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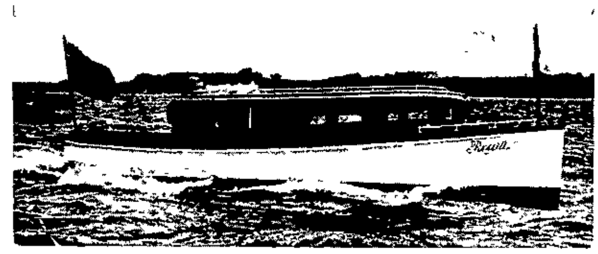

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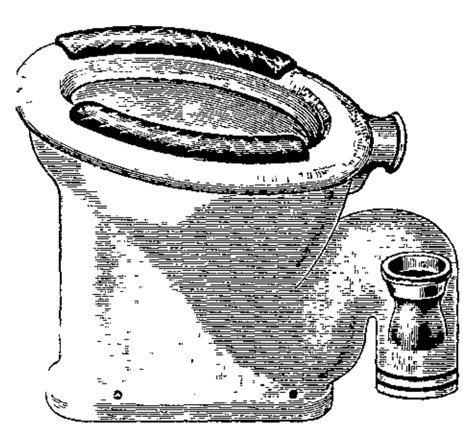

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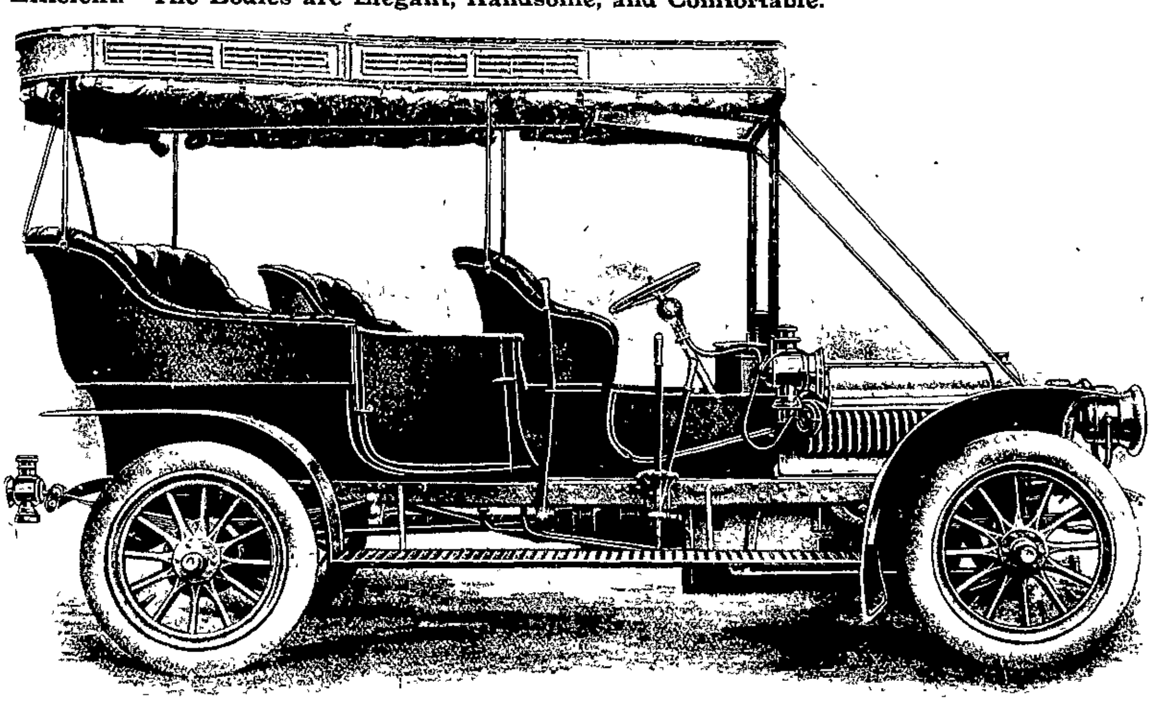

