphurous, nitric, and nitrous acids, floating organic and inorganic matter, and local impurities. Air also contains ozone, which is a peculiarly active form of oxygen; and in 1895 a hitherto unknown and exceedingly inert constitutent called "argon" was discovered.

Oxygen is one of the most important elements of the air, so far as both heating and ventilation are concerned. It is the active element in the chemical process of combustion, and also of a somewhat similar process which takes place in the respiration of human beings. Taken into the lungs, it acts upon the excess of carbon in the blood, and possibly upon other ingredients, forming chemical compounds which are thrown off in the act of respiration or breathing.

Nitrogen comprises the principal bulk of the atmosphere. It exists uniformly diffused with oxygen and carbonic-acid gas. This element is practically inert in all processes of combustion or respiration. It is not affected in composition, either by passing through a furnace during combustion, or through the lungs in the process of respiration. Its action is to render the oxygen less active, and to absorb some part of the heat produced by the process of oxidation.

Carbonic-acid gas is of itself only a neutral constituent of the atmosphere, like nitrogen; and, contrary to the general impression, its presence in moderately large quantities (if uncombined with other substances) is neither disagreeable nor especially harmful. Its presence in the air, however, provided for respiration, decreases the readiness with which the carbon of the blood unites with the oxygen of the air, and therefore, when present in sufficient quantity, may cause indirectly, not only serious, but fatal results. The real harm of a vitiated atmosphere is caused by its other constituent gases, and by the minute organisms which are produced in the process of respiration. It is known, however, that these other impurities exist in fixed proportion to the amount of carbonic acid present in an atmosphere vitiated by respiration. Therefore, as the relative proportion of carbonic acid may be easily determined by experiment, the fixing of a standard limit of the amount in which it may be allowed also limits the amounts of other impurities which are found in connection with it.

When carbonic acid is present in excess of 10 parts in 10,000 parts of air, a feeling of weariness and stuffiness, generally accompanied by a headache, will be experienced; while with even 8 parts

THE RESIDENCE OF MR. CRACROFT WILSON, CHRISTCHURCH. [*S. Hurst Seager, Architect.*

in 10,000 parts a room would be considered close For general considerations of ventilation, the limit should be placed at 6 to 7 parts in 10,000, thus allowing an increase of 2 to 3 parts over that present in outdoor air, which may be considered to contain 4 parts in 10,000 under ordinary conditions.

Analysis of Air.

The amount of carbonic acid present in the air may be readily determined with sufficient accuracy for practical purposes, in the following manner:

Six clean, dry, and tightly corked bottles, containing respectively 100, 200, 250, 300, 350, and 400 cubic centimetres, a glass tube containing exactly 15 cubic centimetres to a given mark, and a bottle of perfectly clear, fresh limewater, make up the apparatus required. The bottles should be filled with the air to be examined by means of a hand-ball syringe. Add to the smallest bottle 15 cubic centimetres of the limewater, put in the cork and shake well. If the limewater has a milky appearance the amount of carbonic acid will be at least 16 parts in 10,000. If the contents of the bottle remain clear, treat the bottle of 200 cubic centimetres in the same manner; a milky appearance or turbidity in this would indicate 12 parts in 10,000. In a similar manner, turbidity in the 250 cubic centimeter bottle indicates 10 parts in 10,000; in the 300, 8 parts; in the 350, 7 parts; and in the 400, less than 6 parts. The ability to conduct more accurate analyses can be attained only by special study, and a knowledge of chemical properties and methods of investigation.

Air Required for Ventilation.

The amount of air required to maintain the standard of purity can be very easily determined provided we know the amount of carbonic acid given off in the process of respiration. It has been found by experiment that the average production of carbonic acid by an adult at rest is about 6 cubic foot per hour. If we assume the proportion of this gas as 4 parts in 10,000 in the external air, and are to allow 6 parts in 10,000 in an occupied room, the gain will be 2 parts in 10,000; or, in other words, there will be $\frac{2}{10,000}$ = .002 cubic foot of carbonic acid mixed with each cubic foot of fresh air entering the room.

Therefore, if one person gives off .6 cubic foot of carbonic acid per hour, it will require .6 — 002 = 3,000 cubic feet of air per person to keep the air in the room at the standard of purity assumed —that is 6 parts of carbonic acid in 10,000 of air.

The following table has been computed in this manner, and shows the amount of air which must be introduced for each person in order to maintani various standards of purity:

"GOODREST," THE NEWLY ERECTED RESIDENCE OF A WELLINGTON GENTLEMAN.
[G. G. Schwartz Architect.

RESIDENCE OF MR. R. E. MCDOUGALL, CHRISTCHURCH.
[England Bros., Architects.

Air Required for Ventilation.

Standard Parts of Carbonic Acid in 10,000 of Air in Room	Cubic Feet of Air Required per Person.	
	Per Minute	Per Hour
5	133	8,000
6	67	4,000
7	44	2,667
8	33	2,000
9	27	1,600
10	22	1,333
11	19	1,151
12	17	1,000

While this table gives the theoretical quantities of air required for different standards of purity, and may be used as a guide, it will be better in actual practice to use quantities which experience has shown to give good results in different types of buildings. Authorities differ somewhat in their recommendations on this point, and the present tendency is toward an increase of air.

The following table represents good modern practice and may be used with satisfactory results:

Air Supply for Various Classes of Buildings

Air Required per Occupant in	Cubic Feet per Minute	Cubic Feet per Hour.
Hospitals	50 to 80	3,000 to 4,000
High Schools ..	50	3,000
Grammar Schools	40	2,400
Theatres and Assembly Halls..	25	1,500
Churches	20	1,200

Force for Moving Air.

Air is moved for ventilating purposes in two ways—first, by expansion due to heating; and second, by mechanical means. The effect of heat on the air is to increase its volume and therefore lessen its density or weight, so that it tends to rise and is replaced by the colder air below. The available force for moving air obtained in this way is very small, and is quite likely to be overcome by wind or external causes. It will be found in general that the heat used for producing velocity in this manner, when transformed into work in in the steam engine, is greatly in excess of that required to produce the same effect by the use of a fan. Ventilation by mechanical means is performed either by pressure or suction. The former is used for delivering fresh air into a building and the latter for removing the foul air from it. By both processes the air is moved without change in temperature, and the force for moving must be sufficient to overcome the effects of wind or changes in outside temperature. Some form of fan is used for this purpose.

Measurements of Velocity.

The velocity of air in ventilating ducts and flues is measured directly by an instrument called an *anemometer*. It consists of a series of flat vanes attached to an axis, and a series of dials. The revolution of the axis causes motion of the hands in proportion to the velocity of the air.

Air Distribution.

The location of the air inlet to a room depends upon the size of the room and the purpose for which it is used. In the case of living-rooms in dwelling houses, the registers are placed either in the floor or in the wall near the floor; this brings the warm air in at the coldest part of the room and gives an opportunity for warming or drying the feet if desired. In the case of schoolrooms, it is best to discharge air through openings in the wall at a height of 7 or 8 feet from the floor. This gives a more even distribution, as the warmer air tends to rise and hence spreads uniformly under the ceiling; it then gradually displaces other air and the room becomes filled with pure air without sensible currents or drafts. The cooler air sinks to the bottom of the room, and can be taken off through ventilating registers placed near the floor. The relative positions of the inlet and outlet are often governed to some extent by the building construction; but, if possible, they should both be located in the same side of the room.

The vent outlet should always, if possible, be placed in an inside wall, else it will become chilled and the air-flow through it will become sluggish. In theatres or halls, which are closely packed, the air should enter at or near the floor, in finely divided streams, and the discharge ventilation should be through openings in the ceiling.

RESIDENCE RECENTLY COMPLETED FOR MR. MINTY, AT KAIAPOI. [W. V. Wilson, Architect.

How to Use Portland Cement

FROM THE GERMAN OF L. GOLINELLI.

FIRST PAPER.

IT is an established fact that Portland cement is superior to all other hydraulic materials, natural or artificial, and for this reason it is widely distributed throughout the world. Its use would, however, be far greater if the knowledge of the applications and methods of testing of cement had kept pace, during the past ten years, with the improvements which have been made in quality and methods of manufacture. Even in sections where the manufacture of Portland cement has been extensively and successfully developed, and where one would consequently expect to find a certain amount of knowledge of the subject, a correct understanding of methods of testing and intelligent use of cement is often painfully lacking. The preparation and use of cement mortar, as practised in many cases by masons, or their helpers, is not only imperfect, but wasteful. Better work could often be done with less material if careful methods were used. In the case of Portland cement such careful methods are especially necessary and profitable, and if they were followed by the common complaint that Portland cement is too expensive would soon be no longer heard. Those who do intelligent and careful work have for a long time recognised the injustice of this charge. On the other hand, it is undoubtedly true that a high-grade material like Portland cement, which in skilful hands may be usefully and economically employed for an immense variety of purposes, is especially liable to suffer from ignorance and misuse.

I. PROPERTIES OF PORTLAND CEMENT.

DEFINITION AND MANUFACTURE.

Portland cement is a material which hardens in the presence of water, prepared by burning at a sintering temperature an intimate mixture consisting essentially of lime (or carbonate of lime) and clay in certain approximate proportions.

The raw materials, clay and carbonate of lime, are ground and mixed according to their character in either the wet or dry way. If the dry process is used, the mixed materials are moistened with water and moulded into blocks. In the wet process the bricks are made from the wet material after it has been reduced to the proper consistency. After drying the bricks of cement material are burned in suitable kilns to the point of sintering. The resulting "clinker" is ground to a fine powder; this is the finished cement.

In the most modern or rotary system, the raw materials are reduced to a very fine state by grinding in a dry or wet condition, and then burning, in that fine condition, in rotary furnaces lined with firebricks. The furnaces are on a slight angle; the finely-pulverised raw materials enter at the upper end and travel slowly forward. The coal is ground almost as fine as cement, and is forced in at the lower end of the furnace, and explodes like gas, producing an intense heat, ranging from 2500° to 3000° Fahrenheit.

CHEMICAL COMPOSITION.

The raw materials indicate the nature of the constituents of Portland cement. These are silica, alumina, iron oxide, lime and a small amount of magnesia. Alkalies and sulphates are also always present, and are derived from the raw materials, which are never found pure in nature.

The presence of sulphuric acid (sulphate of lime) is also due to the sulphur in the fuel employed and to the addition of a small amount of gypsum (sulphate of lime) for the purpose of making the cement slow-setting.

The composition of good Portland cement usually varies between the following limits:

Lime	62 to 65	per cent.
Silica	20 to 26	,,
Alumina	7 to 14	,,
Magnesia	1 to 3	,,
Alkalies	traces to 3	,,
Sulphuric Acid	traces to 2	,,

According to the character of the raw material used, each manufacturer determines the correct composition of his product within the above limits, and this composition must be kept uniform by constant chemical analysis. The widespread belief that defective quality of cement is due to bad raw materials is seldom well founded; the fault is generally due to incorrect proportions and careless manufacture.

In studying the qualities of Portland cement, the following points are to be especially noted:

1. Form and fineness of grain.
2. Colour and specific gravity.
3. Time of setting.
4. Hardening.
5. Strength.
6. Constancy of volume.
7. Hair cracks and shrinkage cracks.
8. Behaviour under extreme heat and cold.
9. Additions and adulterations.

FORM AND FINENESS OF GRAIN.

When examined under the microscope, particles of hydraulic lime have a more or less rounded form. Portland cement, on the other hand, shows thin leaflets of shale-like structure, like pounded glass. The high quality of Portland cement is in part due to this shale-like character since greater density of mortar results from the greater surface of contact and smaller proportion of voids between the particles.

As to fineness of grinding, it may be mentioned that the coarser particles of cement act practically like sand. It is therefore important that the grinding be not too coarse. A residue of not more than 5 per cent. on a sieve of 75 meshes to the linear inch may fairly be demanded. The finer the grinding, the more sand can be used with the cement. It should be remembered, however, that poor cements, especially those too high in clay or imperfectly burned, are especially easy to grind to great fineness. Such cements may be generally recognised by their yellowish colour and the spotty appearance of the work.

COLOUR AND SPECIFIC GRAVITY.

The colour of Portland cement should be a greenish gray; a yellowish or reddish gray tint indicates generally an inferior, light-burned product, or one to which under-burned or "dusted" material has been added.

Portland cement has a high specific gravity, a quality which contributes to its high value. No other hydraulic material has so high a specific gravity, or yields so dense and resistant a mortar. The specific gravity of Portland cement is from 3.12 to 3.25.

TIME OF SETTING.

When Portland cement is mixed with a suitable quality of water, a plastic paste is produced, which after a time becomes hard. The change from a semi-liquid to a solid mass is called setting and the time required for this change, the time of setting. Cement is said to be set when it resists a light pressure of the finger nail on the surface.

It is of the greatest importance to know the time of setting of a cement which it is proposed to use, since a cement which has become set and has been again mixed up with water, possesses little or no hydraulic energy. The mistake of mixing "set" mortar anew with water occurs only too often, and gives rise to the unjust complaint that the cement does not harden or possesses no strength. Great care should therefore be taken to mix only such a quantity of mortar as can be conveniently used up in the time available; this can be easily managed when the time of setting is known. Remnants of mortar which have become set should be discarded and must under no circumstances be again worked up with water. The determination of the time of setting is extremely simple, and may be made by any mason at the place where the cement is used. The best method is as follows:

The cement is mixed with water to a thick paste, worked one to two minutes with a spoon or trowel and spread out in the form of a pat on a glass plate. This pat should be about one-half inch thick in the middle and thin at the edges. As soon as the surface resists a light pressure of the finger-nail the cement is set. Since the temperature and the proportion of water used are of great influence on the result, it is best to have the cement and water at the ordinary temperature of 60 to 70 degrees, and to use not more than 30 to 32 per cent. of water. The water must be clean. The pat should be protected from sunshine and drafts of air.

It is in the power of the manufacturer to produce either quick-setting or slow-setting cement, as may be required. A cement which requires two hours or longer to set is called slow-setting. Such cement is preferable to that which sets quickly, on account of its greater strength. Quick-setting cement is used only for certain purposes. Slow-setting cement can be made to set more quickly by using warm water, and also by limiting the water used to the smallest possible quantity.

Among the substances which modify the time setting may be mentioned:

Potash and soda, which hasten the setting. Sulphates and calcium chloride, which retard the setting.

In all cases the consumer will do well to notify the manufacturer what time of setting is desired, also for what purpose the cement is to be used. In this way many unjust complaints in regard to quality, and many unnecessary expenses, may be avoided.

JOHN WILSON AND CO.'S PORTLAND CEMENT WORKS AT WARKWORTH, AUCKLAND.

HARDENING.

The set cement is capable of hardening, either in water or in air, and in a short time will acquire a high degree of strength. The processes of setting and hardening should not be confused. The latter begins at the point where the former ceases, and continues up to the highest strength which the cement attains after the lapse of many years.

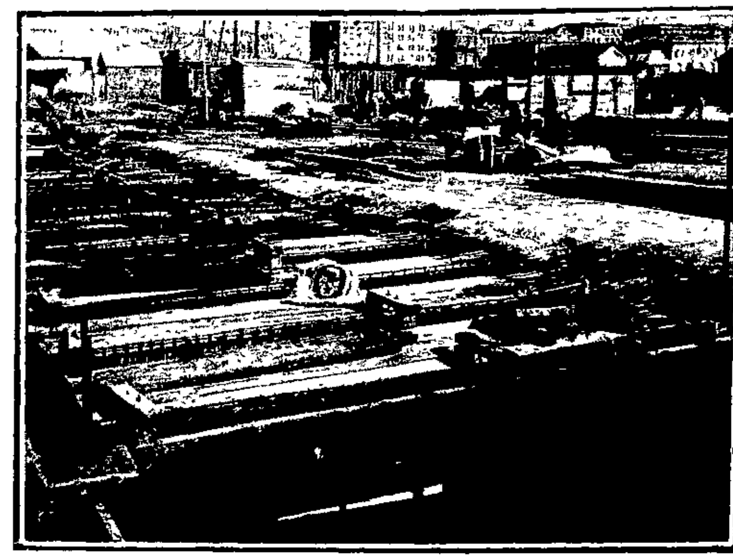
As to the nature of the hardening process, to account for which various theories have been advanced, it need only be here stated that the hardening consists in chemical combination with water taking place under certain physical conditions. Among the most important of these conditions are rest during the setting, and protection from too rapid drying out. The latter point can not be too strongly insisted upon. If the cement is deprived of the necessary water it can never reach its full hardness.

STRENGTH.

Portland cement attains within a few days a high degree of strength.

In the use of cement for building purposes compression strength is the quality generally required. Cement is, however, generally tested only for tensile strength, owing to the fact that the tests of tensile strength can be made much more quickly, simply and cheaply than those of compression. There is also a definite (though by no means exact) relation between the two tests,

FERRO-CONCRETE WHARF CONSTRUCTION, AUCKLAND: UNDERNEATH VIEW.



FERRO-CONCRETE WHARF, AUCKLAND: VIEW SHOWING DECKING.

the compression strength being generally from 8 to 12 times the tensile strength.

The German official standards for Portland cement require that a mixture of one part cement with three parts normal sand shall show a tensile strength at 28 days of at least 227lbs. per sq. in.

It is by no means simple, however, to make tensile strength tests in such a manner as to give reliable results. Complaints in regard to the quality of cement are often due entirely to faulty testing. In the preparation of briquettes, the temperature and quantity of the water used, the character of the sand employed, and the thoroughness with which the mortar is worked, are of immense influence on the results. The strength will generally be greater the less water used; nevertheless it is always necessary to use such a quantity of water that it shall show itself on the surface of the briquette on tamping it into the mould. Long and vigorous working of the mortar increases its strength. In extensive building operations the use of mixing machines, especially pans with edge runners, is therefore highly advantageous.

CONSTANCY OF VOLUME AND CRACKING.

Strictly speaking, there is no such thing as constancy of volume, either in the case of mortar or stone, since heat and cold, wetting or drying, modify the volume more or less. Portland cement also suffers changes of volume on hardening in water or in air. In the case of good Portland cement, however, these changes are extremely small and much less than those which occur in different kinds of stone. Bad cements, on the other hand, may show the dangerous quality of cracking or swelling. This shows itself in a strong expansion, which destroys the cohesion of the mortar and may cause its total destruction.

Cement which swells badly, if laid between retaining walls, shows an immense power of expansion, even to the extent of forcing out the stones of the masonry.

The swelling does not show itself until after the setting. The worse the fault is the sooner it will appear. It shows itself, also, sooner in water than in air. In pats of cement kept under water this defect is to be noticed in the appearance of fine net-like cracks, or in worse cases in curving of the pats and the appearance of cracks around the edges. It is characteristic of expansion cracks that they run from the edges toward the centre of the pat and are widest at the edges and narrower toward the centre. These expansion cracks should not be confused with shrinkage cracks, mention of which will be made later.

The swelling of cement is always due to defects in manufacture. These are:

1. Faulty composition of the raw material, especially too high a proportion of lime.
2. Imperfect preparation of the raw material.
3. Imperfect burning of the clinker.
4. Too high proportion of sulphate or magnesia.

According to the German official requirements, a cement is considered to be constant in volume if a pat, kept 28 days under water, remains perfectly flat and free from cracks. Swelling, due to too much lime, shows itself in this test with certainty within a few days or weeks. Cement containing too much magnesia, however, and burned to the point of sintering, shows noticeable expansion only after the lapse of long periods, extending even to several years. Only chemical analysis, or the guarantee of the manufacturer, can afford protection against the danger of expansion from excess of magnesia. Experience has shown that the presence of magnesia up to 3 per cent. is entirely harmless.

In conclusion, two other peculiar appearances may be mentioned which are often erroneously considered to indicate swelling of the cement.

It is sometimes noticed that pats of neat cement, left in air, lose considerably in strength, and after a certain time become soft or friable, while similar pats kept in water are faultless in all respects. This is especially liable to occur in the case of pats made very wet and allowed to dry out immediately after setting. If, on the other hand, the pats are kept moist during the first stages of hardening, this defect is not developed. Cracks, similar to those produced by swelling, are also produced when placed in water too soon, or before the setting is complete. To prevent this the official requirements specify that test pieces shall be kept 24 hours in moist air before placing in water.

SHRINKAGE CRACKS AND HAIR CRACKS.

Portland cement mortar without sand, exposed to the air, diminishes in volume. If the drying takes place gradually and uniformly, as in a closed room, the cement shows no defects. Too rapid drying, in draughts of air or in sunshine, without the precaution of keeping the cement moist, causes so-called shrinkage cracks. These may be distinguished, in pats of cement, from expansion-cracks by the fact that they appear during the setting and show themselves as irregular curved lines extending over the middle of the pat. As already stated, the formation of shrinkage cracks is due to faulty use of the cement, and has practically nothing to do with its quality. Very finely ground cements are, moreover, more likely to show hair cracks than those which are more coarsely ground.

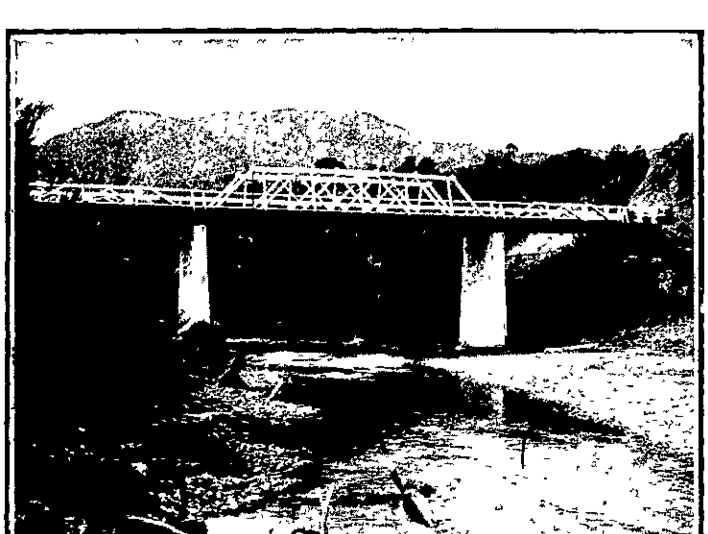
Hair cracks appear as fine lines on cement work which has stood some time. They are especially to be noticed on cement which has lain in the open air, and are due to frequent changes between wet and dry conditions. Hair cracks and shrinkage cracks occur chiefly when pure cement or mortar too rich in cement is used. They may be certainly avoided by the addition of sufficient sand and suitable treatment of the work.

(*To be continued.*)

Gas-heated Baths.

The employment of gas for rapidly heating the water for baths has, according to the *Gesundheits-Ingenieur* of June 17, made great progress in the past 20 years, but many fatal accidents have arisen owing to improper arrangement of the apparatus. Mr. Schafer has found that in Germany alone 11 deaths have been caused in the past 12 years by faulty construction of heating apparatus, while in 17 cases the accidents did not prove fatal. By reference to diagrams a number of designs are given to indicate arrangements for fixing the gas-heater out of the bath room altogether, either on the floor above, or in a room beneath, or by a very simple modification of the heating apparatus it may be placed on the same level as the bath room, but in another apartment. It is pointed out that by one or the other of the above systems much greater security for life, health, and property can be secured at a very small additional expenditure.

The rails of the Mexican Gulf Railway are laid on mahogany sleepers, and the bridges built of white marble. In West Mexico is a line with ebony sleepers and ballast of silver ore drawn from old mines beside the track. The engineers constructing these railways had no material on the route, and found it cheaper to use precious materials than to import the ordinary kind.



BRIDGE OVER THE HIKUWAI: SHOWING CONCRETE PIERS.

NAPIER BREAKWATER: OVER 10,000 TONS OF PORTLAND CEMENT USED.

Mr. R. L. Levin's House.

This splendid house, built from the designs of Mr. John S. Swan is situated on part of about two acres of land that extends from Hobson street to Thorndon quay, the main approach being from the first-named thoroughfare by a fine carriage drive of rolled Karori gravel. The front elevation is artistically uneven, affecting the English classical style, but in no way has the architect taken conventionality as a guide. The broad flight of concrete steps and tiled dais lead to the pillared entrance in the centre, while overhead is an indented balcony. On the left-hand side is a large bay window, built up square, and overhead is another balcony which extends round the west side of the house, and is for the use of servants. The building on all sides is highly ornamental, flutings here, jutties and friezes there, while over each of the principal entrances is the Levin arms, picked out in plaster. There is another fine entrance on the Thorndon-quay frontage, which give the inmates the choice of three doors—to the drawing-room, the morning-room, and the dining-room. Over the outlook of the latter apartment, and extending over the rear entrance, is another balcony which provides a fine view of the larger half of the harbour and surrounding hills. The roof is covered with terra cotta Marseilles tiles, which give the unchimneyed roof the appearance of a richly hued and highly ornamental canopy. The roof is without the usual cluster of chimneys, for the rooms, except the kitchen, are without fire places, and are steam-heated by radiators of the latest American style. A dive into the basement shows two large boilers, which supply steam to the radiators, and the heat is delicately regulated in the simplest manner. After the basement (where is also the wine cellar), and the main entrance from Hobson street, the eye at once catches the beautiful designs of the tinted lead-light windows, which over and on either side of the two pairs of doors, throw pretty colours on the rich pile under foot. Facing the visitor are doors leading direct to the morning-room, dining-room, and drawing-room, which look out on to Thorndon quay, while the study—facing Hobson street—is found by turning immediately to the right on entering. The vestibule itself is a large apartment, comfortably furnished, dadoed with fine pannelling in polished rimu and gracefully ornamented with fluted pillars of plaster of Paris, surmounted by Ionic caps. On the right hand side, just beyond the study door, is a six-feet staircase in two flights, leading to the first floor, and between the bottom of the staircase and the drawing-room the vestibule runs along to a side entrance. As to the rooms mentioned, all are large, and comfort has been studied right through. The study is pannelled to a height of 10ft. 6in. in polished cedar, above which the walls are obscured by a fancy papier mache of a sage-green tint, terminating in a fancy frieze in lighter shades. Off this room is a lavatory, with marble washstand and perfect conveniences. Here, as elsewhere throughout the house, the electric light fittings, taps, door handles, etc., are all nickel-plated. The dining-room measures 23ft. x 16ft. 6in., and here again are the graceful fluted pillars of white plaster on either side of the large bay window that commands an extensive view of sea and land. This room, which is richly pannelled all round in mahogany and mottled kauri, is indented on one side to accommodate a magnificent solid-oak sideboard. The furniture, also of oak, is upholstered in green leather, an admirable contrast to the dark glowing red of the wall paper. Opening off the dining-room is the butler's pantry, and further on are the kitchen and scullery. The morning-room is a small, but bright, apartment, next to the dining-room, and next to that again is the drawing-room, similar in size to the dining-room, but with a large oriel window in the outside corner, which formation is continued above the roof in the style of a turreted round tower.

Mounting the stairs the pleasing effect of spacious tinted lead-light windows is again met with. The stairway terminates in another large vestibule or landing from which the several night apartments open off. No. 1 bed room on the near-east corner has a fine oriel window commanding a beautiful view, and is elaborately fitted with electric light, including a " burglar switch," which, being pressed, lights up every passage throughout the house. Probably the best private bath room in New Zealand is next to this room. On its rubber-tiled floor, there is a large white enamel Roman bath, with hot and cold water, a showerbath with a large enamel tray to stand in, and a patent Sitz bath. Besides these there is an elaborate marble washstand fitted with hot and cold water, with shining nickel-plated fixings and a swivel mirror attached. Other conveniences in this china-tiled apartment are equally elaborate and convenient. In the natural order of things comes the dressing-room, another nice airy room, papered with pink roses, and having entrance to a breezy balcony. Other bed rooms on a less lavish scale look out on to Hobson street, as do also the servants' bed rooms, all of which are electric-lit and provided with steam radiators. The servants have a comfortably fitted bath room for themselves, and there is still another for guests. There are also linen presses, storerooms, a dispensary, and other small apartments for domestic utility. Where there is steam heat there must be ventilation, and this is arranged on an elaborate system. A visit paid to the garret discovered this usually empty space to be one mass of huge galvanised iron pipes, some of them two feet in diameter, leading from every room in the building to above the floor. Each of these pipes has a regulator, by which the area of draught can be regulated to a nicety. Another specialty is the stove in the kitchen, by which cooking may be done by either burning coal, coke or gas, the fumes from which are led away to the air by the huge ventilator, which is as a canopy over the range.

RESIDENCE OF MR. R. L. LEVIN, WELLINGTON. *[John S. Swan, Architect.*

The house is beautifully illuminated throughout with electric light, and is fitted with telephonettes (so that speech may be had with anyone in another part of the house without moving from the room). Most of the electric lights are fitted with a double switch so that if one wishes to light a way across a vestibule or passage he can switch off the light on the opposite side to that where he turned it on.

The building is of solid concrete with a facing of fine cement plaster, and was erected on the day-work system, under the superintendence of Messrs. H. Andrews and T. Waterhouse (clerks of works, representing Mr. Swan). The plumbing was done by Messrs. Jenkins and Mack ; the electric light, bells and telephonettes were fitted by Messrs. Turnbull and Jones. Mr. W. Newman was the plasterer ; and Mr. W. Tustin was responsible for the painting and paperhanging. Mr. Gerald Fitzgerald acted as consulting engineer to the architect, and Mr. W. Grant was the foreman in charge.

DINING-ROOM, MR. R. L. LEVIN'S RESIDENCE.

DRAWING-ROOM, MR. R. L. LEVIN'S RESIDENCE.

Our Industries: No. 6. A Modern Foundry.

P. & D. Duncan's South British Implement Works.

TUAM AND ST. ASAPH STREETS, CHRISTCHURCH.

THESE works were established by Mr. P. Duncan, in 1865, in premises in Cashel street to the rear of Beath & Co.'s present establishment. Two years later he was joined by his elder brother, the late David Duncan, the firm shortly afterwards commencing the manufacture of ploughs in a small way. The business increasing rapidly, a new position with more room was secured in Tuam street, adjoining the old Wellington hotel, in the year 1876, where more commodious shops were erected and further new lines gone in for—the plant being gradually increased to meet the requirements of the trade. A foundry was added to the works in the year 1880, and on the site of the old Wellington hotel being acquired in 1881, a new fitting shop and foundry were erected on the section, the hotel itself being turned into a store, for which purpose it has served ever since.

In 1894 the business was turned into a company. Mr. P. Duncan, owing to ill-health, retired from the more active management some five years ago. In 1903, increased accommodation being necessary, a section was secured on the south side of St. Asaph street, and an up-to-date foundry erected thereon complete with commodious pattern shop, extensive pattern store, fettling shop, store for castings, motor room and all necessary accessories, making it as complete and modern a foundry of its size as can be seen in the Southern Hemisphere—the old foundry site on the Tuam street frontage being altered and extended into a fitting and machine shop.

These works at present employ 187 hands, and the work is very steady, the output being nearly constant all the year round.

One of the difficulties in implement making in New Zealand is the wide range of work which has to be undertaken to secure sufficient orders to keep all hands going. The work at Duncan's varying with the seasons, repairs to horse rakes, strippers, drays, and reaping and mowing machines are effected in January and February; ploughs, harrows and cultivators in March, April and May; drills, disc harrows and rollers in June and July; and so on throughout the year.

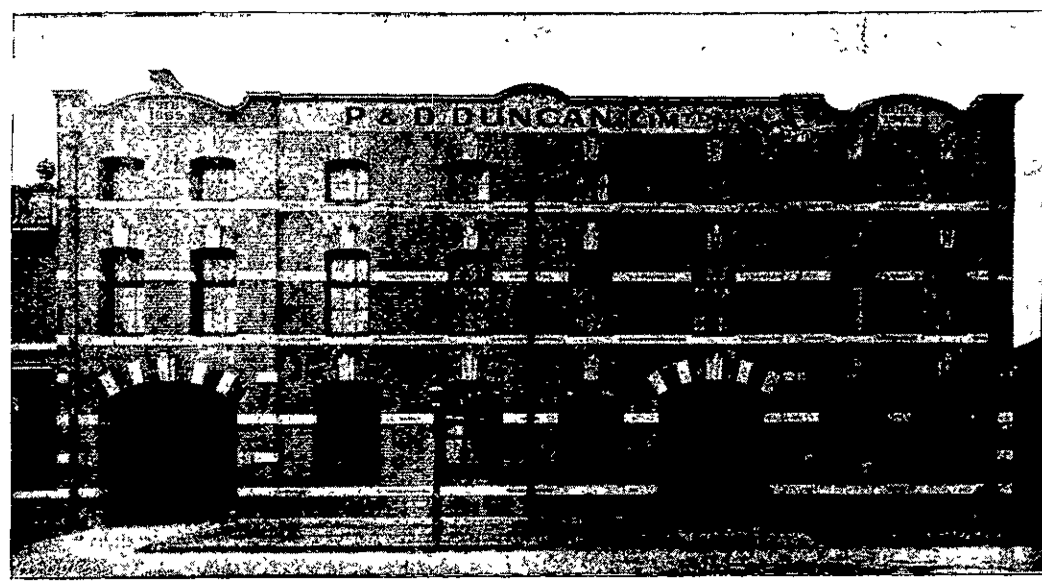
Another difficulty in the implement business in this country, and one not fully understood by those outside the trade, is the diversity of conditions under which agriculture is carried on in in the colony in regard to the quality and condition of the lands cultivated, necessitating a wide range in size and style of many of the implements. P. & D. Duncan, Ltd., for example, manufacture about forty-five varieties of ploughs, twenty-eight different sorts and sizes of disc harrows, and over fifty different varieties and sizes of drills, besides many other lines in like proportions. This is not a matter of choice, but necessity, for the customer requires the machine made a particular way to suit his land, and it is made accordingly.

P. & D. Duncan, Ltd manufacture every class of farm implement—reaping, mowing and threshing machinery excepted—and their goods are well known throughout New Zealand for the highest class material, workmanship and design. In addition to agricultural machinery they also manufacture road-making and repairing machinery, traction wagons, spreading wagons for metalling roads, etc. Although P. & D. Duncan manufacture a full line of implements, ploughs, disc harrows, drills and cultivators form the bulk of their output. In their "Star" drill they claim to have the best drill extant for New Zealand conditions, and their patent turnip and rape sower is undoubtedly as simple and effective a method of doing this work as could well be imagined.

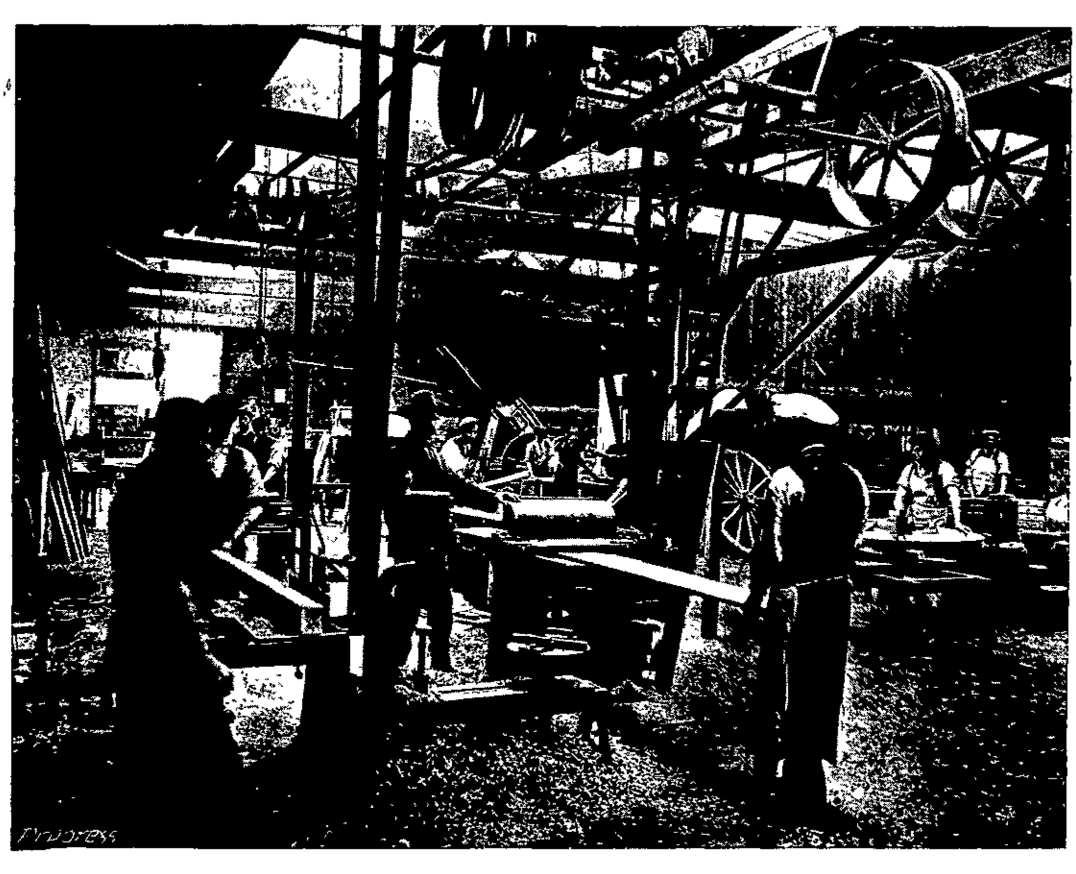
The plant comprises 3 steam hammers, 3 oliver hammers, 2 heating furnaces, 22 blacksmith forges, 4 punching and shearing machines, 10 drilling machines, 10 lathes, 3 screwing machines, milling, shaping, slotting and planing machines, 4 wood planing machines, 2 band saws, 1 circular and 1 swing saw, etc. Power is obtained from 2 boilers, 2 engines, and 3 electric motors employing city current.

The Company's goods are mainly sold by agents in the different centres throughout the colony, but a large trade is done direct with farmers in Canterbury, many of the older settlers and their sons having been customers for thirty or forty years.

Mr. John Duncan is chairman of directors, Mr. L. L. Cordery, F.I.A.N.Z., secretary to the Company, and Mr. James Keir works manager.



ENTRANCE TO FOUNDRY, ST. ASAPH STREET.



WHEELWRIGHT'S SHOP. [*Photos by S F. P. Webb.*

A Turbine Torpedo.

THE application of the turbine principle to the propulsion of torpedoes has apparently been effected with great success in the Bliss-Leavitt invention, which is to supersede the Howell and the Whitehead torpedoes in the United States Navy.

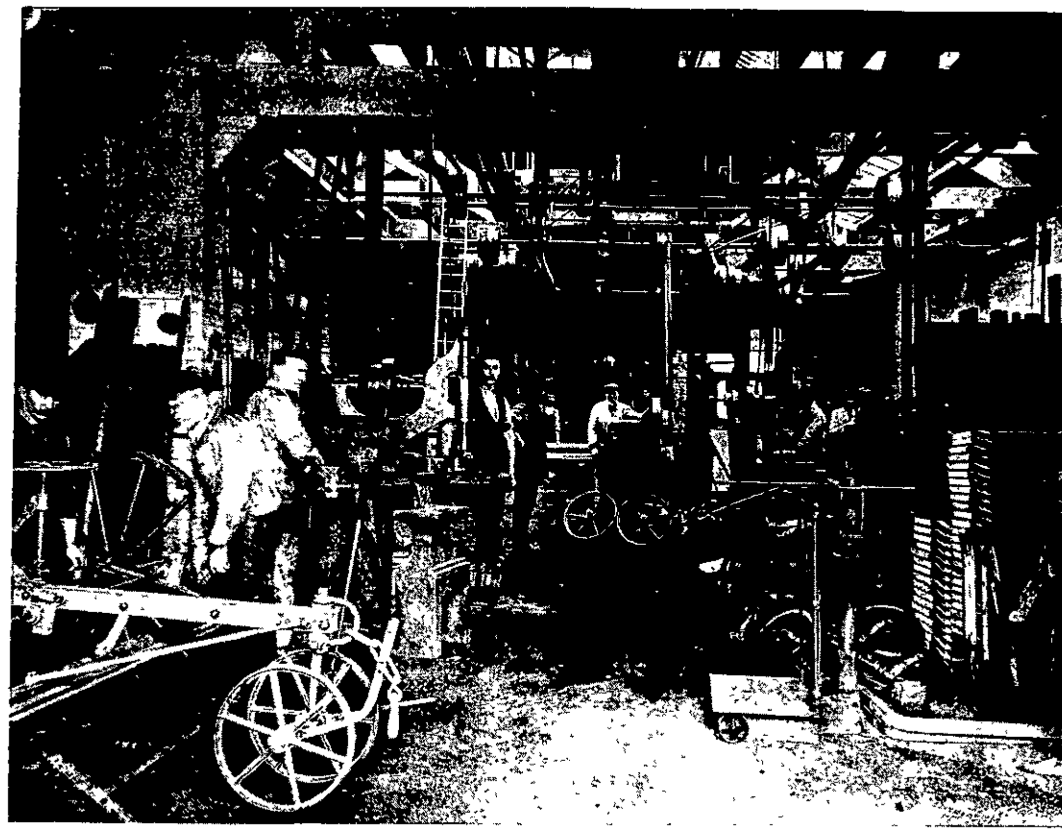
In its general form and arrangement the Bliss-Leavitt torpedo is very like the Whitehead. Its distinguishing features are the use of the turbine principle, not only in the propelling engine, but also in the gear for steering by the vertical rudders. The main engine is a compound air turbine, running at a much higher rate of speed and developing higher power than the old reciprocating torpedo engine. The 18in. Whitehead has a speed of twenty-seven to twenty-eight knots at 1,200 yards' range, falling to about twenty-two at 2,000, which is near the limit of its effective range. The Bliss-Leavitt has a speed of thirty-six knots at 1,200 yards, and still has a speed of twenty-eight at 3,500. Up to this range it can make good practice, which means that a ship armed with this torpedo could sink an enemy about 2 miles away. Part of this great increase in speed and range is due to a device for increasing the working tension of the compressed air by heating it. This is effected by means of a spirit lamp or stove, which is lighted automatically in the air chamber the moment the torpedo is discharged.

There are two main types of turbines. In one, the most usual kind, the steam, air, or water acts by impinging upon blades attached to the shaft that is to be rotated. The other depends upon reaction. Its oldest form is Hero of Alexandria's little engine revolving under the backward drive of jets of steam escaping from points on its circumference. There is a remarkable application of the second kind of turbine in the Bliss-Leavitt. In the Whitehead the rudder is controlled by the Obry gyrostat gear. The gyrostat, a heavy wheel revolving at high speed, and always keeping the same plane of direction, is set running by the release of a powerful coiled spring at the moment when the torpedo is discharged.

18,000 REVOLUTIONS A MINUTE.

In the Bliss-Leavitt torpedo the gyrostat principle is also used to control the steering, but there is no spring to start the revolving disc or wheel. The disc is hollow, and has a number of small nozzles opening from its circumference, each nozzle being at the end of a tube which projects like the spokes of a wheel, but in the line of tangent to the circumference, or forming a right angle with the radius. Compressed air passes into the interior of the disc and escapes in jets from the nozzles, and the result is that the disc is driven round in the reverse direction to the escape of the air. It is claimed that its velocity rises to 18,000 revolutions per minute. The device may be called a turbine-gyrostat, and will doubtless have other useful applications found for it. Driven at this high speed the revolving disc would require an enormous force to divert it from its original course.

After prolonged tests at Newport News, carried out so secretly that even the ubiquitous Yankee reporter heard nothing of them, the United States Navy adopted the Bliss-Leavitt as its service torpedo. Two hundred are now being manufactured, half of them of the 18in. diameter type, and the rest of 21in. diameter. The largest torpedoes in our navy are the 18in Whiteheads. The 21in. Bliss-Leavitt carrying an increased charge of guncotton, will be the most powerful torpedo in any navy. Its guaranteed range is 3,500 yards, but it has been run over 4,000 in the test trials. The only torpedoes above 18in. in diameter that have yet been made anywhere were a set of ten 24in. Whiteheads manufactured for the Japanese Government just before the war. But it is believed that these were intended to be discharged from tubes mounted on land in connection with the defences at the narrow entrance to the Island Sea. The 21in. Bliss-Leavitt is apparently intended for use on shipboard. As no naval Power will allow another to get ahead of it in armaments we may be sure that we shall soon hear of an increase in the size of the Whitehead in European navies, even if they do not follow the example of the United States and try to obtain a weapon like the Bliss-Leavitt.



P. AND D. DUNCAN'S WORKS: ERECTING SHOP.

ELECTRICITY'S TRIUMPHS.

WONDERS OF MODERN INVENTIONS

AT one time the clank and rattle of mechanism amidst a sustained whirring of wheels was what one always heard when visiting a manufactory or a power station. Those were the days when the steam king reigned without a rival; but times have changed. Now the triumph of the blue king—electricity—has reduced motive sound to a minimum, and the giant steam machines are falling into disuse through the advent of a cleaner and more compact method of generating power. This fact was impressed upon a *Post* reporter during a visit to the electrical power house of the Wellington City Corporation, wherein is generated the propelling power for the city and suburban trams, and the lighting and power supply of a few outside institutions.