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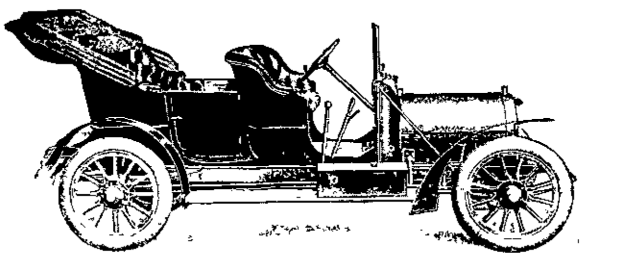

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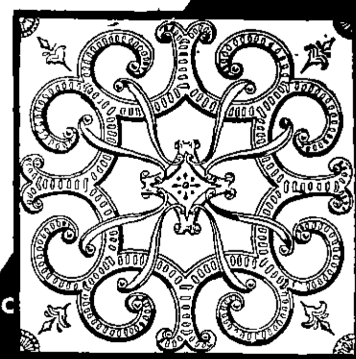

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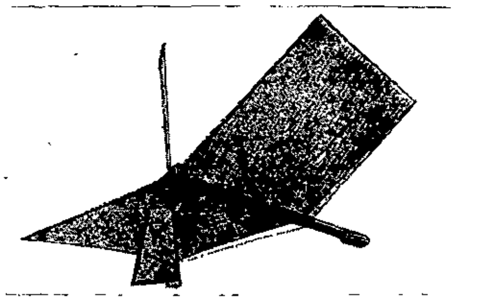
EDITORIAL COMMENT.

The Progress of Aviation.

THE successful flight of the French aviator—the word is, we observe, now in established use—of which news has reached the Dominion during the past month, has drawn attention to the progress made of late in the development of the æroplane, of the "heavier-than-air" type. Of that progress it is noteworthy that the performances of M. Farman stand at the head. This aviator, before winning the Deutsch-Archdeacon prize of £2000, made three different attempts without success. Roughly speaking, the conditions are that the æroplanes must fly 500 metres and back. To do this the æronaut must fly, as one authority puts it, "across the starting line, which is determined by two poles placed 50 metres apart, and then make the turn about another post situated at 500 metres, upon a line running from the middle point of the starting line and at right angles to it. After making this turn the æronaut must come back and cross the starting line while in full flight." This is evidently the course over which M. Farman flew his 1100 yards "through goal posts" as the cables had it. The goal posts mentioned in the message are the two at the ends of the starting line, and the two 500 metres' lengths make 3280.8 feet, or 1.093 (nearly 1100) yards of the English measure. On the first trial, early in November, M. Farman flew the first 500 metres and made the turn around the turning-post and got back over the starting line, but failed to win because he touched ground several times while making the turn. On the 18th of the month he reached the turning-post, but was unable to round the same. On the 23rd this aviator had an interesting experience in other ways, but was prevented by a storm from competing for the prize. His experience was this: After leaving the shed he was obliged to fly across a field to reach the starting-point. Starting with the wind he crossed the field, described a semi-circle, and landed against the wind, having covered 900 metres (slightly over 1000 yards). This was decidedly a good performance—it was flight. So was the next step made in the competition. During the preparations for the flight the wind suddenly increased and blew as hard as 12 to 18 miles an hour. M. Farman started his machine and rose in the air at a high rate of speed. The wind, however, continuing to increase, threatened to carry him off the course indefinitely into space. He therefore decided to wait for better times. These evidently came on the day on which he won the prize, as chronicled by the cables in terms published in our column devoted to the Mastery of the Air. It is clear, therefore, that M. Farman has flown under the required conditions, namely, over a course of 500 metres and back to start, going between fixed goal posts at one end and round a mark post at the other, situated exactly half-way across the course, without touching the ground anywhere from start (flying) to finish, also flying. This is controlled flight That is a great fact.