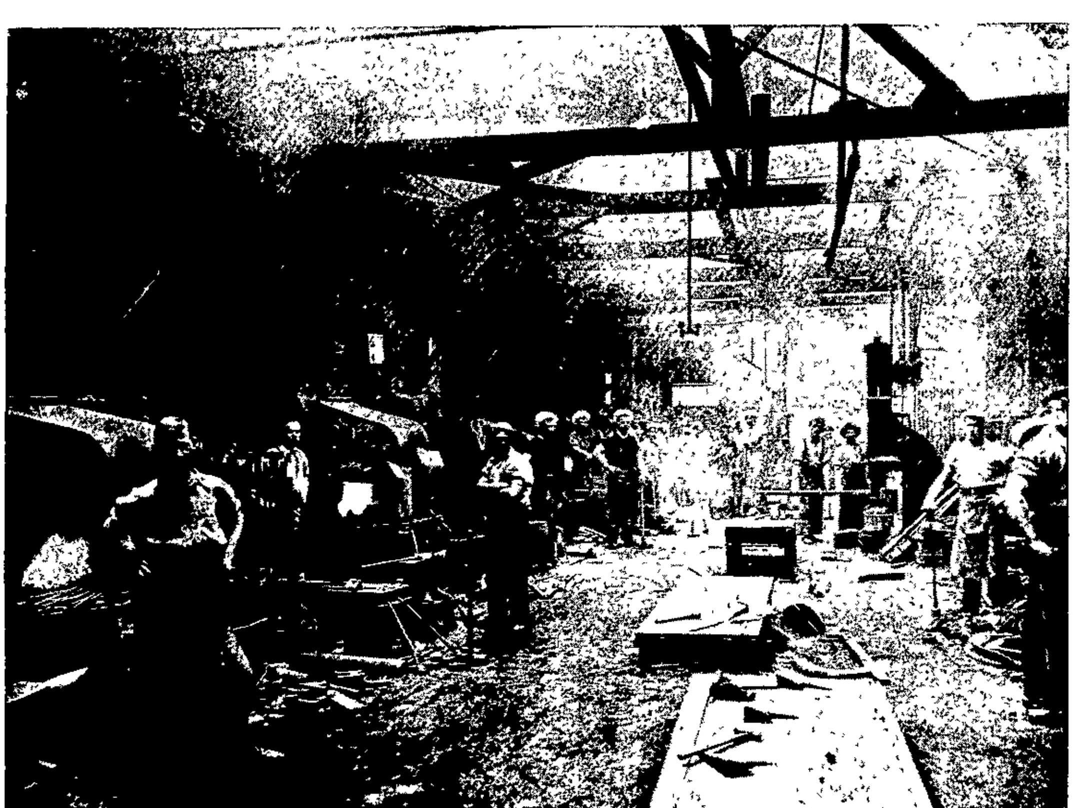
It is a system of delicately controlled gigantic forces, with electricity the king installed supreme and served by steam the satrap. The steam which drives the electrical engines is supplied from boilers to which are fitted the Erith stokers—a mechanical contrivance which feeds coal into the retort fires as required in regulated quantities, and thus entirely obviates the making of smoke, as the gases are consumed in a clear fire immediate they are generated. The system in force a the power house is for the most part self-controlled, and at every turn the triumph of man's mind over seeming impossibilities is apparent.

The chief engineer of the works (Mr. Peter M'Coll) has an office on the top floor, surrounded by a platform from which he has immediate oversight of the whole works. There are three engines in operation, aggregating 1750 h.p., and a huge Belliss and Morcom engine, of 1000 h.p., is now completed. When this latter work is completed the Council will be able to supply electric lighting to all who desire it. The power house has beeen built with a view to extension, and it is up-to-date in every respect. Labour-saving and energy-saving devices are everywhere apparent. Even the clinkers from the fires are utilised by being ground up to make bedding for pavement flags; in short, nothing goes to waste. The water for the boilers is heated in "economisers," which raise its temperature 240 and 280 degrees before it is run into the boilers, and the heat with which this is done is secured without additional cost to the running expenses. There is method in everything. Each gallon of water that passes through the works is mechanically measured and recorded, and there are checks upon coal consumption in relation to steam generation, which enable the engineer to ascertain from day to day what has been the cost and whether the quality of the coal supplied is up to the average.

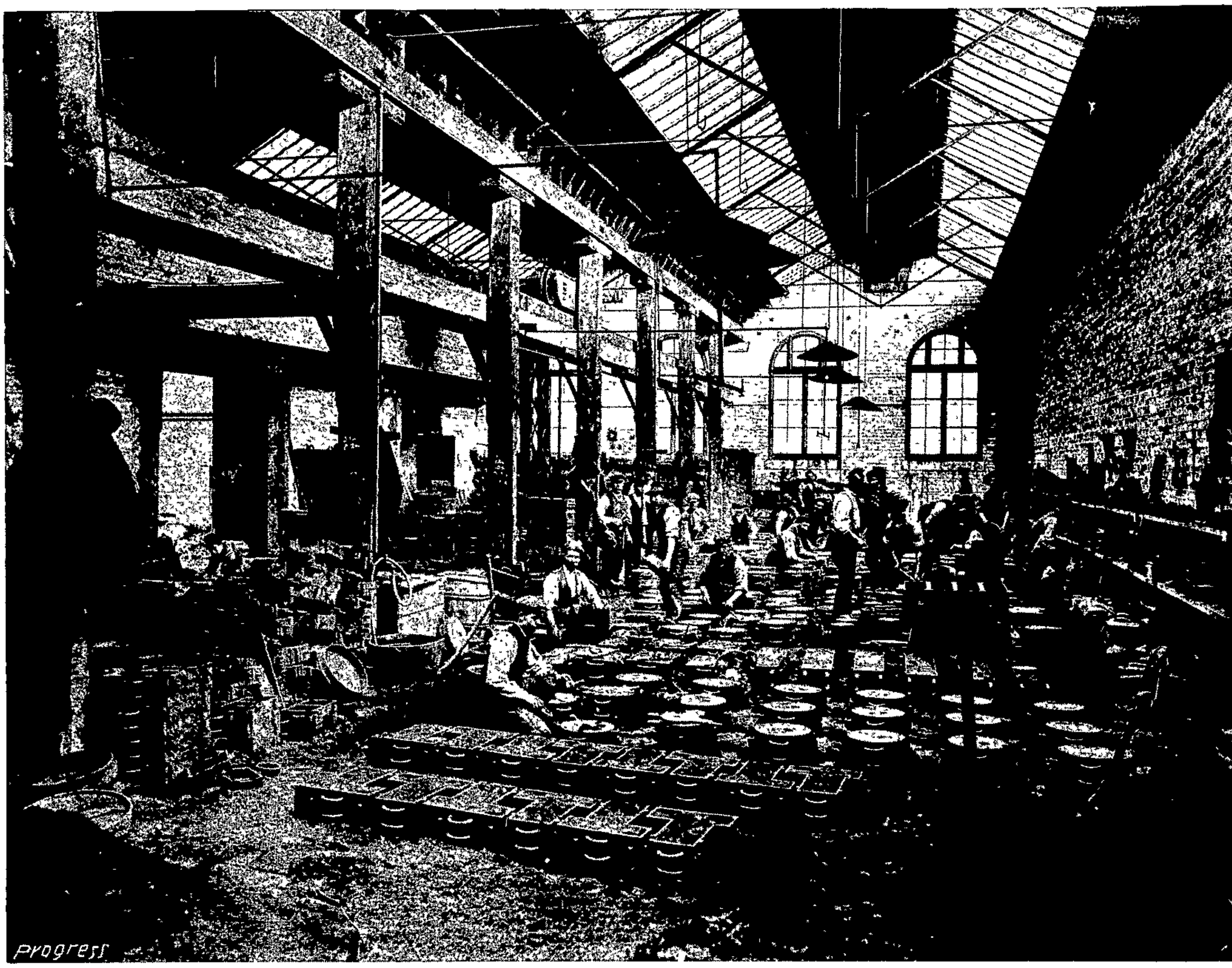
Method is applied down to the merest detail. A bell sounded as the reporter was making the rounds. "That is an alarm to let us know that a big storage tank on the roof of the building is full of salt water for the engines," Mr. M'Coll explained. "If there was too little water an alarm would also be given," he concluded.

The switchboard of the establishment is a huge one, beautifully kept and on a floor below it the electric motors are in constant action. These are run at a pressure of 550 volts, and there is an arrangement which practically prevents any waste of power. When the trams are running at normal speed and in normal number the strain shows but slight variation. But occasionally it happens that a large number of trams are starting together, and perhaps some "steep pinches" are being travelled at the same time. Then there is a demand for greater power. This is provided through the action of what is known as a variable expansion lever, which works automatically. When the strain comes the lever moves rapidly over, and by so doing sets up a stronger current to meet the increased demand. As the demand relaxes the variable expansion mechanism automatically swings back to the normal, decreasing the energy supply accordingly.

The engines at present installed have occasionally to work to their utmost capacity, there being the lighting of the Town Hall and the supply of light to firms to be kept going, in addition to the trams. There is a special machine used for the Town Hall and private lighting supplies. An interesting invention that is installed at the power house is known as a "negative booster." It is an electrical pump which sucks the current through the rails back to the negative side of the machine, working on the car-shed return current. This information as to the scope of a "booster" should fill a long-felt want, for when it was recently noted that the City Council had ordered a "booster" for the Brooklyn tramway one "Constant Reader" wrote to ask if it was "something to boost up the receipts from the line." He was close to the truth, for the saving effected by conservation of the electric current materially affects the relative average of receipts and expenditure. A number of "boosters" are now on the way to Wellington to be installed on the suburban lines. Another improvement in conditions is being effected by



P. AND D. DUNCAN'S WORKS: BLACKSMITHS' SHOP.



P. & D. DUNCAN'S WORKS: MOULDING SHOP.

P. & D. DUNCAN'S WORKS: MACHINE SHOP.

the installation of a "track telephone," which will enable motor men or conductors to ring up the power house, the car shed, or Thorndon despatch station, independent of the public telephone bureau. There are many advantages in this: expedition and facility being the chief. Sometimes it happens that an accident to a tram temporarily disorganises the telephone wires in the vicinity of the overhead track, and in such case as this the existence of an independent telephone service will be especially convenient.

LATEST AND MOST ECONOMICAL METHODS OF HANDLING WOOL BALES.

Recently there has been installed for Messrs. Dalgety & Co., Ltd., a complete conveyor plant in their new wool warehouse, Miller's Point, Sydney. The warehouse throughout has been designed with a view to handling and storing the wool in as little time, and at as small a cost, as possible previous to its being shipped to its destination—England or the Continent of Europe. The conveyor has been installed to do away to a great extent with the loss of time and money (in wages) which naturally occur under the old system of hand trollying, and is designed to deal with 900 bales per hour. It runs the entire length of the building from end to end, and the distance between the centres of the end sprockets is 275 feet. An electric motor is employed to provide the driving power.

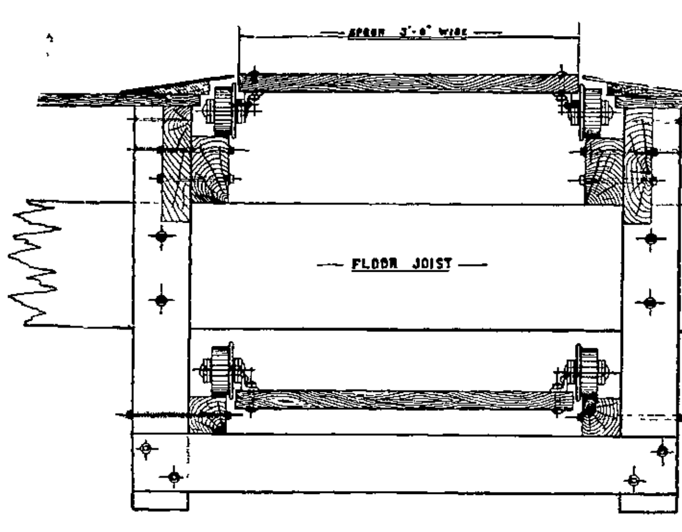
The type of conveyor in question is what is known as a Continuous Wood-Apron Conveyor, and is constructed of two lines of special flanged roller chain which work over sprocket wheels at either end and at the centre, the centre sprocket wheels being the driving ones. Heavy wooden slabs are securely bolted across the two lines of chain, and, as shown by the cross section, form a continuous platform upon which the bales of wool are carried. The upper runways are bolted to the floor joists, and the bottom or return runways are supported by wooden structural work suspended from the floor joists, and, consequently, below the floor level. But the space required below the floor joists is very little, so that there is practically no interference with the storage capacity of the floor beneath. The wood apron of the conveyor, whether in operation or not, forms practically part of the floor of the store, though the top of the slabs are an inch or so above the floor level, so that clearance may be given the floor and the bales as they are carried along. It being necessary to be able to "hand-trolley" the bales from one side of the conveyor to the other or on the conveyor itself, an incline suitable for the purpose is formed on each side of the apron by steel plates securely screwed down to wooden wedge pieces which are fixed to the floor, as is also clearly shown in the cross-sectional drawing. The plates run the full length of the conveyor on both sides, and no difficulty is experienced in wheeling the trolleys over from one side to the other whether the conveyor is in operation or not. The conveyor is reversible, that is, it can be run in either direction, as required, this being effected by simple reversing gear connected with the starting switch.

The motor driving the conveyor is placed in the centre on the second floor, and the reduced speed required is obtained by belt and chain drives with a spur gear on the driving shaft of the conveyor. The electric wiring has been so arranged that the motor can be started and stopped by the foreman in charge, who is situated at the receiving doors on the first floor. The horse power required to drive, when the conveyor is fully loaded, is approximately ten, but the power actually consumed is consideralby less than this, owing to the fact that the conveyor usually carries the bales away so quickly that the men are unable to keep it fully loaded, and it is consequently seldom working at its full capacity. The advantage and economy of the electric system of driving is here apparent, as the motor only develops, at any instant, that amount of power necessary to keep the speed constant.

The bales are received at the door of the warehouse weighed and marked, and are then placed upon the wood apron and carried to whatever part of the warehouse required. Fig. 2 shows a number of bales on their journey, and they are carried along, exactly as shown, standing easily on end on the moving platform. The bales on reaching the bay of the store at which they are required, are hand trolleyed to any part of it; consequently, the conveyor acts as a feeder for the hand trolleys, and the long trolley trips, done by the men wheeling the bales from one end of the store to the other, and returning with empty trolleys, are done away with. The bales are quite easily removed from the conveyor while it is moving, as it only runs at the moderate speed of 100 ft. per minute, and the men find no difficulty in loading or unloading the bales or crossing with their loaded trolleys while the conveyor continues on its course.

The manufacturers are Messrs. The Jeffrey Manufacturing Co. of Columbus, Ohio, U S.A., who have representatives in New Zealand, but the plant described was supplied and erected by Messrs. Gibson, Battle & Co., of 7 Bent street, Sydney.

As this conveyor is a typical example of the modern labour-saving device for handling materials in process of manufacture or packed for distribution, whether in bales, boxes, bundles, casks or even loose, we have no doubt that our readers will appreciate the opportunity of seeing an illustration and reading a description of an example of this up-to-date system, as adopted by such a well-known and experienced firm as Messrs. Dalgety's, Ltd.



CROSS SECTION OF WOOD APRON CONVEYOR.

WOOD APRON CONVEYOR IN OPERATION.

New Petrol Electric Railway Car.

A trial run took place recently between Schenectady and Saratoga, N Y., of a petrol-electric railway coach constructed by the Wolseley Tool and Motor Car Company for the Delaware and Hudson Railroad. The car consists essentially of a petrol-driven electric generator, furnishing current to electric motors geared to the driving wheels, and controlled by a method similar to that employed in the ordinary electric-car equipment. The car is 65ft. long over buffers, and, when equipped, weighs 65 tons, and although it was not designed for high speed, the average running time was about 35 miles an hour, and on several occasions the car attained a speed of over 40 miles an hour. The engine develops 160 b.h p. at a speed of 450 r.p.m. The cylinders are horizontal opposed, six in number, 9in. diameter, 10in. stroke. The engines are started with a cartridge filled with black powder; the cartridge is fired in one cylinder by a hand trigger, the arrangement being similar to the breech mechanism of a gun.

SOME EARLY PATENTS FOR INVENTION.

By E. S. Baldwin, M.E. (Baldwin & Rayward).

A dip into the forgotten past has a fascination for most people, and it is not generally known that such a peep into a former age can be obtained from the English Patent Records on file in Wellington. They carry us back to the time when the authorised version of the Bible was produced, when Shakespeare was producing his plays and James I. was struggling with the Judges of the King's Bench with regard to what he considered his royal prerogative of interfering in the decisions of the Courts of Law. Between this and his other reprehensible action of putting Sir Walter Raleigh to death, James, however, conferred a boon on future generations by granting the Statute of Monopolies, which gave the sole right to the true and first inventor to use, make and vend an invention within the realm. British Patent No. 1 being the first patent on record is particularly interesting. It might be expected that it would relate to contemporary matters, such as a composition for polishing armour, locks for canals, combined cross-bow and pike, all of which are dealt with by patents immediately subsequent. We find, however, that it relates to the broad and perennial subject of the manufacture of maps and plans. The patent, with naive disregard for patriotism, sets out that London is behind Paris and other continental cities, of which complete plans had been in existence for some time, and the deed confers upon "our lovinge subjecte Aron Rathbone," the sole right to make, use and vend maps of the city of London, Westminster, Yorke, Bristol Norwich, Canterburie, Bathe, and the twoe Vniversities, Oxford and Cambridge, and their suburbs. In quaint terms it sets out that "wee doe by theis p'sentes, for VS our heires and successors, straightlie charge, p'hibite, and forbidd, all and singuler bodies politique and corporate, and all and everie p'son or p'sons, as well as our naturall borne subjectes as aliens, dezines, and stranngers, other than the said Aron Rathbone and Roger Burges, their executors, administrators, deputies, and assignes, and such as shall by them, or some of them, bee sett at worke, lycenced, or authorised, that they or anie of them, do not p'sume, attempte, or take in hande, duringe the the said terms of twentie and one yeares, to make, carve, describe, imprinte, sett forthe, or counterfeite, or sell, utter or dispose of within this our realme, or anie other of our domynions, or exporte out of the same the said mappes'

This document concludes in the following terms. "And lastlie, we doe hereby for VS, our heires and successors will and comande all justices of peace, maiors, sherriffes, bailliffes, constables, and all other the officers, ministers and subjectes of VS, our heires, and successors, to whome it shall or maie appertaine that they and everie of them bee from tyme to tyme aidinge helpinge, and assistinge to the saide Aron Rathbone and Roger

Burges, theire executors, administrators, assignes, deputies, and servantes, in the execucon of theis our Lrs Patente — as they tender our indignacon and displeasure, and will avoid the same at theire Vttermoste perills, although expresse mencon &c."

"In witness whereof &c. Witness ourselves at Westm, the eleaventh daie of March.

Pbre de prinato sigillo, &c."

The principle that an invention must be novel, to be entitled to protection, did not exist in the year 1617, the date of this patent. The applicant was the first to undertake the manufacture in the realm, and he asked for a monopoly, which was granted to him. A somewhat similar provision applies in Great Britain at the present day, where the first importer, though not the actual inventor, is entitled to protection.

Coming now to our own colony, interest centres in New Zealand Patent No. 1. We find it was granted to Purchas and Ninnis, in the year 1857, for treating New Zealand flax. The drawings accompanying the application are very crude. The specification is as follows :—

26 MARCH 1861.

"PURCHAS, Arthur Guyon, Clerk, and NINNIS, James, Mining Registrar, both of Onehunga, Auckland.

(An invention for the preparation of the Fibre of the Phormium Tenax and other plants for the manufacturing purposes).

The specific object of the invention is to separate the fibre of various plants from the cortical and other vegetable tissues of the plants, so as to render the said fibre fit for manufacture into cordage or woven fabrics.

The principle claimed is that of percussion.

The mode of application is by means of beaters, hammers, beetles, or stampers, made of various forms and sizes to suit the particular plant or kind of plant which is to be operated on. The said beaters may be made either wholly of wood or iron, or other metal, or in part of wood and in part of iron or other metal; or of various metals combined; or of any other suitable material; and may have their faces either plain or wrought, and may be made to act either by gravity or springs, or by any other convenient mechanical arrangement; and may work upon either wood or metal, or other material, fixed or movable, with or without springs.

The machinery may be driven by any kind of power.

The raw material is subjected to percussion, either in a fresh state or after maceration, and may be worked either with or without water.

The fibre may be dried immediately after percussion or washed and then dried; or subjected to maceration and further percussion before drying.

Several forms of beaters are shown in the drawing."

By the date of British Patent No. 5 it was apparently recognised that a patent might become a source of revenue to the Crown for we find that Thomas Marraye in return for the monopoly of making swords was compelled to pay "duringe the whole terme of twentie and one yeares, the yearlie some of five poundes* sterling of lawfull money of England into the receipte of the Exchequer at Westm," until the trade be well established, after which "the yearlie rente or some was to be increased to "tenne poundes."

At the date 1627 of Patent No. 38 the "yearlie rente" had risen to "foure hundred poundes" for the monopoly of manufacturing iron.

Patent No. 8 dated January 9th, 1618, approaches more nearly to the requirements of a present-day specification which must "particularly describe and ascertain the nature of the invention"

It reads: "Whereas wee are informed that the said drawing and drayning of myne's, myneralles, and colepittes, and raysing of waters aforesaid, is to be done and performed by the vse of C'teine engines and instrumentes by Robert Crumpe, newly devised and found out as aforesaid, which are farre different and exceeding all engines, instruments, or devises heretofore oute or vsed in or aboute the p'misses (that is to say) by a c'teine hollow trunck or pipe of one entire length, to be made of tymber or leade, which is to reache from the waters that are to be drawne or raysed vnto the toppe or place where the same waters shalbe to vent or yssue forth, att the foote of which said trunck or pipe so made of entyre length as aforesaid, and in some other partes or places thereof, there are to be placed and fyxed C'teine suckers, drawers and other devises, and other engines of brasse, copper, or other metal, and att the vpper part or end of said trunck or pipe there are to be planted and placed severale peeces of tymber fyxed and framed together, wherein are likewise to be placed c'teine suckers, drawers, and other devises, together with one or more wheele or wheeles with spindles and cranks of yron or brasse, whereby the waters may be drawne or raised from any depth whatsoever."

For the monopoly of making the above pumps which avoided the necessity of a series of pumps one above another, Roberte Crumpe was enjoined to pay a yearly sum of ten pounds for twenty-one years.

*The "pounde" of those days signified the pound of silver that was coined into twenty shillings, a shilling, in the middle ages, having had the same value as to-day.—[Ed. PROGRESS.]

CRUISING TURBINES FOR WARSHIPS.

By E.S. FORTIS.

THE application of steam turbines to the propulsion of warships is a more complex problem than that of its application to ordinary mercantile vessels, principally because so much coal is consumed in cruising at low powers and very low speeds. In all cases it involves many elements other than the actual change in the application of the motive power. Thus, if the original propeller and shafting of the ordinary reciprocating (piston) engine are retained, the same speed of revolution of the propeller must also be retained and the turbine engine which replaces the piston engine would compare most unfavourably in weight and space. It is, therefore, necessary to drive the screws at a higher rate, and at the same time the diameter and other dimensions of both the screw and its shafting must be reduced and suited in other ways to the new conditions. In the Amethyst, three screws are used in place of two in the Topaze (piston engines), and the rate of revolution is almost exactly doubled. There is by this means a comparatively large saving in weight and space, because within the same limits about 40 per cent. more power is obtained. In the Carmania (turbines), three screws are also fitted in place of two in the Caronia (piston engines), and the rate of revolution is increased about 90 per cent. This results in an apparent gain of about $11\frac{1}{2}$ per cent. in power and about one knot in speed, with possibly about 5 per cent. less weight. In both the Amethyst and Carmania there is an undoubted gain in economy of fuel, whether it be calculated on a propulsive h.p. basis or in gross weight per knot. The latter is perhaps the more correct way of looking at matters in which turbines are concerned.

A large cruising radius for warships is best secured by limiting the size of the engine to that necessary for some power somewhat below the full power. Naval engines of the piston type have for many years past been designed for a maximum efficiency at about 70 per cent. of the full i.h.p., and this policy seems even more desirable with regard to turbine engines. Turbines used in shore practice for generating electricity, where the brake h.p., or energy of rotation of the shaft, can be easily measured, are well known to be capable of carrying a considerable overload, amounting to nearly 40 per cent. in some cases, with only a very moderate decrease of efficiency, and with a comparatively small increase in coal consumption per unit of power.