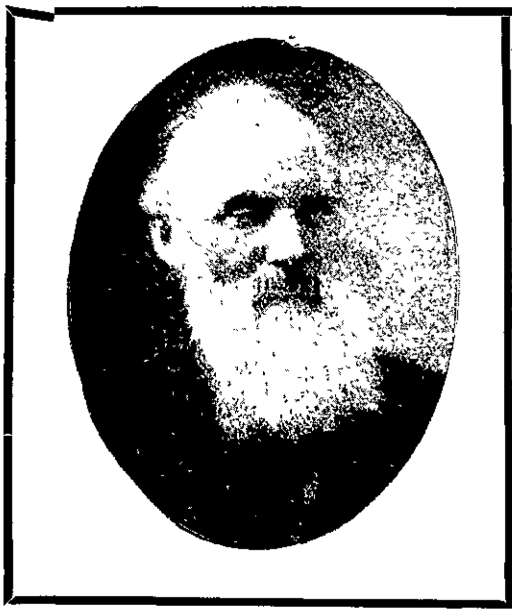
As to the conditions, though nothing appears regarding them in the cabled accounts of the flight for the prize, there is little doubt, judging by the descriptions of the previous trials to which reference has been made above, that the weather was calm. The second great fact about the æroplane, therefore, is that it has not mastered the art of coping with the powers of the air, even to the same extent as the dirigible; for the dirigibles all have proved themselves equal to a wind of 30 miles to 35, whereas the æroplane which has won the big Parisian prize was once defeated by a wind of a little more than 18 miles an hour. There is hope, however, in the statement of an eye-witness, an expert according to the limited lights that aviation has so far provided for the experts to be fashioned by, which is as follows: "The fact that he was able to manœuvre the æroplane and keep it on a fairly level keel, under such adverse conditions, is another evidence of the inherent stability of this type of machine." Now, of course, the main question at the present stage of the æroplane development is of stability rather than pace or power. It follows, therefore, that the winning of the prize is a great advance on the road which everyday's experience seems to declare to be the right one. Fifty years ago the Duke of Argyll argued that without weight greater than air, like the weight of the birds who fly in the air to great distances and keep the air under all possible conditions, flight of the controlled order would always be impossible. The experience of M. Farman reminds us of the dictum of the distinguished authority by supporting his conclusion. Stability gained, the stability after which so many have striven in vain during later years, power to cope wth the conditions of the air, various and terrible as they are, will follow as day follows night.

This stability, is it attainable in perfection? The question may be asked hopefully in view of certain details of other experiments than those of M. Farman above referred to. We have, as explained elsewhere, to-day a record of the failure of Santos Dumont's latest æroplane. But recent advices received show that though the failure of this æronaut with his new machine was complete in the matter of the big prize, he achieved some good results at the preliminary trials, varying direction and dip at will for fairly long distances under conditions of good stability. He has a motor of 20 horse-power, his machine is known as a "monoplane," its sustaining surface is of 107 square feet, and it has no more than 2¼ lbs. per square foot to carry. This monoplane is after the style of Hargreaves' æroplane, patented in Sydney,



"HARGREAVES" AEROPLANE (1890) SYDNEY, N.S.W.

N.S.W., in 1890, the illustration of which we published in these pages last March, and now reproduce. Add a big two-bladed screw, horizontal and vertical rudders stem and stern, a motor at the head, and three wheels tricycle fashion underneath, with a saddle for the æronaut, and you have a good idea of the new Dumont machine which has some points in its favour. Lastly we have to consider a suggestion made by a noted æronaut in the leading æronautical publication, *La Conquete de l'air,* for the application to aviation of the gyroscope. The suggestion is supported by the plea that the thing which has secured the stability of two kinds of oscillating vehicles ought to secure the same advantage for the æroplane which suffers from lack of stability in an especial degree. On the whole, then, it appears that the aviators have achieved actual flight, and are preparing to improve their position.



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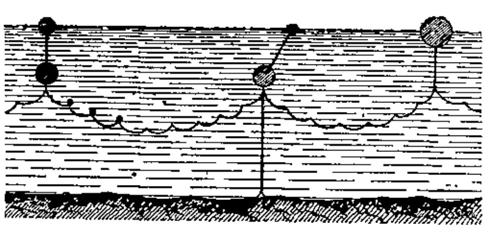
A GREAT CAREER.

Part I.

"A man so universal that he seemed to be all science's epitome." Such a paraphrase of a famous verse might fairly stand for the description of the position attained in the scientific world by the late Lord Kelvin, so difficult it is to decide where he was really pre-eminent. At the outset of his career his teeming brain seemed to press him into the study of the whole range of scientific discovery. In his early twenties he was an astronomer, and even a musician, and, if we may judge by analogy where there is no direct evidence of proficiency, it seems certain that he was on the high road to eminence in both these regions of human effort so far apart from each other. Would he, one can not help wondering, have rivalled Wagner with a



THE PROPOSAL OF DESPAIR.