The large apparent increase of i.h.p. in the Amethyst may not have been anticipated, but in any case it was considered advisable to fit special turbines on each wing shaft for cruising purposes. Increased work per lb. of steam and economy of steam can only be obtained by increasing the rate of expansion; the same quantity of work, assuming hyperbolic expansion, can be obtained from 1lb. weight of steam, whether it be expanded either from 200lb. down to 100lb. absolute, or from 10lb. down to 5lb. absolute, because the rate of expansion is the same in each case. With the same final pressure, which for turbines is practically obtainable in the condenser, the rate of expansion can only be maintained by admitting steam at its highest pressure. At very low powers the steam is necessarily reduced in pressure by throttling and although some of its heat energy may be devoted to improving the quality of the steam at the instant of admission it has very small useful effect, and does not overcome a decrease in the rate of expansion from, say, 150 (150 to 1lb. absolute) to 20 (20lb. to 1lb. abs.). With piston engines the rate of expansion is fairly well maintained by "linking up" at low powers, and therefore cutting off the admission of steam earlier in the stroke of the h.p. piston.

Cruising turbines are fitted for naval purposes, and being of smaller capacity (and also somewhat differently constructed with regard to blading), the steam commences its work at a higher pressure and thus tends to maintain the rate of expansion. At low powers, with their aid, a higher efficiency than with the Topaze engines can be maintained until the power decreases to about one-eighth of the full power, with a speed of about 14.2 knots. An alteration, by which it is now possible to utilise the auxiliary exhaust steam in the l.p. turbines, is said to improve the economy of the Amethyst still further and to enable it to compare favourably with the Topaze down to $10\frac{1}{2}$ knots. The cruising turbines are not used for propelling purposes at the higher powers, but revolve idly in the vacuum created by the condenser, with the l.p. turbines fitted on the same shafts.

Recent comparisons of efficiency relative to pressure show that there is a loss rather than a gain by using higher pressures for certain single-stage expansion turbines. If this be applicable to the peculiar circumstances of warships, then cruising turbines are unnecessary; but these conclusions point particularly to the economical importance of as little moisture as possible in the steam, both on admission and during expansion, and of expanding in the stages. An excessive rate of expansion in any one stage produces excessive moisture and fluid friction, whose resistance more than counter balances the increment of kinetic energy obtaining from a greater fall in pressure. The percentage of moisture in the steam on its exit to the condenser from turbines is probably double that from piston engines working with similar initial and condenser pressures, which tends to show that the two or three stages of expansion adopted at present are insufficient for the best working economy at full power, and that if a greater number of stages were adopted it would be unnecessary to fit cruising turbines.

Up to the present there has been a disposition in turbine vessels to fit the maximum, rather than the most economical, power within the space and limits allowed. If the engines of the Amethyst had been designed for 10,000 instead of the equivalent 14,000 i.h.p. obtained, would it have been possible to dispense with cruising turbines without any appreciable decrease either in efficiency at low powers or of the highest speed? Every element which contributes to the total efficiency of the propelling plant points to a favourable result. Turbines of smaller power would require less steam, and the boilers, which are now worked above their most economical rate of steam production, would give an increased efficiency of about 13 per cent., making 65 per cent. instead of the 52 per cent. now obtained at full power. The efficiency of the screws, also, principally owing to their slower rate of revolution and to less frictional resistance from a possibly reduced blade area, might be increased from 60 to about 70 per cent. These two elements, without taking into account the possible increases in efficiency which might be obtained respectively from the steam as a working substance, from the engine mechanism, and from the thrust mechanism, would increase the overall efficiency in the ratio of $\frac{65}{52} \times \frac{70}{60} = \frac{35}{24} = 1\frac{11}{24}$, or about 44 per cent. This result corresponds very closely with the apparent increase of power obtained from the Amethyst over the Topaze, which Mr. Parsons puts at 42 per cent. With such a large margin it appears very probable that the full speed of the Amethyst could be obtained from turbines of not much greater than two-thirds of the present power and without serious loss, or possibly without any loss, in efficiency; while at lesser powers a greater steaming radius would undoubtedly obtain at all speeds.

Recent trials and the generally satisfactory working of various vessels prove conclusively the superior economy of steam turbines in fuel, weight and space. Until the establishment, and more or less general acknowledgment, of their merits the fitting of unnecessarily great engine power was excusable; but if my reasoning is correct, and it is frankly admitted that the information on which it is based is not absolutely conclusive, then it should be recognised that there is for each vessel a limit beyond which any increase in power becomes inefficient and practically useless for the purpose for which it is designed. For naval vessels the lower this limit can be pitched, while still retaining, by possible overloading, the highest practicable speed, the more economical and useful will they become for their extended employment as cruisers and for purposes of war.

A train telegraph system, which provides for communication between drivers and stations, and includes an automatic signal in the engine cab to show when another train is in the block, has been invented by an American. Two metallic conductors are laid, insulated to form block sections, and the engines are fitted with the necessary electrical apparatus. When a train enters a clear block the signal in the cab displays a white light; but in case of another train being in the block, or a rail broken, a switch open, a red light would be shown and a bell sounded. The station attendant would also be able to operate the signals on the engine.

COUNTING & COUNTING MACHINES.

By J. Watkin Kinniburgh.

FIRST PAPER.

Although it is impossible to say in what remote age the art of speech began, we may conjecture that the sounds first used, and the signs and gestures which would necessarily accompany them, expressed a very limited number of fundamental ideas, such, perhaps, as would indicate food, danger, etc.; and, judging from the state of language amongst the lowest types of human beings now existing, it may be taken that long ages elapsed between the utterance of the first articulate sounds and the earliest conception of the idea of number—although that of quantity would necessarily be of earlier birth. With the complex human intelligence of to-day, as we know it, it is difficult to imagine a human being with absolutely no sense of number, but it becomes more easily conceivable when we consider that such a sense is entirely absent in the lower animals. Take away one from a litter of kittens in the mother's absence, and upon her return she does not realise that there is *one less* than before. Probably her sense of quantity and locality will tell her that the space and place occupied by her progeny is less, and that there is something wanting, but she has apparently no idea that there are now, say, five kittens instead of six. There are uncivilised peoples to-day whose perception of number is limited to two, three and four, and whose ideas of quantity are simply expressed by words corresponding to "few," or "many," etc., and the entire absence of words expressing notation is not at all rare. There are races in Africa who cannot express numbers in language, even to the extent of the fingers of one hand. Dr. Peacock, early in last century, mentions the Yancos who could not count audibly beyond three because they could not express that idea by anything more simple than Poetar-rar-or-inco-aroac. The aborigines of Australia, probably the lowest in the existing human scale, cannot count beyond four. To the anthropologist the extent of knowledge of numbers possessed by different races, and their systems of verbal notation, are of great importance in forming his theories of origin and migration. A better instance could not be given than the immense difference observable between the lowly and ignorant Australian aborigine and the high intelligence of the New Zealander. Where the former have absolutely no system of notation, the latter, and indeed most of the Polynesian races, have one which, though only verbal, is as perfect as that of Europe in the tenth century, and probably the most perfect amongst uncivilised peoples of the world, a pure decimal system capable of expressing clearly and definitely any number from one to a thousand.

The earliest and most natural means of counting was by means of the fingers, and without doubt the decimal systems were originally derived from this method. The word *rima*, used to express five amongst Polynesians, also signifies the hand. Maoris call the hand *ringa*, but this is only one of the many similar slight differences in Polynesian dialects. Amongst the native Mexicans and the Caribs the same word that signifies a score means "one man," *i.e.*, ten fingers and ten toes.

There is ample evidence existing in the languages of to-day to show that the art of counting verbally, to a more or less limited extent, must have been in use from very early ages. There is not the slightest doubt that we are indebted to the far East for the introduction to the world of the science of numbers, at what time cannot be determined. History fixes neither the author nor the time, but it was not until the adaptation of signs or characters to represent numbers that the science began to assert itself and became capable of written expression.

THE EARLIEST ATTEMPT AT A COUNTING MACHINE.

Centuries before the introduction of the decimal notation to Western Europe the Chinese were proficient in the art of decimal arithmetic, and had devised a contrivance to facilitate their calculations. This invention is probably the oldest existing artificial aid to mental work, and, like many other Chinese inventions, they still use it, not only in their own country, but wherever they migrate. It is known as the Shwampan, and consists of a double series of beads sliding on fixed wires or rods. On the left hand series there are two beads on each wire, and they represent fives, whilst on the right there are five beads representing the numbers one to five. In the illustration the number indicated by the position of the beads is 7,604,823,609. It will be noticed that in this arrangement there is apparently a superfluous bead on each side of the dividing line, and any sum could be indicated by having one bead only in the left hand division, and only four in the right hand. But in the hands of the Chinese these extra beads perform important functions, and are not only used for carriage from one column to another, but for the operations of multiplication and division, so proficient are they in the use of this device.

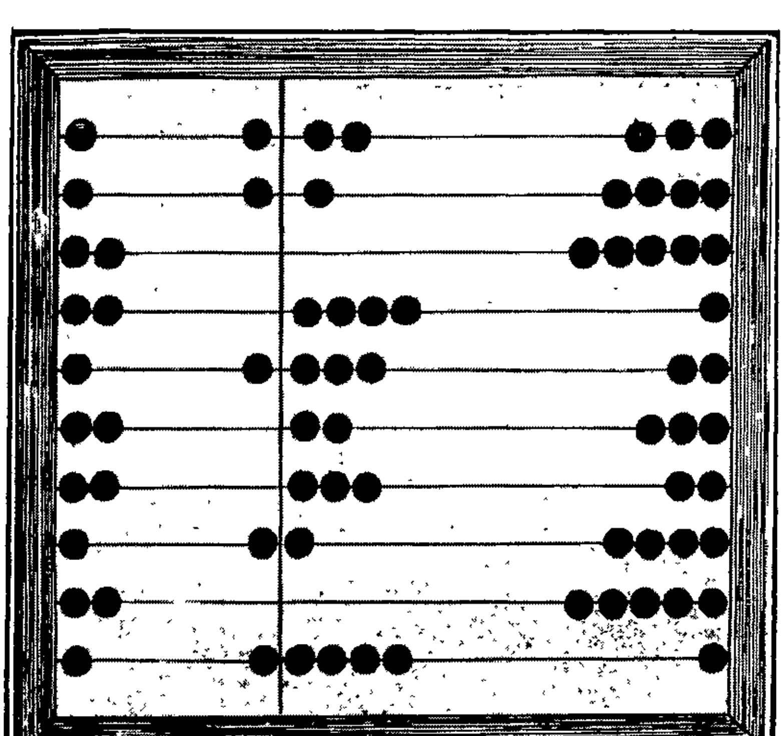
The Abacus, which derives its name from the first letters of the Greek alphabet, but which is plainly an adaptation of the Shwampan, was used in various forms by the ancients, and is used to-day in our infant schools. The form given in the illustration appears to have been one of the simplest and most generally used. It will be seen that in this device the wires contain alternately four beads and one bead. The single bead always represents five, and the others the numbers one to four. A contrivance of this kind could only be used to perform addition or subtraction, but no doubt it was enlarged or improved upon at different times until the introduction of written systems of notation supplanted it.

It was not long after the adoption of the decimal notation that the first modern contrivance for mechanical calculation made its appearance.

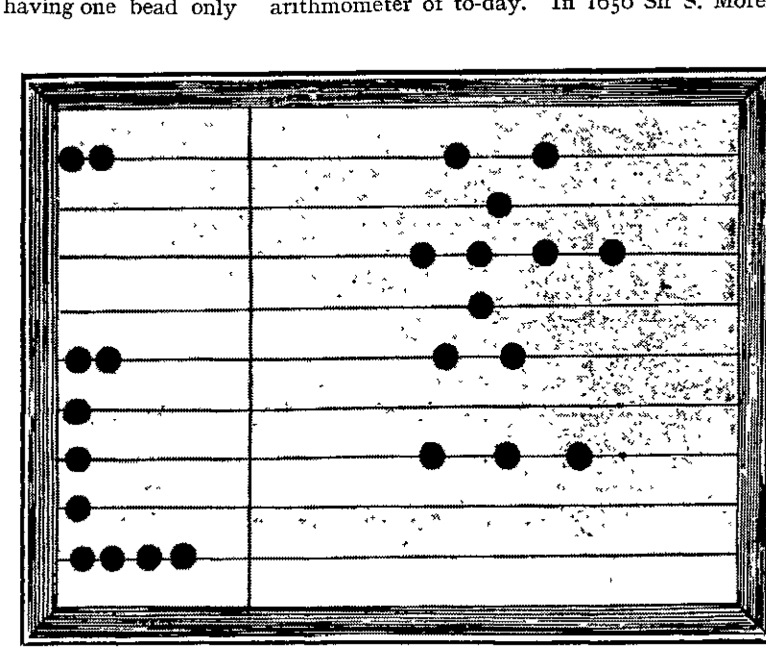
About 1614 Neper, Baron of Merchiston, in Scotland, invented his Rods, since commonly known as "Napier's" Bones. These, as shown in the illustration, consist of a series of rods, the first of which is used as an index rod. Each of the others starts at the top with a unit which is added to itself until, in the bottom division, its sum equals nine times the original number. It is really a movable multiplication table, the principal feature of which is the method of arranging the tens figure of the product on the left of the diagonal line. When it is required to multiply one number by another you place the rods so that the multiplicand appears along the top, and then entering with the unit figure of your multiplier, you set down the result, combining the right hand or lower figure in one diagonal with the left or upper one in the next rod. You then enter the table with your tens figure setting down this result beneath the first, but one figure to the left, as in ordinary multiplication, and so on. The operation of division can be performed almost as quickly as multiplication by arranging the rods to represent your divisor along the top and taking out suitable multiples thereof from the table, deducting them from the dividend, and borrowing for the remainder as in ordinary division.

To enable us to fully appreciate the value of this contrivance we must bear in mind that in those days there were very few who could perform the simplest rules of arithmetic without great labour. The system of notation was novel, and men had not only to learn the new system but to discard the old; they had to unlearn in fact, and a generation must have passed before people became in a degree familiar with the new ideas.

So soon, however, as the notation was fairly understood and taught, inventive genius was devoted towards invoking the aid of mechanics in performing the laborious operations of arithmetic. Gunter's scale was invented about 1620. This was the forerunner of the slide-rule of to-day, and may be, perhaps, considered more as a mathematical instrument than a calculating machine. It consisted principally of a logarithmic scale, and the aid of a pair of compasses was required in working it. In 1642 Pascal, then a youth, devised an arrangement of gear wheels and cylinders to assist his father in special arithmetical work necessitated by his occupation as an officer of the French Government. This machine was the forerunner of the arithmometer of to-day. In 1650 Sir S. Moreland



SHWAMPAN.



ABACUS.

invented a machine for performing the operations of addition and subtraction, following this in 1663 by another for working out questions in plane trigonometry, and yet another three years later adapted for the addition of money.

In 1671 Leibnitz constructed a calculating machine, which was very complicated and never came into general use. About the same time Polenius, an Italian, invented a multiplying machine. In 1700 Deleprene and Boitissendeau brought out a machine for performing the four arithmetical rules. Viscount Mahon made a small machine in 1750, and in 1775 a larger one, and again in 1777 still another, all of which would perform the four arithmetical operations. In 1815 Dr. Roget brought out the double logarithmic scale or sliding rule, thus improving Gunter's invention of nearly a century before. From 1815 to 1871 Professor Babbage devoted his energies to the construction of his great difference and analytical engines. He completed his first difference engine about 1820, and although he laboured at the second and improved one for some fifteen years, and received various sums from the British Government amounting in all to £17,000, the engine was never completed. His great effort was the construction of the analytical engine, which, though certain parts were put into working order, was never completed, and remains to this day a philosopher's dream. He died in 1871, and left no working plans that would assist a successor in carrying on the work, although his writings and descriptions of the engine no doubt opened up the way for the machines that followed. From 1837 to 1842 Sheutz and his son designed and constructed their first experimental machine, but it was 1853 before the complete working machine was finished. This machine is about the size of a small piano, and its construction was doubtless suggested by Babbage's reports. It is in essence a difference engine, and by a simple adjustment would give results in the mixed senary system of notation, as in degrees, minutes, and seconds. It would not only calculate tables but would stereo the results in lead sheets for any number of reproductions. Another important feature of its work was the automatic correction of the last retailed figure of the results which increased by one if the first discarded decimal was 5 or over. This machine was bought from the inventors by an American gentleman, and is now to be seen in the Dudley Observatory at Albany, New York.

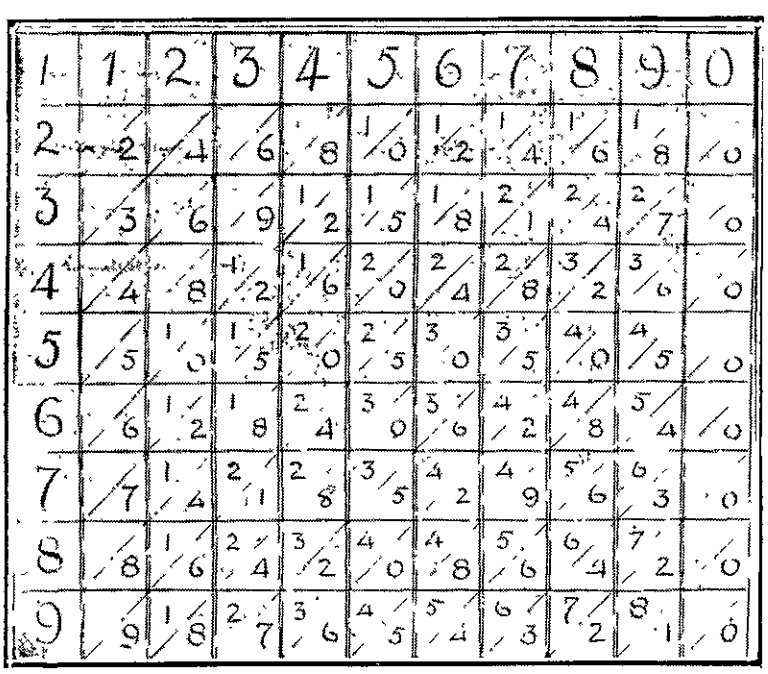
On the strong representations of Dr. Farr, the British Government arranged with Messrs. Scheutz and Mr. Donkin, an English engineer, to construct an improved machine at a cost of £1200. This machine was a beautiful piece of work, and may still be seen in Somerset House by authorised persons. It was used in calculating and stereotyping, at one operation, a large portion of the English Life Table No. 3. The great drawback was its extreme delicacy, and that, combined with its high cost, prevented its adoption for general purposes. About 1840 Staffel, a Russian inventor, brought out a machine of different construction from all its predecessors, but it does not appear to have been successful.

In 1850, Thomas (de Colmar) invented a small machine to perform arithmetical operations. It was improved by him and others, and came into general use as the Arithmometer. About seventeen years ago this machine was further largely improved by an English mechanic named Tate.* It has since been regarded as the standard calculating machine. Hundreds are in daily use in all parts of the world. I have used one of these machines for sixteen years, and it is still in splendid working order. Its mechanism is beautifully constructed, and its workmanship is thoroughly British; not made to wear out in a year or two, but to last a lifetime if it is properly treated. In operating this machine for multiplication, the multiplicand is set on to the bottom plate by hand; the units figure of the multiplier is then expressed by turning the motor handle as many times as that figure represents. The result is shown on the top movable slide, which is then pushed out to the right one division. The handle is then turned as many times as will express the tens figure of the multiplier, the product of which is simultaneously added on to the previous result, and so on. The extent of the numbers to be multiplied together is not limited by the size of the machine, as partial results can be worked and combined.

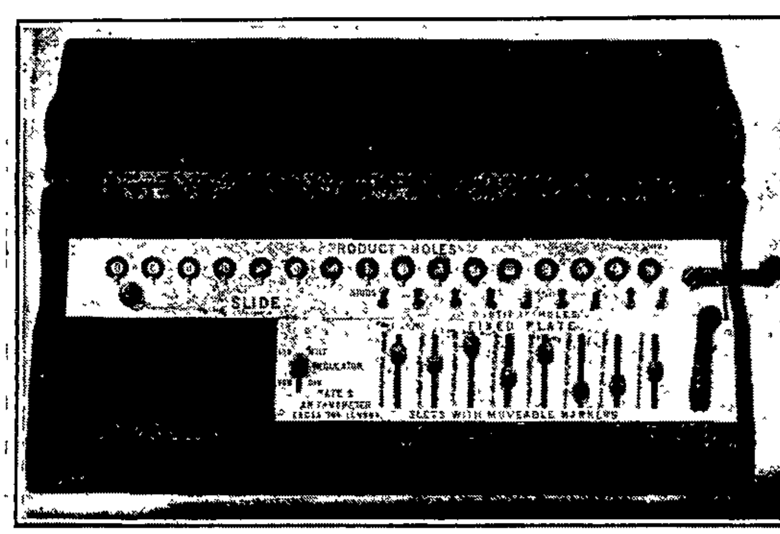
In division the regulator is pulled over to the division sign, and the divisor set on the left of the fixed plate, whilst the dividend is set on the movable plate as far to the left as possible. The handle is then turned until the amount showing on the movable plate becomes less than the divisor, when the movable plate is shifted to the right, thus bringing in a new figure as in ordinary division. The result, the sum of which equals the number of turns of the handle, gradually appears in the small holes called the quotient holes. This operation may also be extended indefinitely.

It is possible, by the use of two or more Arithmometers working in conjunction, to perform the work of a difference engine, but as this paper is not a scientific treatise, I merely state the fact without further comment.

(*To be continued*).



NEPER'S RODS.



IMPROVED ARITHMOMETER.

Distillation of Iron, Nickel, and Other Allied Metals.

In a recent number of the *Comptes rendus de l' Academie des Science*, Moissan describes further experiments on the distillation of metals in the electric furnace. This investigator, who has already succeeded in distilling copper, gold, and the metals of the platinum group, has now turned his attention to iron and its allies (vide *The Times Engineering Supplement*, February 7, 1906, page 47; and March 7, 1906, page 75). Manganese was found to be the most volatile metal of this series, a specimen containing 2 per cent. of carbon readily distilled when heated with a current of 500 amperes and an E.M.F. of 110 volts. The distilled metal was distinctly crystalline. Another sample of this element free from carbon but containing 4 per cent. of silicon was volatilised even more readily, but the ebullition was rendered irregular by the violent evolution of occluded gases. Nickel and chromium came next in order of volatility, about half a pound of the former distilled completely in nine minutes with 500 amperes and 110 volts. In the case of iron, an experimental difficulty arose owing to the molten iron carbide occluding gases and liberating these subsequently with considerable violence as the boiling point was reached, so that a large proportion of the metal was projected from the crucible. In this case the best result was obtained by heating the metal gradually with a current of 1,000 amperes and 110 volts, when 50 per cent. of a 2lb. specimen was volatilised in 20 minutes. The boiling point of uranium is somewhat higher than that of iron, a current of 900 amperes and 110 volts being required to volatilise this element. Molybdenum and tungsten were found to be the least volatile metals of the series and only boiled regularly after prolonged heating with the foregoing current. Like iron and manganese, molybdenum occludes gases when in the molten condition. Tungsten has the highest boiling point of any metal hitherto examined in the electric furnace.

German Locomotive Tests.

The entire space in the June issue of the *Verhandlungen des Vereins zur Beforderung des Gewerfleisses* is devoted to an account of the trials of three different types of locomotives at express speeds on the Hanover to Spandau Railway, over a length of 151.3 miles, more than two hours being necessary for the trip. It was felt that the former speed trials between Marienfelde and Zossen were over too short a length of line to secure accurate results in points of fuel consumption and steam-raising capacity. Even here, however, the fuel needed to get up steam was about 25 per cent. of the whole quantity used for the run. Some details in connection with the running of the Paris and Calais express trains are discussed, and formulæ are given based on these results, obtained by four coupled, four-cylinder locomotives of the Atlantic type. The three test engines are described in detail and fully illustrated. The Hanover coupled, four-cylinder, compound Egestorf engine, No. 608, delivered in November, 1903, was in the best running condition. The Cologne Grafenstaden, No. 58, coupled, four-cylinder compound engine, built in 1902, was not in equal condition; the tubes at the insertion into the firebox leaked badly, and certain of the axles ran hot, and other defects are enumerated. The Elberfeld coupled No. 6 engine, with steam superheat, built by Borsig in 1903, was likewise in faulty condition; the tubes were leaky and other defects were apparent. A detail section is given of the gradients, together with a plot of the curves on the whole length of line selected for these experiments, and full particulars are given of the rails and road formation. There were 20 runs in all, 17 with trains and three light. Very searching tests and measurements here described were taken at intervals of one minute throughout the run in all cases, and the results are plotted as graphic diagrams. External air temperature, wind force or pressure, and temperature of the feed water were likewise ascertained. The intention was to consider both the outward and homeward runs, but it was found that the period arranged for the stay at Spandau did not always suffice to execute the requisite repairs to the engines, so that only the figures on the outward trips were recorded. For various reasons only six of the runs were strictly comparable, and from these a series of tabular statements have been drawn up. The results are fully discussed from the points of view of fuel consumption, feed water supply, steam production, use of oil and grease, speed, tractile power, and vibration, and many other considerations incidentally arising are dealt with by Mr. Leitzmann in this exhaustive essay.

*Since the above was written Tate has put on the market an important machine with much simpler parts and at a greatly reduced price. I have been using one of these for some time and am thoroughly satisfied with it in every way.—J.W.K.

THE PANAMA CANAL.

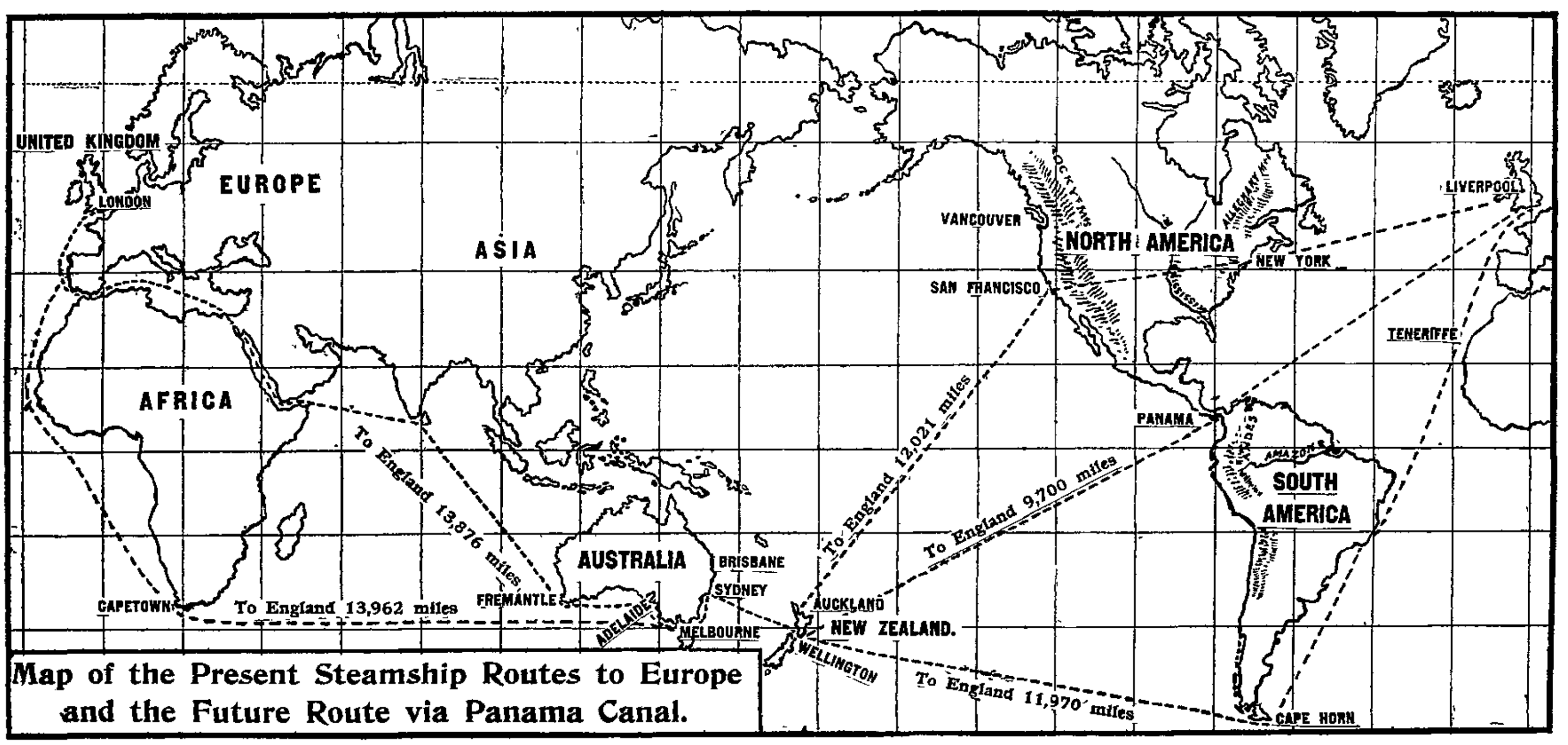
By P. J. O'Regan.

The news recently cabled that a lock canal has been decided on by the American Government, means that the great enterprise of piercing the Isthmus of Panama will be completed much sooner than would necessarily be the case if de Lesseps' idea of a sea-level waterway had been adhered to. The great Frenchman, in his zeal to "marry the two oceans," actually dug a third of the channel; but, though the Americans have for some time been working assiduously on the route selected by de Lesseps, a great deal more will have to be done before reaching the point at which the lock proposal will take shape. The waterway planned by de Lesseps was to 72 to 78 feet wide at the bottom, it was to contain 30 feet of water, and was to be from 92 to 164 feet in width at the water surface. At the Culebra Ridge the waterway was to be three-quarters of a mile wide at the top, and 360 feet deep, or 540 feet as measured by the slope of the cutting on the higher side. The Americans have selected the route chosen by de Lesseps, but their determination to adopt a lock canal necessarily means less excavation. The canal when complete will be 46 miles long, or, if we measure from a depth of 36 feet of water on either side, the distance will be 54 miles. The Suez Canal is 99 miles long, but, nevertheless, the Panama Canal is a much more formidable undertaking, for the Suez route not only has the advantage of several lakes, but lies for the remainder of the distance through a sea of sand. The Panama Canal will follow the bed of the Chagres river for some distance, and this, though it means a saving of labour in one way, implies an outlay of some £5,000,000 for a dam which, when completed, will be by far the largest in the world. The rainy season at the Isthmus lasts about eight months, during which time the rivers are in high flood. The object of the dam is to maintain a normal flow in that part of the river bed which will be included in the waterway, and it will be erected across the valley of the Rio Obispo just above its junction with the Chagres. The proposed reservoir will be 3120 feet long at the base, and 6370 feet at the top, while its height will be 146 feet. By its means the flood water will be held back, and carried off to the sea by lateral channels along the hillside. As one writer has graphically put it, the rainwater will be "hung up" above the river bed, and thus will the Canal be made immune from damage by floods.

What will be the effect of the Panama Canal on the world's commerce? It is impossible to answer the question in the space of an article like this. That the Canal will revolutionise commerce goes without saying, and in this connection the reader may draw his own conclusions by studying the map of the world. Doubtless, however, it will help him if we place a few facts before him, more especially as he may readily verify them for himself. A glance at the map of the two American continents shows that all their great rivers flow into the Atlantic Ocean. The stupendous mountain chain of the Andes runs along the Pacific coast of the Southern continent, with the result that rivers draining into the Pacific are short and rapid torrents, while those pouring their waters into the Atlantic are majestic streams several thousands of miles in length. Turning to the Northern continent we see that two immense mountain ranges—the Rockies on the Pacific Coast and the Alleghanies on the Atlantic—enclose between them the great valley of the Mississippi. The word "Mississippi" is an Indian equivalent for "Father of Waters," and the name is well deserved, for the Mississippi and its tributaries provide about 30,000 miles of navigable water. The Mississippi flows into the Gulf of Mexico, and is therefore shut off from service to the Pacific coast, just as are the great rivers of the Southern continent. The Panama Canal will change all that, for it will enable vessels to sail from the interior of either continent along both coasts. This spells the end of the Panama railway as a means of transit, and it must seriously impair traffic on the American transcontinental rails. But it must also involve an enormous gain to the commerce of the two Americas; in fact, the contemplation of the potentialities of the Canal to American coastal trade enables us to realise that the Americans are wise in proposing to run the waterway at a loss as far as tolls are concerned. They must gain very much in other directions.

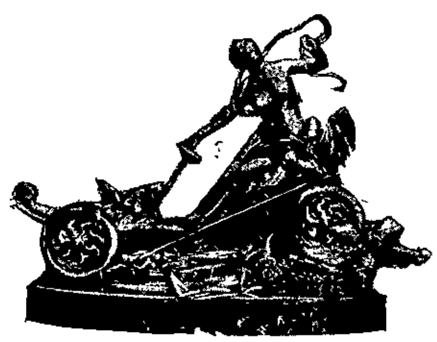
But a question of more practical concern to New Zealanders is the effect of the Canal on their own country and on Australia. A cursory glance at the map of the world shows that, after the Americans, we have more to gain in distance than any other country in the world. Let the reader follow the course of ships from Auckland to San Francisco, let him follow the railroad from 'the City of the Golden Gate" to New York, and thence to London. Then let him follow the dotted line which marks the track of ships from London to Cape Horn and from Cape Horn to Wellington, and he will have a figure approximating to a parallelogram. Let him now draw a line from Wellington or Auckland to Panama, and thence to New York or London, and he will have a line bisecting the parallelogram—in other words, dividing it into two triangles; and, since any two sides of a triangle are together greater than the third side, it follows that the Panama route must be shorter than either of the others. In the course of a lecture some weeks ago on the Canal, the writer mentioned that the Panama route would save 3,000 miles on the route via Cape Horn, as between Wellington and New York or London. A few days later he was assured by a friend that he was incorrect, as there was really very little difference in distance owing to the greater curve in the earth's figure along the Panama route. My authority, however, is Professor Lawrence of the Royal Naval College, Greenwich, and I find the statement fully borne out by a return furnished by the Marine Department and laid on the table of both Houses last session on the motion of Mr. Duthie. Now, a saving in distance of 3,000 miles means a saving of about nine days' steaming, and that surely implies a great gain for the New Zealand producer. At present the Argentine pastoralist can reach London in less than half the time it takes us, but a gain of nine days must give us a decided advantage as compared with the present state of things. I have not as yet, however, touched on a point of much greater importance to us. Let me ask the reader to glance once more at the map of North America, and to note that, with the single exception of San Francisco, all the great American seaports are situated on the Atlantic coast; that is to say, on the side of the great continent remote from us. A shipment of goods, say from New York to Wellington or Auckland, may be sent in either of two ways—it may be borne the whole distance by sea, in which case it would have to come round Cape Horn, or it may come by "the overland route," in which case it would have to be carried by rail from New York to San Francisco, and shipped thence to New Zealand. When the Canal will have been completed, however, neither route will be used, for the goods will be shipped at New York, and borne to their destination by sea in nine days less time than is now possible. Let the reader recollect that sea-carriage is much cheaper than railage, that the Panama route will lie through regions of comparative calm; let him think of the saving involved in the reduced handling of the goods, and he will realise the far-reaching effect of the Panama Canal on the commerce of this country, even if he takes no account of the increased means of propulsion which are certain to be adopted in a few years. Certainly those people who talk glibly about "shutting out American goods" can never have given a thought to the Panama Canal!

One point more: The stretch of ocean between Panama and Auckland or Wellington will constitute the longest run in the world without a coaling station. Hence it seems clear that all steamers coming from and going to Australia, via Panama, must touch either at Auckland or Wellington. This fact alone must be one of great importance to New Zealanders, and many others equally interesting and reassuring will suggest themselves to the reader who considers the points I have touched upon. The Canal will in all probability be completed by 1914—that is to say in eight years hence, and let us hope that many who read this article may yet enjoy the luxury of a journey to the other side of the world by the new route. Increased commerce means increased travelling facilities, and a closer spirit of brotherhood as between nations. We may say with confidence that this wonderful undertaking will contribute in no small degree to abate the dangers of insularity to the people, both of this country and of Australia. I have given but a rough outline of the picture. The careful reader may complete it for himself and he may even realise that the federation of mankind is not after all the idle dream of impracticable visionaries.



Map of the Present Steamship Routes to Europe and the Future Route via Panama Canal.

At a preliminary meeting held on the 26th June last the *modus vivendi* of the Feilding Road Car Co. was discussed. A condensed report appears elsewhere in this issue.



The ....Motor.

MOTOR NOTES.

BY "ACCUMULATOR."

The N.Z. Automobile Co. Ltd. was incorporated on the 13th ulto., with Mr. H. Leicester as secretary.

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Fig. 3 illustrates an 8-h.p. Reo car recently delivered to Dr. Douglass, of Nelson.

* * * * * *

The Government have under consideration a scheme for employing motor delivery vans in connection with the State Coal Department.

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Two of the well-known Yorkshire patent steam wagons will shortly arrive in the colony for use in the brick-carrying trade.

* * * * * *

The N.Z. Automobile Co. report that they have disposed of fifteen Ford cars during the past two months.

* * * * * *

A new Dennis petrol-driven 'bus, with patent worm drive, is to arrive in the colony at the end of August. The agents are the N.Z. Automobile Co., Wellington.

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The widespread strike in the French motor industry will, if continued, render acute the already serious delay in the delivery of various commercial motors, including motor omnibuses.

* * * * * *

It has been found by a representative of the *Daily Mirror* that it is possible to travel round London by electric tram cars and motor 'buses, covering no less than 79 miles in 12 hours, at an average cost of one halfpenny a mile.

* * * * * *

Fig. 1 illustrates a 16-h.p. Reo car which won the Mount Washington International Climbing Contest, and lowered the record of its class 23 minutes in 8 miles, beating its nearest competitor by 8 minutes. The Mount Washington Climb means 8 miles of steep, rocky road.

* * * * * *

In the course of his speech at a luncheon given by the directors of the Daimler Motor Company, Limited, at the Coventry works, on the 2nd June, Mr. E. Manville, chairman of the company, announced the fact that the Daimler works would, at no distant date, be turning out large numbers of commercial vehicles.

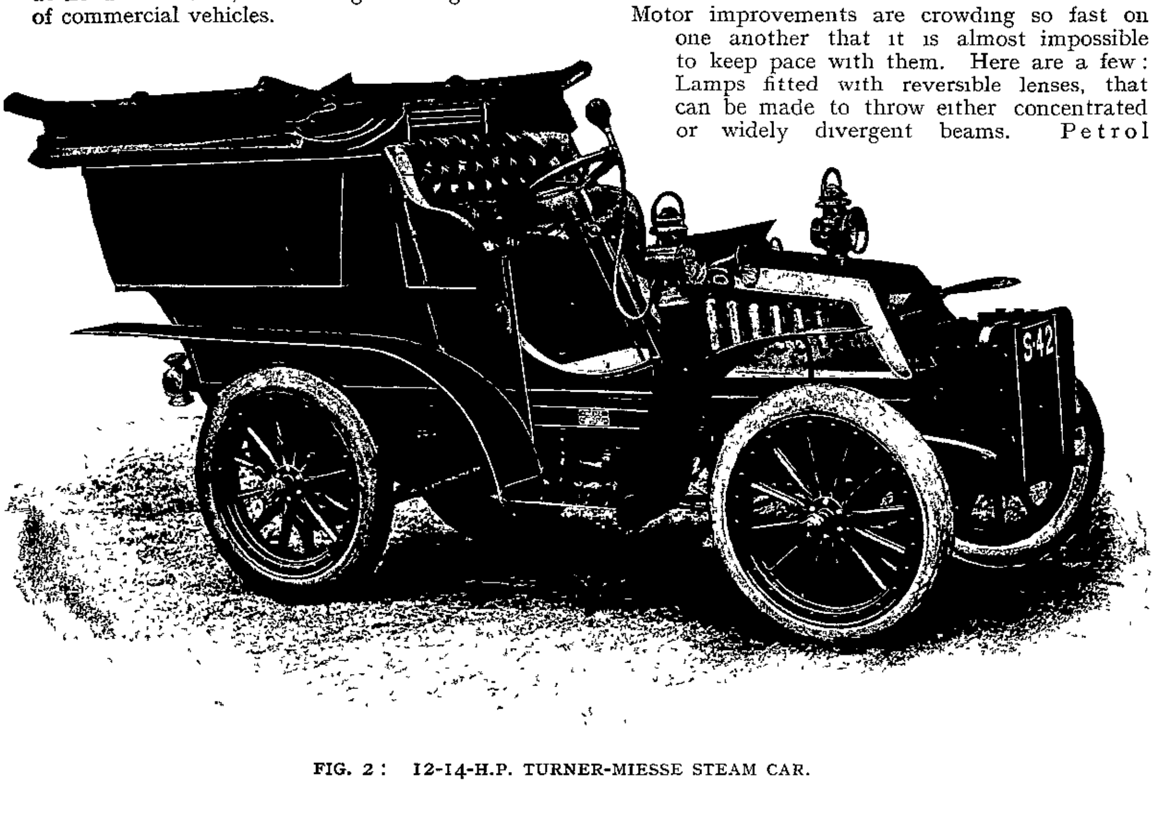

FIG. 2: 12-14-H.P. TURNER-MIESSE STEAM CAR.

Some interesting correspondence from the Turner-Miesse Co. appears in this issue. It seems that this company considered our enquiry which appeared in the March motor number as to "Where are the Steam Cars?" of sufficient value to warrant their supplying the answer. Their letter will be found on another page.

* * * * * *

Edinburgh Corporation has to be added to the list of local authorities which are modifying their tramway projects owing to the arrival of satisfactory motor 'buses. The last month has witnessed the excision of all clauses from the Corporations Bill, now before the British Parliament, which contain proposals for tramway extensions in the suburbs.

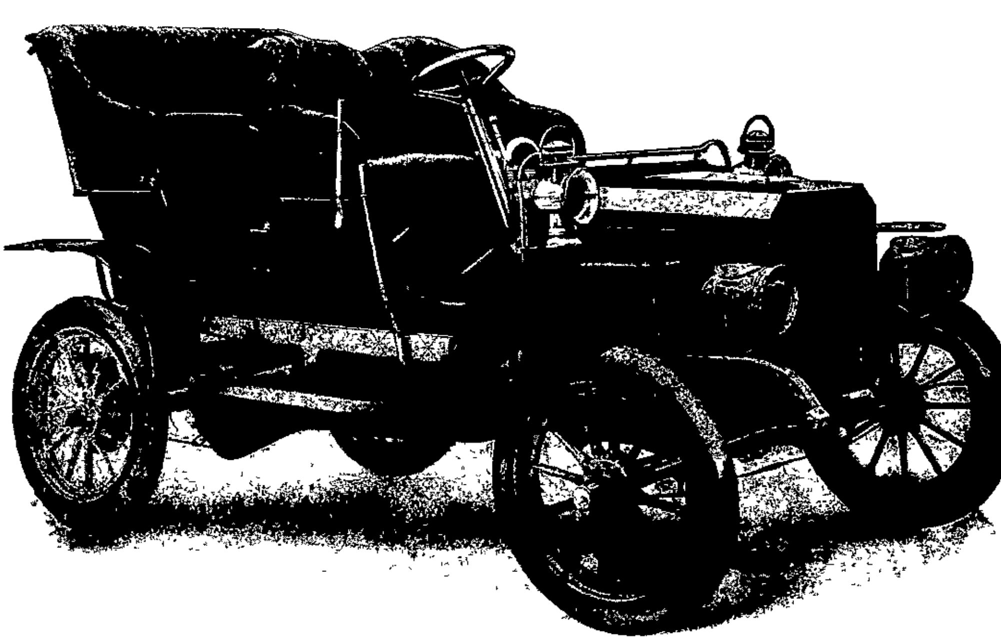

FIG. 1: 16-H.P. REO CAR THAT WON THE MOUNT WASHINGTON (U.S.A.) INTERNATIONAL CLIMBING CONTEST.

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Fig. 5 is an illustration of the Reo 16-h.p. 10-passenger 'bus, with a speed of 18 to 20 miles with a full load. This car is the machine that won the American National Trophy at the recent 6 days' Economy Contest. The machine carried its full load for six days, travelling 682 miles at a total cost of 10/8 per passenger. This car also won two other medals, in the same Contest, for economy, including tyre charges, and another trophy for the least gasolene cost per passenger.

* * * * * *

Motor improvements are crowding so fast on one another that it is almost impossible to keep pace with them. Here are a few: Lamps fitted with reversible lenses, that can be made to throw either concentrated or widely divergent beams. Petrol gauges which show the state of the tank. A combined watch, compass, and aneroid barometer fastened to a patent speed gauge. Goggles made with side mirrors working on hinges, by which the driver can see behind him without turning his head or taking both eyes off the road in front. The safety glass screen is a triumph. Two sheets of plate glass are fastened together with a sheet of celluloid between them, and the result is that when indignant foot-passengers heave half bricks, or the car tries to ride over a bull, the glass does not splinter. It merely "stars" or cracks. The celluloid sheet keeps the pieces in place, and it is just as transparent as the single sheet of glass.

* * * * * *

The new motor car which has been built for Mr. G. W. Perkins, the American millionaire, puts all others in the shade. It has a drawing-room and a bed room. The former is furnished elegantly, and has revolving chairs fastened to the floor. The bed room has a couch and a complete dressing-table. There is an electric light over the couch, so that, when reclining, the millionaire may read comfortably. There is a megaphone over the head of the chauffeur, connected to speaking tubes to various portions of the car, so that commands may be passed without moving. Electric heaters warm the apartments throughout, and at the back there is a dainty little cooking kitchen. There is a roll-top desk in the passage way, and Mr. Perkins uses this on his journeys for his correspondence. The car cost £5,000, and in case Mr. Perkins wants a run for mere enjoyment, he is having another car built of an ordinary pattern. Apparently the £5,000 affair does not conduce to enjoyment.