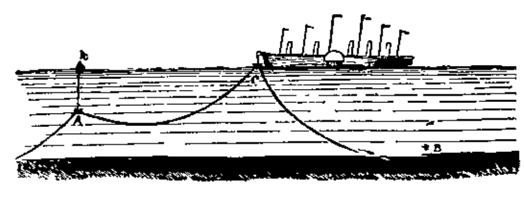
stately series of symphonies, or the Herschels in closeness of observation, or the achievements of Newton and Laplace and the other great men? The question is, of course, bootless. But one can say safely that with his mathematical instinct for accuracy, his marvellous sense of order, his untiring industry, and his never-failing inspiration he must have made a prodigious mark. Many things have been said of him, but of these none were truer than the saying that he possessed all the qualities which are necessary to convert ingenuity into genius.

Recognising early that some limit must be set to the field of his activity, Professor Thomson turned from the last-named pursuits, concentrating his mind on the practical field open to his boundless enterprise. He had attained to his position early through his proficiency in mathematics, graduating, like many other great men before him, as second wrangler of Cambridge University. Prominent among these may be mentioned Clerk-Maxwell and Clifford, who with him made the three best mathematicians produced in the British Isles during the last century. To the soundness of his mathematical knowledge and the close rigour of his mathematical training were no doubt due the extraordinary skill to which Thomson attained in after years as an inventor. It was this skill in the minutest details which built up the value of his patents. The wealth they brought him, directly and indirectly, may be gauged by the fact that his will was proved the other day for nearly a million of sterling value. Unlike many men of his genius the professor carried his genius with him into the region of business; a fact to be estimated by his position at the head of several firms, notably the Kelvin Company, of Glasgow. Some of these were established to manufacture the various articles of his invention, such as the compass, the deep-sea sounder, the galvanometer, the numerous dynamometers, ampere meters, volt meters, watt meters, and the rest; while others were concerned with their distribution throughout the various markets of the world. One can easily picture the veteran, who had watched the paying out of the first Atlantic cable by the light of instruments of his own invention, presiding also at the meetings of the directors whose business it was to regulate manufacture and distribution, and we may declare without fear of contradiction that the value of his originality, shrewdness, and method told their tale in the one department as they had done in the other.

It was not by cheese-paring that he made that large fortune above alluded to, for he enjoyed life in expensive fashion. His mansion at Gilmore Hill, Glasgow, was one of the finest of the western suburbs of that city, and he kept a yacht in which he entertained often a large and distinguished company, and made voyages not confined to the magnificent waters of Scotland and the British Isles generally, but extending to the Norway fiords and the more distant Mediterranean.

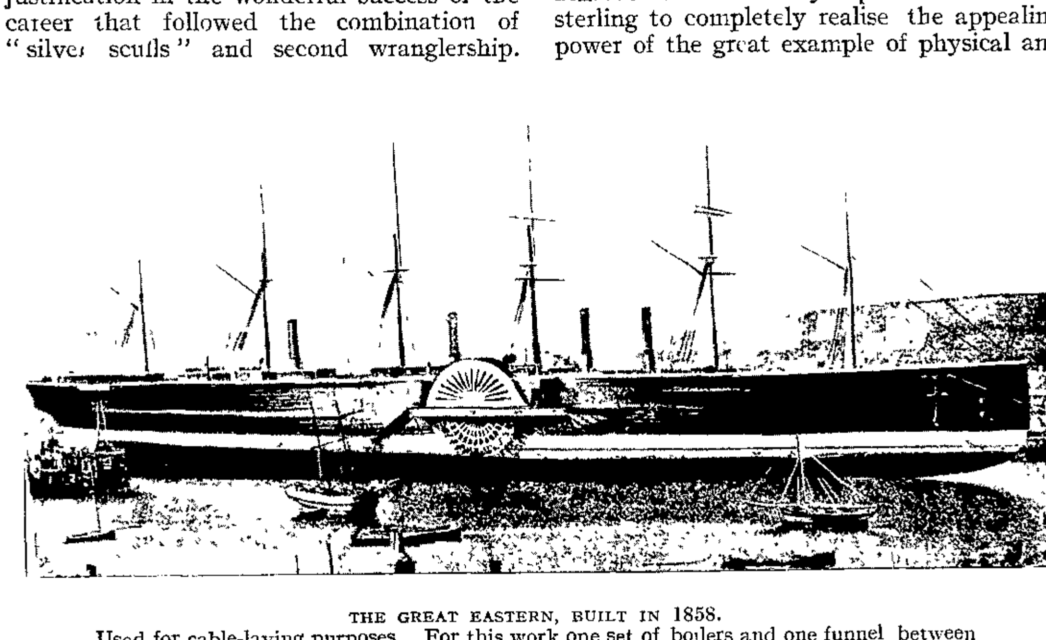
Mention of these aquatic tastes recalls the fact that Thomson, during his career as a student, attained to eminence in athletics, as well as on the intellectual side, becoming so distinguished that he carried off at Cambridge on one occasion the much coveted "Silver Sculls."