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From the bulk of correspondence received by the last American mail we learn that almost every British and Foreign motor-car factory is overtaxed with Home orders. So much so is this that great difficulty is experienced in filling colonial demands. Indeed, the factories which have contemporaneously gauged the dual requirements of a Home and export trade are virtually the only ones which can entertain colonial orders at the moment, and, possibly for some time to come. Amongst these the Argyll people may be reckoned with as displaying a prescience that has no record in the chronicles of a similarly expanding industry. A few years ago this celebrated Scotch concern foresaw the congestion that would ensue on the non-completion of all orders, whether Home or Foreign, with the result that to-day they can boast the largest and most complete plant in the world, a plant that is enabling their famous product to reach out to the most distant parts of the habitable globe in fulfilment of urgent orders. Other British firms which have kept pace with the times are the Napier, Wolseley, Turner-Miesse (steam), and Alldays, all of which are pushing export trade to the detriment of the products of less resourceful concerns.

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Mr. J. Liddiard, writing to PROGRESS, under date 25th May, 1906, says:—"The motor 'bus, as Londoners have it, is by far the most remarkable of modern street developments. The other day I stood in the Edgeware road for 10 minutes, and during that time there passed 18 motor 'buses, larger and more comfortable in every way than the old horse 'buses.

Twelve months ago there were about 10 motor 'buses in the whole of London, the pioneer line selecting Edgeware road as its route. At that time the vehicles were about half the size of the present ones, they had no outside seats, and five minutes inside were sufficient to suffocate the passenger with petrol fumes. But one never spent five minutes inside, for the sufficient reason that after about two minutes the rattle-trap broke down, and somebody had to spend half an hour underneath fixing it up again. Also, the ancient motor snail could only go a limited distance, because it couldn't negotiate the hills. At the present moment there are thousands of motor 'buses in London, and they take the hills at a handspring, nor do they stink nor break down. And the monopolistic General Omnibus Company, which grinned contemptuously at the petrol car at first, finds itself outpaced by eight or ten rival concerns, and it is spending the whole of its time placing orders (on the Continent, of course—this is "Freefood" England) for motor 'buses, and finding new routes for old horse vehicles that took two hours or thereabouts to do six miles. Likewise, it is revising its scales of charges in a tremendous hurry, for you get an extra-sized penn'orth when you take a motor 'bus."

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Fig. 7 represents a 16 h.p. 3-cylinder compound light touring car constructed by the E.H.V. Co., Middletown, Conn., U.S.A., and from the specifications received by last mail we take the following particulars :—

Seating capacity, five ; wheel base, 96½" ; tread, 56½" ; drive bevel gear shaft or double chain, direct on high speed ; tyres, 28 x 3½" ; weight, approximately 1,650 pounds, empty ; colour, maroon and dark red ; upholstering, best of leather, genuine hair filling, double woven springs in cushion ; equipment, two oil side and one tail light, horn and tube, tyre pump, two extra spark plugs, extra valve and Champion repair kit of tools in canvas case.

Fig. 4 represents a 16 h.p. 3-cylinder Doctor's Stanhope constructed by the same company. The body of this car is of special aluminium ; seating capacity, two ; wheel base, 82" ; tread, 56½" ; drive, bevel gear shaft or double chain, direct on high speed ; tyres, 28 x 3" ; weight, approximately 1,400 pounds, empty ; colour, maroon, dark green or black ; top, Stanhope, best buffed leather ; upholstering, finest quality of leather or broadcloth, with pockets in the sides of seats and large easy springs at the back ; equipment, two oil side and one tail light, horn and tube, tyre pump, two extra spark plugs, extra valve, and Champion repair kit of tools in canvas case.

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Fig. 6 depicts a 30 h.p. 4-cylinder Peerless touring car, the following description of which has reached us from the Peerless Motor Car Co., Cleveland, Ohio, U.S.A. —

Motor.—Vertical four cylinders, water cooled. Cylinders cast in pairs, valves on side, interchangeable and mechanically operated. Crank shaft, connecting rods and bearings readily accessible. All gears housed and oiled by splash. The Peerless 1906 motor, like all other Peerless motors, is so built as to give the greatest possible power and speed. At the same time the greatest care has been taken to make the 1906 engine so simple in construction and so readily accessible that it is easy to keep in perfect condition, even in the hands of the layman who knows very little about gasolene engines. The cylinders are cast in pairs for compactness and rigidity.

Valves.—The intake and exhaust valves are located in offset ports on either side of the engine, and are mechanically operated by half-time shafts. Intake, exhaust valves and springs are all interchangeable.

Compression.—The cylinders are of a special material, carefuly bored out, reamed, then lapped or polished, so that the inside surfaces are smooth and perfect when cars are shipped out. The advantage is good compression, even when the motor is new ; it does not have to be worn in service before developing its best power and efficiency. Even the head of the combustion chamber is finished so that no fin or projecting point can become unduly heated or collect carbon deposits which cause premature ignition and consequent injury of the motor. This also gives us the same number of cubic inches in each cylinder.

Balance.—The piston and rings, connecting rods and wrist pins are all carefully machined, not only to ensure a perfect fit, but so that they will weigh exactly alike. Therefore, the motor is evenly balanced and runs almost without vibration and with a minimum of wear.

Lubrication.—Lubrication of the pistons is effected through tubes running to cylinders from the forced feed lubricator.

Accessibility.—As an example of the accessibility of the motor, the lower half of the crank case is divided into two parts. The lower section is so designed as to be readily removable without taking the motor from the frame or removing the dust pan or any part of the car. By simply removing a number of bolts this lower part of the crank case can be dropped, exposing the crank shaft, connecting rods and bearings for inspection and repairs. In this lower section a long groove or pocket projects below the bottom of the crank case and is tapped out at each end to receive a plug. These plugs can be removed in a minute's time, and with them all foreign matter and dirty oil. The crank case can then be flushed and refilled, and the owner satisfied that his crank case has clean oil and that his lubrication is properly taken care of.

Crank Shaft.—The crank shaft is of solid drop forging, specially hardened and ground to exact size. The bearings, three in number, are unusually large and are of a special white bronze metal, which affords the very best wearing qualities.

Gear Housing.—Every gear of the motor is housed in an oil-tight compartment of the crank case and runs in oil. Even the water-pump gear is housed, and likewise the governor which is carried in the half-time gear wheel, and only its working arm protrudes through the case. This ensures an almost noiseless motor, and one where wear of working parts is reduced to the lowest possible factor. Oiling of the crank-shaft bearings and wrist pins, cam shaft and cams, is by splash from the dip of the connecting rods into the oil in the crank case.

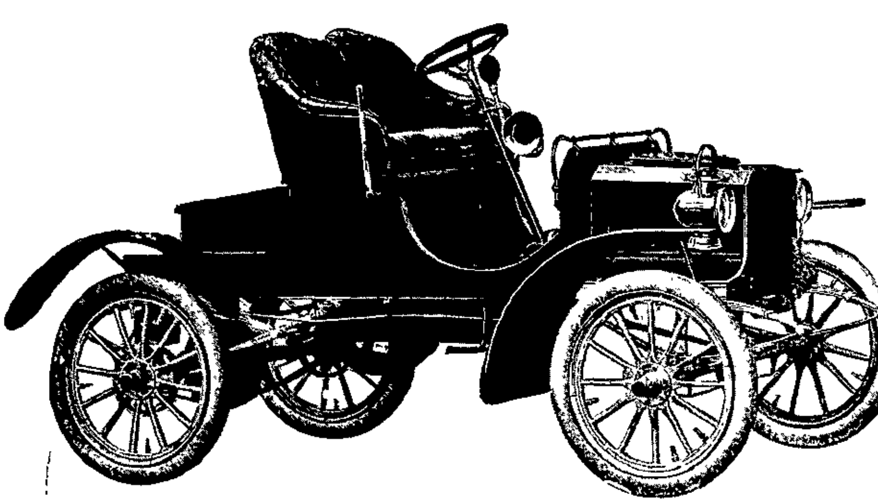


FIG. 3 : 8-H.P. REO CAR RECENTLY DELIVERED TO DR. DOUGLASS, NELSON.

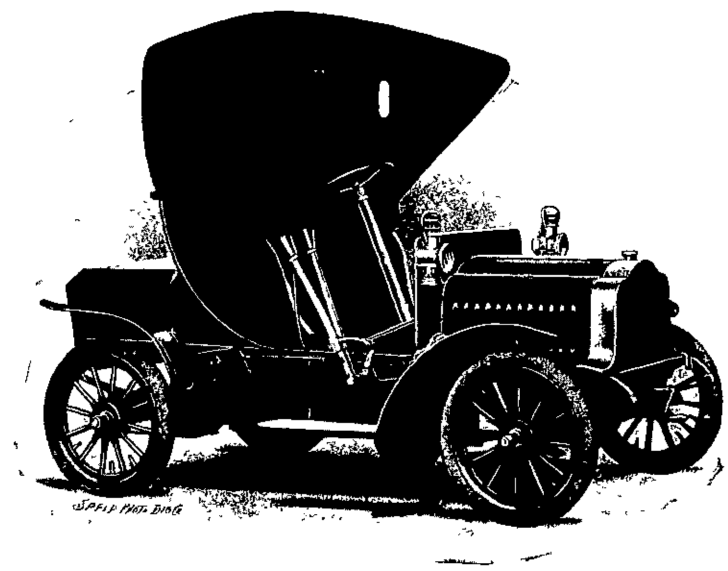


FIG. 4 : 3-CYLINDER 16-H.P. COMPOUND DOCTOR'S STANHOPE.

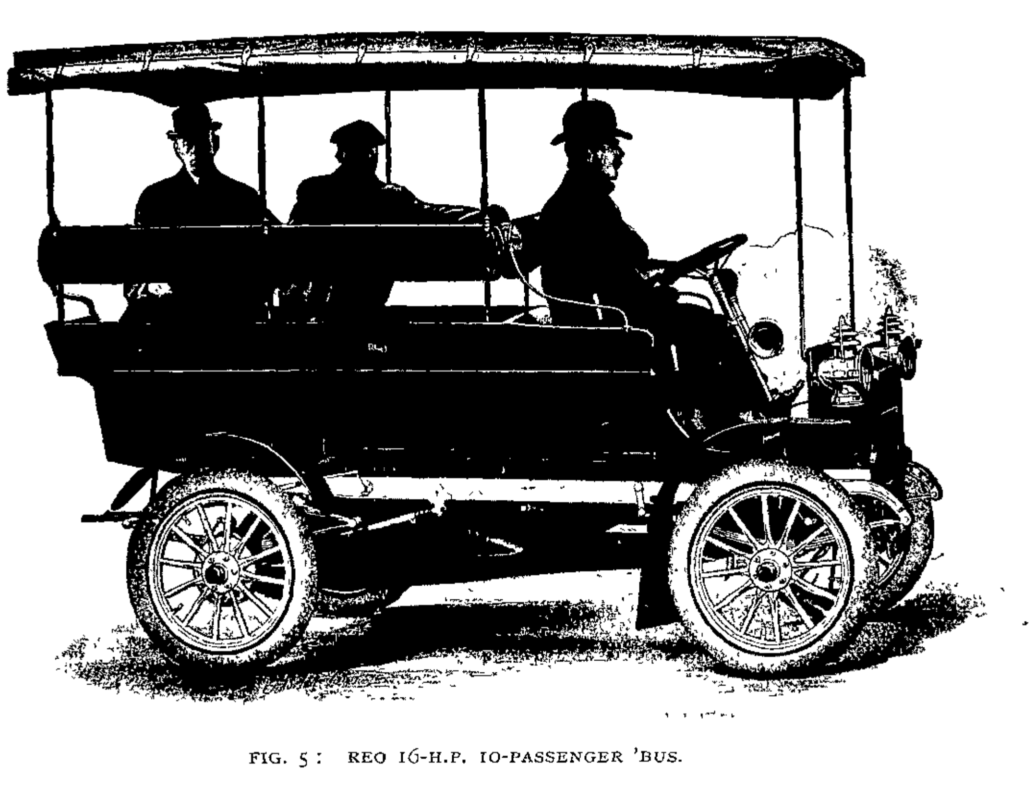


FIG. 5 : REO 16-H.P. 10-PASSENGER 'BUS.

Where are the Steam Cars?

The Editor, PROGRESS.

Sir,—We have perused with interest your article in the issue of March 1st, "Where are the Steam Cars?" We cannot agree with your statement that the machinery in a steam car is more complicated than that of a petrol car, or more liable to get out of order. We claim that a steam car is less complicated than a petrol car and less liable to get out of order, and we think we could bring ample proof of the justice of this contention.

Will you permit us to call your attention to the following two letters which appeared in different motor journals. The writers of both these letters are private individuals without any mechanical experience:—

"*Re* Turner-Miesse steam cars. I have had mine for over 7 months, and have driven over 1,800 miles. I have never had anything happen to any part of the car or machinery, and I have not looked at the engine or ground in a valve. I clean the nipple each journey, and don't have any trouble with the furnace. I have had to tighten the brakes (owing to wear), but the engine, pumps, and generator have given no trouble at all, and I have had but one puncture. I drive the car myself and a boy does the cleaning down. If I were to sell this car, I should buy another with a larger body, as there is ample power. I went to London recently with five up, and had a good tour round, altogether about 350 miles, and no trouble at any time. My first stop was at Bishop Stortford, 80 miles, and I filled up with paraffin and water as it was a handy spot. I consider the great advantage of a good steam car lies in what it has not got, viz. sparking plugs, accumulators, coils, gears, clutch, etc, and another thing: I once had a rare bang on the arm in starting up a petrol engine, and don't want another. By all means go for a Turner-Miesse · treat it properly and you are bound to have complete satisfaction."

"Your correspondent 'W.R.C.R.' wishes to know of the good points of steam driven cars. Let us consider the ultimate aims of the makers of petrol cars which are reliability, power, ease of control, flexibility, cheapness of running, ditto of maintenance (including tyres), silence, simplicity. The Turner-Miesse cars have all these good points, and in addition, no changing of gears, no clutch, and no electricity. As a private owner, I have driven one of these cars (a 10 h.p.) for a year and a half, and am very pleased to be able to say a good word for them."

Further, you state the cost of running per mile is greater with a steam car than with a petrol car. This, again, we do not consider a correct statement. The consumption of paraffin or kerosene, by a 10 h.p. Turner-Miesse steam car, carrying a load of four or five passengers, is approximately 1¼ gallons per hour. You will observe that the Turner-Miesse steam cars use kerosene as fuel, and we think you will admit the great advantage of being able to use a fuel which, we understand, can be readily obtained in your country at a moderate price. We feel quite sure that you are entirely unprejudiced, and that you will grant us the necessary space to remove any misapprehensions that may be caused by the article in question. We are pleased to say that the modern steam cars of the type of the Turner-Miesse are growing steadily in popularity in this country. We are increasing our output every year, and if any of your clients are desirous of taking up an agency, we shall be pleased to send full particulars on receipt of enquiry. We should also like to take this opportunity of informing your readers that we are now manufacturing light steam commercial vehicles, using ordinary kerosene as fuel, carrying a load up to two tons, or 16 to 20 passengers. The construction of these vehicles is so simple that they can be placed in the hands of any man of average intelligence after a short tuition, with complete success.—We are, etc.

TURNER'S MOTOR MANUFACTURING CO., LTD.,
J. B. DUMBELL,
Managing Director.

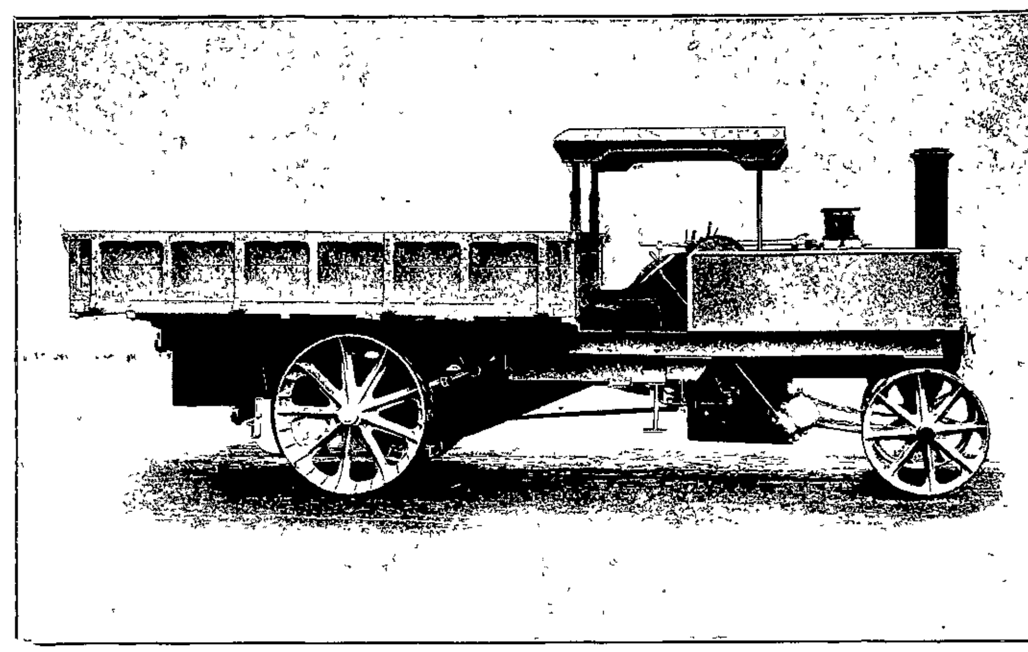
Economical Motoring.

REMARKABLY LOW RUNNING EXPENSES OF A 10-12-H.P. "ARGYLL."

ABOUT a year ago, says *The Sketch*, of May 16th, 1906, Argylls London, Limited, which is the independent company formed to take over the retailing of Argyll cars in London and a certain distance round, were, in the person of their chairman and managing director, Mr. Eustace H. Watson, seized of an idea—to wit, to offer a prize of five pounds and a certificate to any paid driver of an Argyll car who had driven his car five thousand miles at a minimum cost for fuel, repairs, etc. The first claim has been made by W W. Parks, a driver in the employ of Messrs. McDowall, Stevens and Co., who ran a 10-12 horse-power two-cylinder Argyll car for the conveyance of their travellers in and about London. The figures as detailed hereafter, show a total expenditure of £25 11s. 3d. so far as actual running costs go. This works out at 1.181d per mile, while the petrol consumption is at the rate of 16.74 miles per gallon.

The major portion of this tour of 5,000 miles odd has been covered over London streets, which, as is well known to all who drive much in the congested thoroughfares of our overgrown city, cause much waste of fuel by the frequent starting, stopping and declutching they necessitate. Under such circumstances it cannot be gainsaid that the figures are very creditable, not only to the driver but to the car. This will be readily admitted when I point out that the maximum amount allowed for expenditure by Argylls London to any driver applying for the premium is £42. Mr. Watson informs me that there are a number of drivers in charge of both two and four cylinder Argylls who are almost on the point of completing the 5,000 miles necessary to qualify for the prize and certificate, and that these will be able to show figures as satisfactory as those here quoted.

At the risk of a suggestion that I am dwelling at too great a length upon one subject, I shall venture to give the items making up this total amount of £25 11s, 3d. Expenditure: petrol, 310 gallons, £11 7s. 2d.; engine oil, 13 gallons, £2 10s.; machine oil, 10s.; grease and paraffin, 4s. 3d.; paste, dusters and waste, 13s. 9d.; renewals, 4 sparking plugs, 6 valve springs, 1 fan belt, 2 ball races, £2 9s. 10d.; repairs and adjustments, £6 16s. 6d.; sundries, 19s. 9d.; total, £25 11s. 3d. Other amounts given, which clearly cannot be put to running charges, are tyre, one inner tube (not used) £1 14s.; sundries, oil-can, 1s. 6d.; 1 spoke brush, 2s. 6d.; hose for garage, £1; 1 second-hand accumulator, 10s. No figures are set down for charging accumulators, as they were charged from the firm's electric light installation.



A NEW TYPE OF STRAKER TIPPING WAGON, 25 OF WHICH HAVE RECENTLY BEEN DELIVERED TO THE BRITISH GOVERNMENT.

Motor Boots.

Parisians were recently startled by seeing a big-booted man whizzing along the Avenue des Champs d'Elysees and thence to the Bois de Bologne at the rate of 25 miles an hour. It was M Constantini, inventor of motor boots, displaying his new footwear. The boot resembles tiny automobiles, 15 inches long fixed on high boots. Each has four rubber-tyred wheels eight inches in diameter. Accumulators are carried in a belt. They transmit by wires one and one-fourth horse power to each motor. The motor can be run at a speed ranging from 6 to 30 miles an hour. Each boot weighs 16 pounds, but as the feet are not lifted up the weight does not matter. Constantini claims to have travelled several hundred miles with them. He intends to travel from Paris to St. Petersburg on them.

A postal card from the globe-circling motorist, Mr. Charles J. Glidden, has been received from Saigon Cochin China, showing that his mileage up to the 24th March had reached 32,000 miles, covering a period of 257 days. In a postcript Mr. Glidden adds that "China and Japan come next. Have planned fifty thousand miles in fifty countries, to finish 1911."

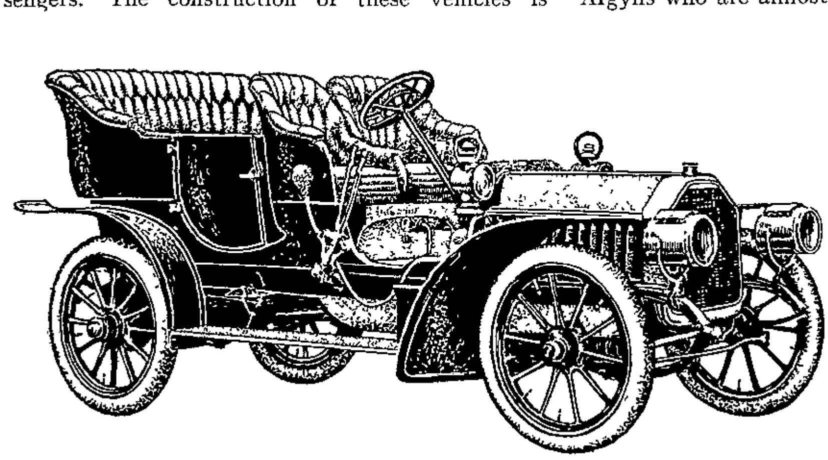


FIG. 6: 30-H.P. PEERLESS TOURING CAR.

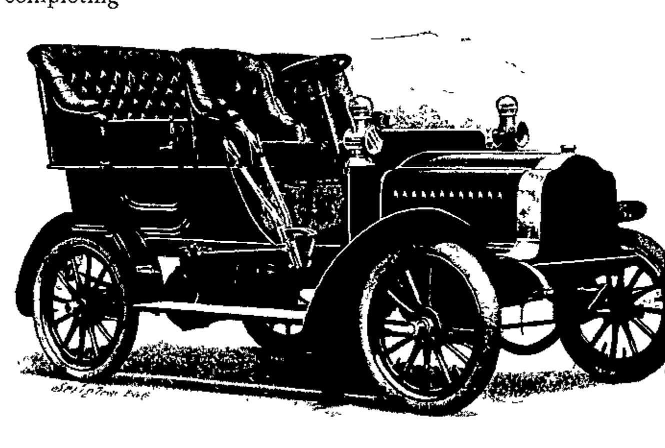


FIG. 7: 16-H.P. 3-CYLINDER COMPOUND LIGHT TOURING CAR.

THE ROTATION OF THE EARTH.

EVERY schoolboy nowadays is taught something of the physical nature of the earth on which we live, and any one who should venture to say that the earth does not revolve on its axis, but remains stationary while the heavens revolve around it, would be treated as a Rip Van Winkle, and even children would smile at his ignorance. But if he should ask for proof of his error, what percentage of the general public could supply it? In this matter the great majority of mankind walk by faith and not by sight, for the rotation of the earth is not obvious to the eye. Indeed, what is obvious to the eye is rather in favour of our hypothetical Didymus, for each day we see the sun rising in the East in the morning, passing across the heavens and setting in the West in the evening, while the stars in the same way appear to revolve round our earth. It is true that this phenomenon, when intelligently considered, is seen to be compatible with a theory of rotation of the earth on its own axis, but it does not give a conclusive proof, and for this we must seek elsewhere. Some might be satisfied that this theory is correct on the ground of its greater probability and rationality, as, while the other and older hypothesis, if correct, would involve the conception of tremendous velocities of travel of the sun, and still more of the stars, in their orbits round the earth, the modern hypothesis only demands a peripheral velocity at the earth's equator of a little more than 500 yards per second. Still, is there any means, we are led to ask, by which the rotation of the earth can be made manifest to the eye?

We owe to a French physicist, M. Leon Foucault, a very beautiful and simple experiment which proves conclusively the truth of the theory of the earth's rotation. This experiment has been recently repeated by French astronomers and physicists in the Pantheon at Paris, the scene of Foucault's classical demonstration fifty years ago.

The apparatus for the experiment may be readily obtained by all, as it consists of nothing more than a simple pendulum. Let a small pendulum—a lead ball hung by a fine steel wire—be suspended from the summit of a wooden frame similar to that seen in the photograph, and place the frame upon a smooth table. Now set the pendulum swinging in any fixed direction, and while it is swinging, give to the frame-work a slow movement of rotation round a vertical axis. What happens? It will be seen that the pendulum does not follow the motion of the frame, as might be expected, but continues to swing in its original plane of vibration, or in a plane parallel to it if the point of suspension has been moved relatively to the table while the frame was being rotated. If the frame is turned through a considerable angle from the position it occupies in the photograph, the pendulum will still remain swinging in one fixed direction, namely, towards the window opposite the observer.

Foucault started with this little experiment in order to illustrate the fundamental principle that the plane of oscillation of a simple pendulum remains constant in direction and then by a slight modification of the experiment he applied this principle to test whether the earth is in rotation or not. Draw a line on the table above which the pendulum has been suspended, and let this line pass directly under the point of suspension of the pendulum. Set the pendulum to swing in a vertical plane containing this line, so that the bob of the pendulum, when it begins to swing, passes backwards and forwards along this line and close to it. Now if the earth does not rotate, but remains fixed in space, this line on the table must remain fixed in direction, and as we have seen that the direction of oscillation of the pendulum also remains fixed, we should expect to find that the pendulum would never deviate from this line which it followed at the outset. On the other hand, if the earth does rotate, then the direction of a line such as that we have drawn is constantly changing in space. So far as surrounding objects on the earth are concerned, no change of direction is evident, for these are all subject to the same movement; but if the line was drawn originally to point to a particular fixed star, in a short time it will no longer point to that star but to another part of the heavens. Assuming then that this relative motion is due to the rotation of the earth on its own axis, we see that the line is actually changing its direction from moment to moment. But the pendulum does not change its direction and there should therefore be an apparent deviation of its line of oscillation from the line on the table which it originally followed. We should expect to find after a time that, instead of following the line on the table, the pendulum would swing in a direction crossing that line at an angle.

Under the two hypotheses, then, we must expect quite different results in this experiment. What actually happens? Foucault showed that the pendulum gradually deviates from the original line, and that if instead of one line we place on the table a large chart marked like a compass card, with its centre directly under the point of suspension of the pendulum, the direction of oscillation of the pendulum will appear to change gradually from one line to the next till it has completely "boxed the compass" and has returned to its original line. The actual time taken for a complete circuit depends upon the position of the place of observation upon the earth's surface. If the experiment were made exactly over the North or South Pole, the period of revolution would be exactly twenty-four hours, and the pendulum, passing through an angle of 15° each hour, might be used as a clock; but in latitudes such as those of London and Paris, the period is increased by the fact that the vertical at these places after a time ceases to coincide with the central position of the swinging pendulum, but makes an angle with it. At Paris, where Foucault made his experiments, the period of revolution is about thirty-two hours. At the Equator, if we swing the pendulum in the Equatorial plane, then the rotation of the earth does not alter the direction of this plane, and therefore the pendulum should not show any deviation, as observed in higher latitudes. This has been tested by experiment at Quito, only a quarter of a degree from the Equator, and the pendulum showed no deviation. Thus we have clear and striking proof that the earth does rotate, a proof that appeals to the eye and is not difficult to understand.

Foucault's original pendulum was only 6½ ft. long, and with this he conclusively proved his

FOUCAULT'S PENDULUM FOR DETERMINING THE ROTATION OF THE EARTH.

case. But for the purposes of better demonstration he began to look out for opportunities of using long pendulums, as he thereby could obtain very slow and steady oscillations. At the Paris Observatory he was able to repeat his experiment with a pendulum 11 metres long (13 yards approximately), but finally in 1857 he was invited by Napoleon III. to make use of the dome of the Pantheon. Here he gave his classical demonstration with a pendulum having a bob weighing 28 kilogrammes suspended by a thin steel wire 67 metres long. In the recent repetition of this experiment under the auspices of the Astronomical Society of France, the weight and length of the pendulum used were the same as those of Foucault's pendulum, and the conditions of the experiment were made to resemble those of 1857 as much as possible. The table was marked with lines to show angular deviation, and was used some time ago at the Pantheon. The period of a pendulum of this length is over 16 seconds for the complete double swing, and with this slow movement it was possible to observe the deviation even between two consecutive oscillations. By sprinkling sand on the table at a distance of 4 metres from the centre, and providing the bob of the pendulum with a spike at the bottom, the observers could measure the progress of the pendulum per minute or per hour along the circumference of this circle, and the actual measurements were found to agree very closely with the theoretical values.

The simplicity of Foucault's experiment should be an inducement to many to try it for themselves, and teachers may provide a most instructive lesson for their pupils by having an apparatus constructed suitable for class-room use. The little frame with short pendulum to demonstrate the fundamental principle, a longer pendulum consisting of a lead ball of 2 or 3 lbs. weight suspended by thin steel piano wire, say 6 ft. in length, or more if there is room, from a suitable suspending device, and a graduated dial to place under the bob for the better observation of the deviation—these are the only essentials. Recently a young French engineer, M. Cannevel, has furnished a complete outfit for the experiment in a small cabinet measuring 8 in. x 6 in. x 2½ in.

Business Notes.

Keith, Hutcheson & Wilson (James Stephen Keith, John Hutcheson, and Thomas Wilson) ship chandlers, riggers and sailmakers, Wellington, have dissolved partnership, J. S. Keith retiring.

* * * * * *

Edward Anderson & Co. Ltd. (private company) have been registered with a capital of £25,000, in 5000 shares of £5 each. Objects: To acquire and carry on the business of china and glassware merchants. Subscribers, with number of shares each:—Edward Anderson, 4,980 shares fully paid up; Elizabeth Anna Anderson, 20. Registered office, Wellington.

* * * * * *

J. A. Nash & Co. Ltd. (private company) have been registered with a capital of £8,950, in 1790 shares of £5 each. Objects: To acquire the business of J. A. Nash & Co., of Wellington, and Manawatu Hardware Co., at Palmerston North. Subscribers, with number of shares each:—James Alfred Nash, 704; Henty Stratford Porteous, 142; John Samuel Watchorn, 472; Leonard Sutton, 472.

* * * * * *

Taranaki Oil and Freehold Co. Ltd. have been registered with a nominal capital of £15,000 in £1 shares. Subscribers for five shares each:—William Thomas Jennings, M.H.R., Francis Peacock Corkill, George William Browne, Michael Jones, William Thomas Gardner, James Hawkins, and Thomas Kingwell Skinner. Registered office, Devon street, New Plymouth; secretary, John Spencer Selwyn Medley.

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Ellis Motor Co. Ltd. have been registered with a capital of £4,000, in 4000 shares of £1 each. Objects: To acquire from Peter Ellis, of Wellington, engineer, the rights of a rotary engine invented by him. Subscribers, with number of shares each:—Samuel Bolton, 100; A. H. Pringle, 100; Herbert P. Rawson, 50; G. Hutchinson, 25; John Highet, 50; Graham S. Pringle, 50; W. P. Pringle, 50; and others. Registered office, Wellington.

* * * * * *

Robertson & Co. Ltd. (private company) have been registered with a capital of £15,000 in 15000 shares of £1 each. Objects: To take over the engineering business of Robertson & Co., Phœnix Foundry, Wellington. Subscribers, with number of shares each:—David Robertson, 14,992; James Alex. Robertson, 1; Hannah Robertson, 1; Jane Virtue, 1; Helen Newson, 1; Marjory Bannatyne, 1; Thomas Young, 2; William D. Robertson, 1; Registered office, Wellington.

* * * * * *

Taranaki Petroleum Co. Ltd. have been registered with a capital of £120,000, in £1 shares. Objects: To acquire from the liquidator the business, assets, etc., of "The Moturoa Petroleum Co., Ltd." for 56,000 ordinary shares credited as fully paid up. Subscribers for five shares each:—Daniel Berry, Murdoch Fraser, George Charles Fair, John Walter Wilson, William Humphries, Michael James Jones, and John Rollo. Registered office, Egmont street, New Plymouth; secretary, David Laing.

* * * * * *

New Zealand Automatic Gate Co. Ltd. have been registered with a capital of £4,500, divided into 4,500 shares of £1 each, of which 1500 are considered fully paid up. Objects: To purchase from S. S. Hartley a New Zealand patent for "improvements in and relating to farm gates." Subscribers, with number of shares each:—Charles B. Pharazyn, 100; James B. Campbell, 50; H. Harcourt, 50; George F. M'Lean, 50; Peter H. Miller, 50; S. S. Hartley, 50; W. E. Hughes, 25; Registered office, Wellington.

..Legal..

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

RECENT DECISIONS.

Patent. Combination of known elements. Mechanical equivalents. Claims appendant to principal claim.—Mr. van Berkel was the grantee of a patent for a machine for slicing German sausages and like meats, consisting of a revolvable circular knife of spherical or dished form, and a table having a to-and-fro movement adopted to carry the sausage with it against the knife in the direction of the cut (so that only the cutting edge of the knife comes in contact with the sausage during the slicing), whilst with the return of the table executed quickly relative to the forward movement, the sausage is moved forward on the table to the width of a slice. The first claim in the specification was for the machine with the above characteristics, the second for the cutting, the third for the means of reciprocating the table, the fourth and fifth for the means of moving forward the sausage the breadth of a slice. Mr. van Berkel brought an action in Scotland against R. D. Simpson Ltd., for infringement of this patent. It was proved that dished knives and the reciprocating mechanism were both old but had never before been employed in a slicing machine, also that the means of moving forward the sausage was old and closely resembled that in former machines. Prior to the invention there had been no satisfactory machines for slicing sausages, but van Berkel's was at once a commercial success. Prior to van Berkel's patent there had been published in Great Britain Kolbe's specification (U.S.A.) for a device for cutting bread, consisting of a flat knife of irregular edge and a reciprocating table and mechanism, similar to van Berkel's, for moving forward the bread the breadth of a slice. Simpson's machine had mechanical equivalents for the dished knife and the device for moving forward the sausage, but in its reciprocating table the backward and forward motion took place in about the same time. Held by the Lord Ordinary, Dundas, that van Berkel's patent was a valid pioneer or master patent, being a new combination for producing an entirely new and important result; that it was not anticipated by Kolbe's, whose flat knife of irregular edge was neither intended to perform nor capable of performing the meat-slicing operation of van Berkel's dished knife; that Simpson's differentiation in the motion of his machine was of no practical utility; that Simpson's apparatus, consisting of purely mechanical equivalents of van Berkel's, had infringed, and that van Berkel's second and subsequent claims should be constructed, not as claims for subordinate integers, but as appendant only to the principal claim for the invention. *van Berkel and others v. R. D. Simpson Ltd.* XXIII. *Reports of Patent Cases*, 237.

Patent. Publication. Combination.—Mr. Peacock, the proprietor of a patent for rotary disc ploughs, brought an action against D. M. Osborne & Co. and the International Harvester Co. to restrain them from infringing his patent. They pleaded, *inter alia*, that his invention had been anticipated by a description and drawing of Peacock's invention in a number of the official *Gazette* of the United States Patent Office, containing 168 pages, which had been in the Patent's Office Library for 10 days before the date of Mr. Peacock's patent. They also pleaded that the invention was not new and was not the proper subject matter of a patent. There was no evidence that the description of the invention in the United States *Gazette* had been seen by anyone. Held by A'Beckett, J., where the public have the opportunity of reading the prior publication, it is unnecessary to consider that whether anyone has availed himself of the opportunity, and that there was proof of prior publication of Peacock's invention, which, however, was protected by a section of the Victorian Patents Act, providing that when any patent for exclusive use in parts out of Victoria of any invention first invented in Victoria has been obtained, a patent may be granted for such invention at any time within one year from the date of the granting of the first of such patents, notwithstanding that such invention has been published in Victoria within one year. Held further that a combination is not a mere aggregation of unpatentable improvements in different parts of a machine. There must be some novelty in result either by the different parts having some new inter-action as between themselves or the machine acquiring some new function. It is not enough that, as the result of these various improvements, you have a stronger or more handily worked machine. The plaintiff was decided to have a good claim for weights in the wheels of his plough, which had been infringed, but could not succeed because other claims in his patent were invalid as not being good subject matter for a patent. 1906, *Victorian L.R.*, *p.* 375.

Principal and Agent. Approval of Contract by Principal. Secret Limitation.—Carmichael, Wilson & Co. were appointed, by an agreement in writing, agents of The International Paper Co., of the U.S.A., for the exclusive sale in Australia of the Company's paper. The agreement provided that "all transactions shall be made in the name of the International Paper Company to whom all the contracts shall be submitted for approval. A contract was made in writing between H. Spicer & Co. and the Paper Co. for the supply by the latter of paper, and was executed by Carmichael, Wilson & Co., purporting to act as agents for the Paper Co. Before the execution of this contract Spicer & Co. asked for production of the agreement appointing Carmichael, Wilson & Co. agents of the Paper Co., but inspection was refused on the ground that it contained privileged matter, and Spicer & Co. knew nothing of the clause requiring the Paper Co.'s approval of contracts. The Paper Co found difficulty in supplying the paper, and in the course of a conversation between Mr. Carmichael and Mr. Gates the representative of Spicer & Co., the former said, "My people in New York don't like having to leave their marks off," and when Gates replied that he could not re-open the contract, Carmichael answered, "But some of the paper is on the way." Later Carmichael said, "You know the trouble there has been in New York in connection with supplies—they have had to import from Scandinavia—we may be late with the first delivery, will you give me an extension of time." In an action for failing to deliver the paper, the Paper Co argued that there was no evidence that the contract had been approved by them, and Spicer & Co were nonsuited on this ground. A new trial was granted and it was held that it was within the scope of Carmichael's authority as agent to make the above statements, and that they were some evidence that the contract had been approved by the Paper Co, also that on the evidence the jury would have been entitled to presume that Carmichael had obtained the Paper Co.'s approval by cable before making the contract. Cohen, J., was of opinion that as Spicer & Co. had been refused information as to the clause requiring approval they were not bound by it, and that from the statements made by Carmichael it might be inferred that the Paper Co. knew of the contract and had ratified it by their silence and non-repudiation. *Spicer & Co. v. The International Paper Co. VI. N.S.W. State Reports*, 170.

Company. Power to Borrow. Bill of Sale.—The Golden Rhine Mines of W.A., Ltd., executed in England a bill of sale in the form of a debenture to the Ida H. Gold Mining Co., to secure £600 and further advances. Both Companies were English mining companies registered in Western Australia. The bill of sale was only registered in Western Australia in accordance with the provisions of the local Bills of Sale Act. Within three months of registration the chattels comprised in the bill of sale were seized by the sheriff under a writ of execution issued by Jones Brothers. The Ida H. Co. claimed the goods under their bill of sale. On the trial of an interpleader summons the Articles of Association were not produced, and it was argued that the Golden Rhine Co. had no power to borrow. Held by the Court of Appeal that a mining company is a trading company and has implied power to borrow money as properly incident to the purposes of its business, if not prohibited by its Articles of Association. The onus of proving such prohibition lies on the party denying the power to borrow. Held further that a bill of sale executed in England registered in Western Australia is valid in Western Australia, although by the laws of England it may be invalid as against creditors for want of registration although valid between the parties at its inception.—*VII. Western Australian L.R.*, 329.

Life Insurance Written Assurance by Agent Varying Terms of Policy.—Mr Horncastle was induced to effect with the Equitable Life Assurance Society a semi-continue policy for £5 000 on the representation by a memorandum in writing by Mr. Moss, the London superintendent of the Company, that the cash value of the policy at the end of 15 years would be £7,390. When the policy matured, however the Company would only pay Mr. Horncastle £6,106 5s., the amount which they claimed was one under the policy, which contained this clause "The contract between the parties hereto is completely set forth in this policy and the application therefore taken together and none of its terms can be modified, except by an agreement, signed by one of the following officers, (of whom Mr. Moss was not one). Mr. Moss having carefully pinned his memorandum to his policy when he received it, and subsequently deposited both with the Company to secure loans for £5000, sued the Company for the £7,390, to which he considered himself entitled. Mr. Justice Walton held, however, that, even assuming that Mr. Moss had authority to make the representation, it was not admissible in evidence as it was not an agreement collateral and consistent with the policy, but contradicted the policy which was the complete and final statement of the transaction.—*Horncastle v. The Equitable Life Assurance Society of the United States.* 22 *Times L.R.*, 534.

Fire in Hotel. Negligence. Liability for Damage to Lodger's Goods.—Mr. Kellett lodged in the Blue Bell hotel, of which Mr. Cowan was the landlord. Mr. Cowan's servants by his instructions burnt sulphur in saucepans to fumigate two of the hotel rooms. The hotel was burned down and Mr. Kellett's effects to the value of £140 were destroyed, for which amount he recovered damages. Held that Mr. Cowan was liable for the damage, as a duty to use extreme care was upon him, unless he proved that the spread of the fire was owing to *vis major* or the acts of God.—*Kellett v. Cowan.* 1906, *State Reports, Queensland, p.* 116.

Landlord and Tenant. Covenant against Assignment. Fine.—By section 94 of "The Property Law Act, 1905," (N.Z.), taken from "The English Conveyancing Act, 1892," in all leases containing a covenant against assignment, such covenant shall, unless the lease contain an express provision to the contrary, be deemed to be subject to a proviso that no fine or sum of money in the nature of a fine shall be payable for or in respect of such consent. A lease from Mr. Waite to Leon Perrot contained a covenant by the lessee that he would not assign without the consent of the lessors, such consent not to be unreasonably or capriciously withheld. One Chater, in whom the lease became vested, applied to the plaintiff for consent to assign the lease to one, Dear. By a deed the plaintiff granted to Chater's license to assign to Dear & Dear covenanted that he would pay the rent during the rest of the term. Dear subsequently assigned to Escotts who, after the assignment, failed to pay a quarter's rent. Waite sued Dear for this rent, but Dear's defence was that his covenant to pay the rent was a provision for a payment in the nature of a fine. Held by the Court of Appeal that the above section did not prohibit the taking of sum in the nature of a fine, but its effect was as between the parties to the deed—that the deed was to be deemed subject to a proviso that no such payment should be payable, and Dear, therefore, who was no party to the original lease, could not avail himself of the section as a defence. L. J. J. Vaughan Williams and Stirling were of opinion that the covenant was not a covenant for a payment of a fine, L. J. Moulton that it was.—*Waite v Jennings.* 22, *Times L.R.*, 510.

A Locomotive Runs a Factory.

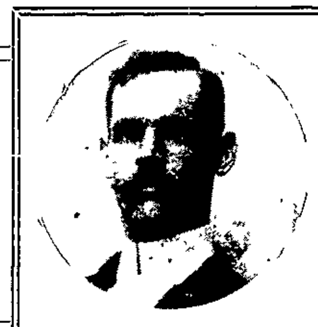
In Baldwinsville, Mass., recently occurred what is probably the first instance of the kind on record, when a locomotive was employed to run a factory. The establishment, says the *Technical World Magazine*, had out-grown the power developed by its old plant of boilers; and, not wishing to shut down long enough to instal a new battery, the proprietors conceived the plan of availing themselves of one of the surplus locomotives from the shops of the Boston and Albany Railroad. The engine used was a small freight engine. It was sidetracked near the factory. The pipes leading to the cylinder heads were disconnected, and one of them connected to the steam dome of the locomotive, leading therefrom to the engine-room of the factory. The plan was perfectly successful, and the establishment thus saved the loss which would have been incurred through inability to fill orders had it been necessary to lay off the men.

Foundry Closed.

We learn with great regret that the Phœnix Foundry, Ballarat, which in the heyday of its prosperity manufactured over a million and a quarter pounds' worth of locomotives and railway rolling-stock, has closed down. The main reason for the step is that the work of locomotive construction has been withdrawn from the firm by the Government. The foundry has also suffered through the lack of a regular demand for mining machinery.

MR. E. W. BUCKERIDGE.

The "Buckeridge" Signalling System.



MR. G. H. BUCKERIDGE.

For many years the problem of how to convey intelligence to the driver of a locomotive of the existence of danger on railway lines has engaged the attention of engineers, including such eminent men as Edison, Preece, Adams, Cahland, Smith, and others. Numerous experiments with various forms of electrostatic induction, and other electrical means, pneumatic, gas, and other automatic devices have been tried · but hitherto the success which has attended these trials has been in some cases only partial, and in others the cost of installation has been prohibitive while their sphere of action has been limited.

In some countries, such as Great Britain, the occurrence of dense fogs renders railway travelling highly dangerous. To minimise this danger various means have been tried to warn drivers of engines in time to allow them to avert accident. The most common method of signalling is to place detonators upon the rails, the explosion under the wheels of the engine giving the driver the necessary warning. This method, besides entailing a great deal of expense in placing the detonators on the line, and in replacing those that have been exploded, also makes it necessary for drivers to travel at reduced speed within congested areas of traffic, although everything may otherwise be in order, and the line quite safe for higher speeds.

It is generally considered by the public that travelling by sea is the most dangerous of all journeyings; but, according to recent statistics the number of persons killed in railway accidents is over sixty times greater than the number of those lost at sea. During the year 1904 there were no less than 10,046 killed, and 84,155 injured upon the railways of the United States of America alone. Ship-owners are compelled by Government to provide their ships with adequate means of saving life in case of accident; while light-houses, costing in many cases tens of thousands of pounds, are erected and maintained by every civilised Government for the same purpose. It should be equally as incumbent upon railway companies or governments to provide life-saving apparatus on their railways, should such means be available at a reasonable cost.

We have been shown an invention devised by two New Zealanders, Messrs. E. W. and G. H. Buckeridge, which they claim will convey warning to drivers upon engines and thus prevent accidents which would otherwise occur. By their method warning can be given to the driver on the cab of his engine to prevent accident in case of —

1. Trains either approaching or overtaking one another; or mistakes by pointsmen, which would put an approaching train upon a line already occupied by another train.
2. Displacement of points.
3. Collapse of tunnels, bridges, and other structures.
4. Washouts of foundations.
5. Slips or floods covering the line.
6. High winds on elevated structures.
7. Excessive speeds round sharp curves.
8. Any discovered breakdown of the permanent way.
9. Trains running into or overtaking trolleys or running into runaway trucks on the line.
10. At crossings on the level.

Besides the warnings given above it is possible by means of this invention to shut off steam on the engine, and to apply the brakes and automatically bring the train to a standstill. There are many other uses that the invention can be put to; but those above are sufficient to show its great possibilities as a means of saving human life, as well as loss of property.

When the old-fashioned semaphore signalling is employed the driver is supposed to be always on the lookout, and always ready to take in the meaning of any signal, no matter what other duties he may have, hence the signal is displayed, and the driver sees and obeys it or not, as the case may be. It is also obvious that the intelligence must be first conveyed to the mind of the driver in the cab before he can act thereon. In many cases the driver has but a short distance within which the governing signal is in his view. Should he pass the signal unobserved, the intelligence it conveyed is useless and has not been properly conveyed to the cab.

With the signal placed in the cab, the driver always has it with him; if it warns him to stop, it is not a momentary warning; it is continuous; he carries it with him; it is continually in his mind; and it is his own salvation or death warrant as well as of those behind him. The smoke from a passing train on another track cannot interfere with his vision. The sudden rain or snowstorm does not compel him to slow up his train; fog has lost its terrors, not only to the driver and those who travel, but also to the owners of the line, who are not compelled to face a loss in revenue by a large increase in labour and consequent loss by reason of congested traffic on account of the slow movement of the trains.

The ideal system of train signalling is one that would allow all trains to keep moving, provided it could be done with safety. This will be the practice at some future day when time has demonstrated that the engine-driver who receives a signal on his locomotive warning him that there is a block on the line ahead may be safely trusted to keep his train in motion at such a moderated speed as will permit him to come to a stand before striking the object which blocks the way.

Messrs. Buckeridge Bros. have been engaged for sometime in making a model of their invention and in giving practical demonstration with the model to a number of prominent and influential men, both in Auckland and Wellington, who are unanimous in their opinions that the invention does what is claimed for it, and supplies a long-felt want. The invention can be placed on railway lines at a cost of less than £40 per mile, while the cost of fitting up the locomotives would be less than £10 per engine.

The essential feature of the Buckeridge system is the electrical conductor, which consists of a series of independent parts arranged side by side parallel and insulated from each other. Each of the parts is in segments, and break between the segment of one part of the conductor is arranged to fall midway in the length of a segment of the other part conductor; thus each segment of each part conductor is independent of any other segment, and to establish a current of electricity through the segments it is necessary that a return be provided by some means.

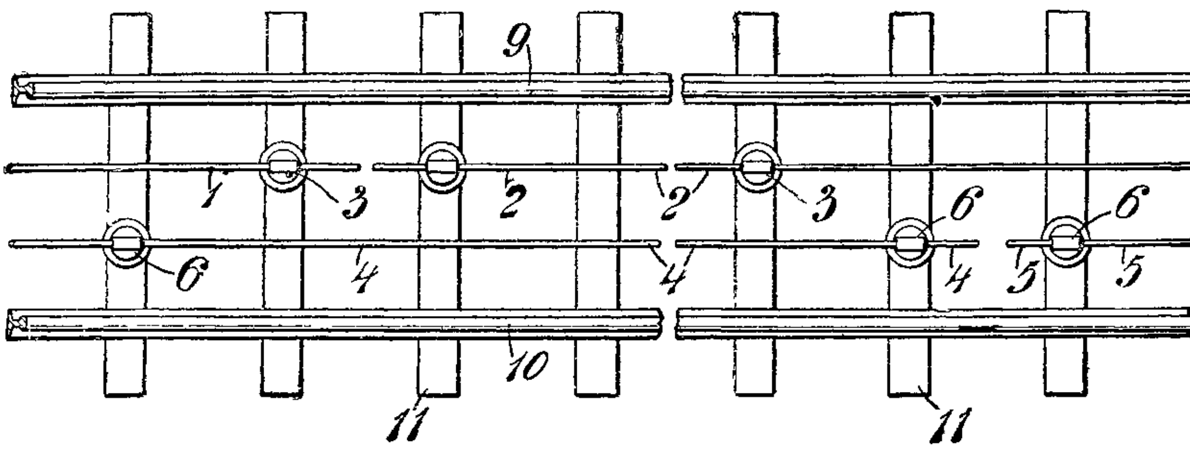


FIG. 1.

The invention will be understood by reference to our illustrations.

Fig. 1 is a plan of a railway track, the rails, 9, being carried on the sleepers, 11, in the ordinary way.

The segments of the conductor are made of the usual material, such as copper wire, the inde-

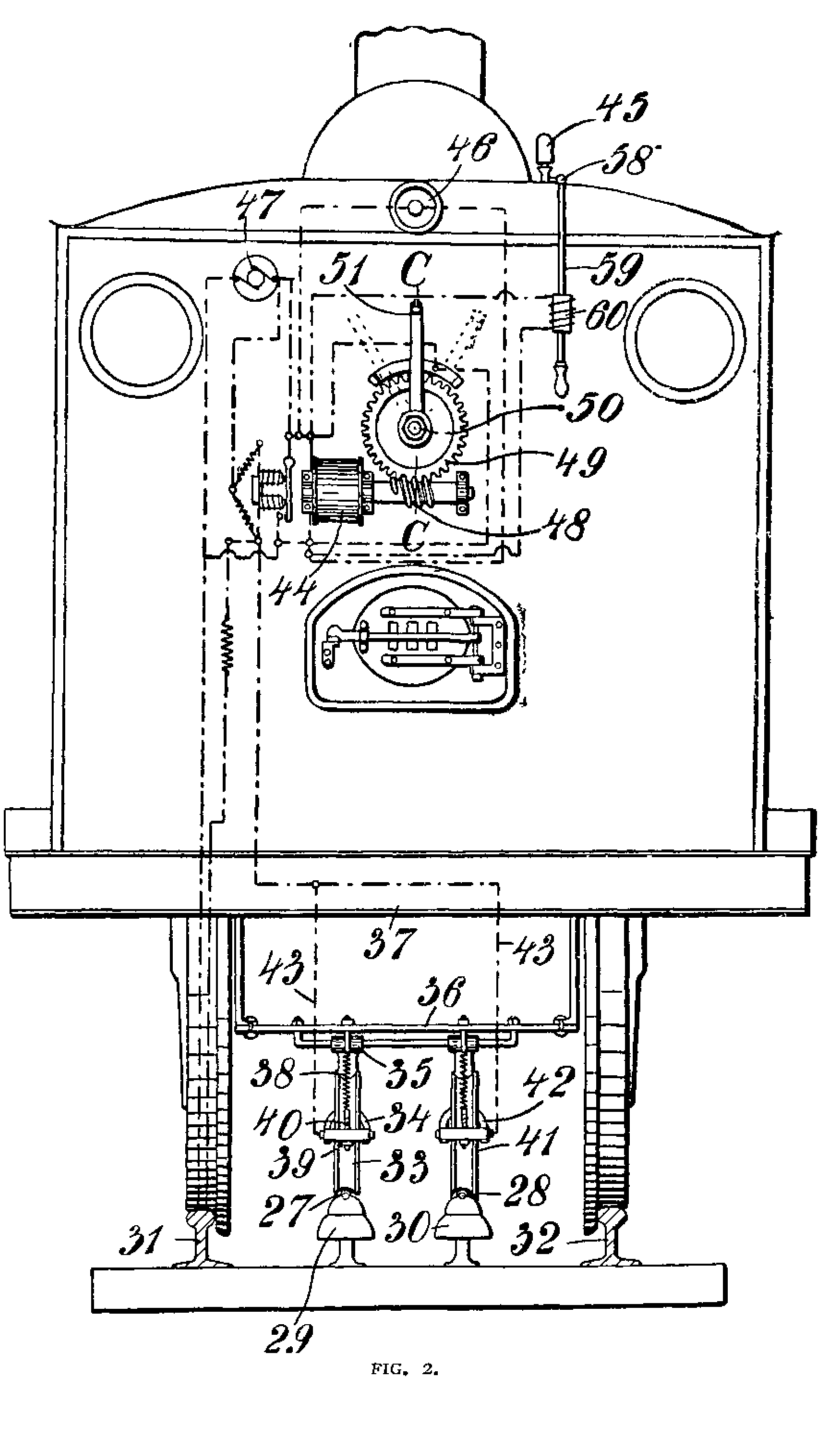


FIG. 2.

pendent parts, 1 and 2, of one part conductor being carried by insulators, 3, while the similar parts, 4 and 5, of the other part conductor are carried by similar insulators, 6.

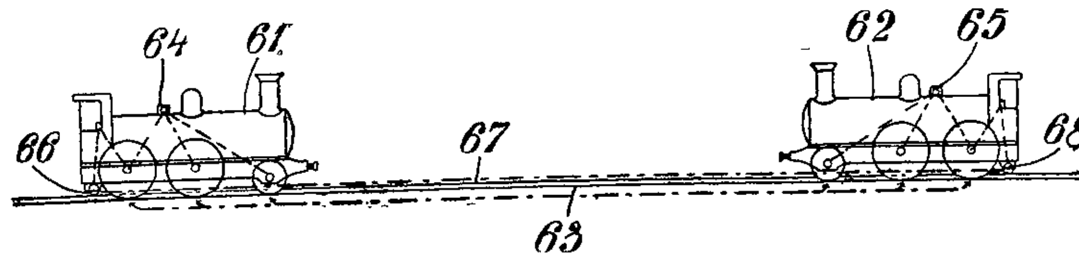
Fig. 2 shows how electrical connection is established between the engine and the parts of the conductor. Insulators, 29 and 30, similar to those previously referred to, respectively carry the parts of the conductor, 27 and 28. The trolley wheels, 33 and 41, are carried by a frame, 35, upon the engine, and each runs upon one of the parts of the conductor. The frame is insulated from the engine but the trolley wheels are connected by wires, 43, with a motor, 44, upon the spindle of which is a worm, 48, gearing with a worm wheel, 49, upon the spindle, 50, of the starting lever, 51. The starting lever, by an ingenious arrangement, is capable of being worked independently of the worm wheel. The wires also lead to a solenoid actuating a whistle and an electric lamp, 46. A constantly running dynamo of small power is actuated in the wire circuit, 43.

It is now necessary to refer to Fig. 3 which diagrammatically illustrates what happens when two locomotives, 61 and 62, are running towards each other upon the same line of rails, one of the locomotives having a constantly running dynamo, 64, and the other a similar dynamo, 65. The locomotives are each provided with a trolley wheel, 66 and 68, respectively, running upon the conductor, 67, and both have the signalling and stopping apparatus shown in Fig. 2.

While the trolley wheels are running upon insulated segments of the conductor the dynamos are not generating effective current; but when a circuit is completed through the segment by means of the trolley wheel of one locomotive arriving upon the same segment as the trolley wheel of the other locomotive, then electricity is immediately generated, which actuates the apparatuses indicated, so that the steam is turned off, the whistle blown and the electric lamp illuminated displaying a danger signal.

Those who have some electrical knowledge will see how readily the conductor may be availed of for signalling under various conditions. For instance, any one or a number of segments may be earthed so that when a vehicle carrying means of generating a current of electricity comes in contact with an earth segment through the medium of the trolley wheel described, a current of electricity passes from the generator through the segment to earth through the earthing medium, and back to the generator through a rail of the permanent way or otherwise.

During its passage the current may be used for illuminating an electric lamp, sounding a whistle, actuating brake apparatus, etc.



BUCKERIDGE SIGNALLING SYSTEM, FIG. 3.

THE BRITISH EMPIRE.

A CENSUS OF ENORMOUS PROPORTIONS.

FOUR HUNDRED MILLION PEOPLE—RELIGIONS, MARRIAGE RATES, AND OTHER FIGURES.

"THE Truth about the British Empire! Price 3s. 5d." So might run the advertisement of a recent Blue Book if so unthinkable a consummation as the competition of Blue Books with the ordinary mass of literature for the favour of the public were ever to come to pass. As it is, this Blue Book bears the formal title of "Census of the British Empire, 1901." It is a deeply interesting inventory—all the more interesting if the reader will imagine the hearts beating behind those solid piles of figures that show the condition of an Empire which covers one-fifth of the land surface of the globe. It is shown that in forty years (1861–1901) the area of the Empire has grown from 8,500,000 square miles to 11,908,378, and the population from 259,000,000, to 398,401,704. To this vast total the United Kingdom itself contributes only a population of 41,458,721 and an area of 121,089. Excepting, however, only the Isle of Man and the Channel Islands, there are more persons to the square mile in the United Kingdom than in any other part of the Empire, the next densest being the Indian Empire with its population of 294,361,056, or 172 persons per square mile. Canada's proportion is only 1.4 and Australia's 1.3—a fact which shows eloquently how great an amount of unoccupied land is still available for the Empire's settlers. There are in the Empire 187 cities or towns with a population of over 50,000. Of these eighty-seven are in the United Kingdom, seventy-eight in India, seven in Australasia, five in the Dominion of Canada, two in the West Indies, two in the Straits Settlements, and one apiece in the Colonies of Hong Kong, Ceylon, Mauritius, Cape of Good Hope, Natal, and the Transvaal. The most populous city next to London is Calcutta—848,000, an increase of 166,000 in ten years. In New South Wales, Victoria, and Western Australia more than half the population are in urban areas, while in New Zealand, South Australia, Queensland, and Tasmania the preponderance is in the rural areas. In Canada the greater proportion of the population live in rural areas, and the same rule holds good in South Africa. But in the United Kingdom 71 per cent of the population live in towns, the proportions in the three divisions of the Kingdom being 31 per cent. in Ireland, 70 per cent. in Scotland, and 77 per cent in England and Wales.

In India, out of 1000 males over fifteen years of age, 708 are married, and 1000 females over fifteen 669 are married. The following table shows the proportions of unmarried, married, and widowed in the United Kingdom and in some of the principal Colonies and Dependencies:

	Proportion per 1000 living. Unmarried.	Married.	Widowed.
United Kingdom	609	334	57
Indian Empire	419	465	116
Cape of Good Hope	649	307	44
Orange River Colony	664	309	27
Canada	617	341	42
New South Wales	657	303	40
Victoria	647	300	53
Queensland	677	289	34
South Australia	652	304	44
Western Australia	647	320	33
New Zealand	657	306	37

Analysis of the occupations of the people shows that 2.2 per cent. of the male population of England and Wales are employed on railways, 2.7 on roads, and 0.8 on seas, rivers, and canals. The information under the head of "Birthplaces" shows that the proportion of Colonials who were born in the United Kingdom is in New Zealand 25.2 per cent. of the population, in the Australian Commonwealth 17.7 per cent., in Canada 7.3 per cent., and in the Cape Colony 3.7 per cent With regard to religions, it is estimated that there are 57½ millions in the Empire professing the Christian religion, and over 295 millions professing "non-Christian religions." The seven greatest religious groups in the Empire may be stated thus

Hindu	208,342,276
Mahommedan	62,884,811
Christian	57,500,000
Buddhist	11,643,432
Primitive Animistic, Pagan	8,910,826
Sikh	2,195,444
Jain	1,334,148

A Gaseous Hydride of Calcium Present in Commercial Acetylene.

Acetylene prepared from certain samples of commercial calcium carbide deposited calcium oxide, even after careful filtration and purification. A systematic examination of a large volume of this acetylene was made, and the gas was passed successively through wash-bottles containing acetone and ammoniacal cuprous solutions, the latter being used to absorb the acetylene itself. Finally, a volatile residue was obtained which burnt in air to calcium oxide and water, and, therefore, appears to be a gaseous hydride of calcium. Since, however, this gas has not been completely freed from air, its exact percentage composition is still in doubt. (*Zeitschrift fur Anorganische Chemie*, 1906, vol. 48, p. 137).

The names of Kepler and Leibnitz recall how genius of the highest order was neglected in former days. John Kepler, as Carlyle reminds us, "did not fare sumptuously among Rodolph's astrologers and fire-eaters, but perished of want, after discovering the true System of the Stars." Poor Leibnitz, nearly a century later, in 1716, was buried at Hanover, with one mourner to do him honour, his late secretary. In the French Academy only was a fitting tribute paid to one of the most illustrious men of the age.

Electrically Operated Cable Winches.

Electric cable winches have recently been employed by the German Telegraph Department for drawing in underground cables. The insertion of the cables into the cement conduits previously required ten or twelve men. The electrically-operated winch gear is distributed over two cars—viz., a smaller car carrying a benzine motor of 6 h.p. capacity actuating a dynamo, and a larger car containing the 3 h.p. electromotor and the winch. The latter is provided with a self-acting cut-out. The haul upon the cables is accurately regulated by electrical adjustments with the results quite unattainable with a direct-acting benzine motor. The heaviest cable, 200 mm. in length, can be laid in about seven minutes

Applications for Patents.

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

21301—F. J. Mahoney, Christchurch: Ventilating system.
21302—D. and F. W. Smith, Christchurch: Golosh.
21303—W. V. Gilbert, Port Elizabeth, South Africa: Toy.
21304—R. Watson, Lochiel: Non-refillable bottle.
21305—J. M. O'Neil and R. A. Marsh, Dunedin: Trolley-wheel bearing.
21306—C. L. K. H. Foot, Takapau: Igniting gas.
21307—M. W. Winter, Wellington: Skirt holder.
21308—D. L. Turner and J. R. Paterson, Wellington: Coating for butter boxes.
21309—J. Hopkirk, Hawera: Pump.
21310—J. S. Hawkes, Wellington. Milk can.
21311—D. Urquhart and C. Sloper, Smithfield: Cutting, washing, etc., sheep paunches.
21312—D. Urquhart and C. Sloper, Smithfield: Hydro-extractor.
21313—J. A. Belk, Feilding: Rail joint.
21314—H. E. McDonald, Petone. Attaching tag to hemp bale.
21315—J. T. Renouf, Wellington: Generating electricity.
21316—A. Ridd, Waipuku: Milking machine.
21317—A. Ridd, Waipuku: Pneumatic teat cup.
21318—J. Irvine, Napier: Fastening fencing wire to standard.
21319—T. Crompton, Christchurch: Glazing bars.
21320—E. Lockerbie, Maitai: Adjustable tap.
21321—S. F. Womersley, Traralgon, Vic.: Butter weigher.
21322—W. Harvey, Auckland: Strainer and aerator.
21323—C. J. Neunhoffer, Melbourne, Vic.: Tyre valve.
21324—J. Nicolson, Riverton: Trolley brake.
21325—M. Bowles, Auckland: Reaming pipes and tubes.
21326—C. A. Beal, Mornington: Folding gates and partitions.
21327—J. Walcott, Dunedin: Coal, etc., elevator.
21328—T. E. Bridger, Dunedin: Extracting teeth.
21329—S. Millar, Eweburn: Harvester.
21330—F. B. C. Allen, Perth, W.A.: Lock nut and bolt.
21331—R. O. Jarrett, Feilding: Disc-loading bar and dumb bells.
21332—W. Nikolsky, St. Petersburg, Russia: Recovery of solvents used in making explosives.
21333—A. J. Fortescue, Sydney, N.S.W.: Wheel tyre.
21334—Maganite Explosives Syndicate, Limited, Cape Town: Explosive manufacture. (H. C. L. Bloxam).
21335—J. L. Kirkbride, Auckland: Street sweeper.
21336—A. J. Edwards, Auckland: Trolley-pole controller.
21337—J. G. Dawson and P. O'Sullivan, Christchurch: Cooking utensil.
21338—L. Schmidt, Hackney, S.A.: Tyre.
21339—L. Friedenreich, Thornleigh, N.S.W.: Yeast-making.
21340—T. Warsop, Nottingham, Eng.: Rock drill.
21341—N. R. Gordon, Melbourne, Vic. Flying machine.
21342—T. Beckett, Rongotea: Propelling vessels.
21343—J. Stewart, Gore: Shifting spanner.
21344—G. Gray, Dunedin: Seed sower.
21345—T. Bush, Wellington: Cap.
21346—J. Cook, Wellington: Trolley head.
21347—E. Oliver, Wellington: Sewing machine.
21348—A. L. J. Tait, Dunedin. Flax washing and drying.
21349—F. A. Alcock, Melbourne, Vic.: Billiard and dining table.
21350—J. W. Andrew, Otahuhu: Urinal silencer.
21351—G. Carder and J. E. Owen, Auckland: Cesspit and gulley-trap.
21352—G. Carder and J. E. Owen, Auckland: Cesspit and gulley-trap.
21353—W. Smith, Gore: Boot and shoe protector.
21354—H. Coale, Baltimore, U.S.A.: Artificial cork.
21355—P. G. Neuernberger and G. Rettig, jun., Chicago, U.S.A.: Type-casting machine.
21356—P. G. Neuernberger and G. Rettig, jun., Chicago, U.S.A.: Type-casting moulds.
21357—J. Sutcliffe, Burnley, Eng.: Forced draughts for fire engine, etc.
21358—H. W. Fox, London, Eng.: Electricity storage.
21359—E. A. Gieseler, Berlin, Ger.: Gravity filter.
21360—L. S. Sawtell and J. S. Hawkes, Wellington: Tobacco-pipe attachment.
21361—K. Matthews, Auckland: Automatically silencing telephone bells.
21362—R. E Hay, Seddon: Boring tool.
21363—J. Mitchell, Auckland: Sewage treatment.
21364—United Shoe Machinery Company, Paterson, U.S.A.: Machine for assembling parts of boots and shoes (O. Ashton).
21365—United Shoe Machinery Company, Paterson, U.S A. Pounding-up machine. (O. Ashton).
21366—J. F. Clarke, Hunter's Hill, N S.W.: Filling bottle with liquid.
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21413—G, Young, Smithfield: Beef tree hook. (R. Erskine).
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21425—C. L. K. H. Foot, Ashley-Clinton: Gas burner.
21426—J. S. McPherson, Wakefield: Axe sheath.
21427—United Shoe Machinery Company, Paterson, U.S.A.: Supporting and positioning work in boot or shoe machine. (E. E. Winkley).
21428—United Shoe Machinery Company, Paterson, U.S.A.: Jack for supporting and positioning work in boot or shoe machine. (E. E. Winkley).
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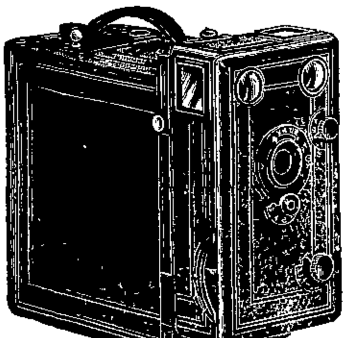

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