It was an example which justifies the decision of Cecil Rhodes to insist upon all-round excellence—both physical and mental—in the scholars holding his now famous and much-sought scholarships. There is a further justification in the wonderful success of the career that followed the combination of "silver sculls" and second wranglership. A biographer said of him:—"Intense intellectual activity and physicial energy have characterised his whole career. At seventeen he had commenced his career of discovery, at twenty-two he was Professor of Natural Philosophy in the University of Glasgow, in 1866 he was knighted for his distinguished services (at forty-two) in connection with the Atlantic telegraph. The highest honours academical were heaped upon him—he was the first scientific man to be raised to the peerage—his name is co-extensive with the whole range of electrical science and molecular physics. No physical question seems too large or too profound for his grasp of intellect. He has estimated the size of atoms and the probable age of the world's maturity. His theory of the dissipation of universal energy is comparable with Newton's theory



THE FINAL SUCCESS, AFTER 33 ATTEMPTS AT RECOVERY.

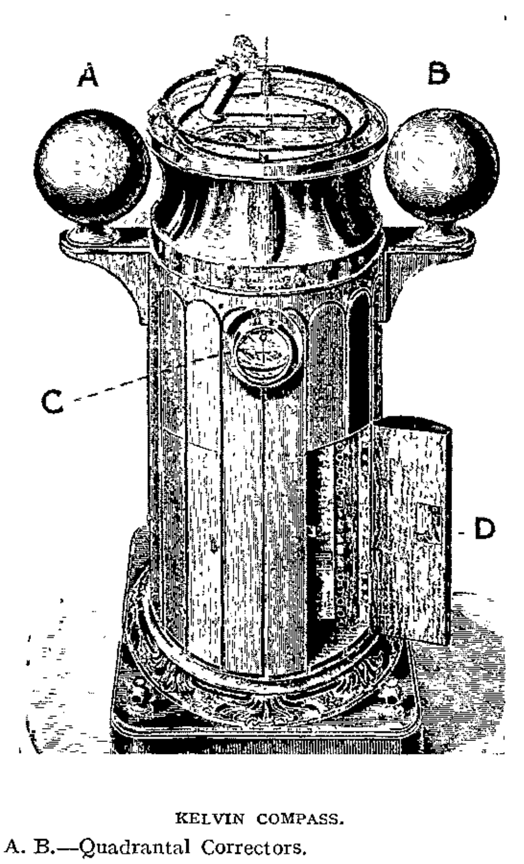
of gravitation, in the largeness of its generalisation, that all motion tends to become heat, and to diffuse itself uniformly. His 'Natural Philosophy' is a monument of dynamical learning, in part the work of Professor Tait, his Edinburgh colleague. His name meets one on almost every page of works on electricity and thermodynamics. In telegraphy his name is a household word. At the remotest stations on the earth's surface his beautiful instruments are to be seen in play, flashing out the message from the ocean. At a recent loan exhibition, his case of electrometers, his tide-calculating machine, his improved compass, his pianoforte apparatus for sounding the deep sea, testify to the range and quality of his inventive genius. In America his fame is as great as it is at home." One has but to add that the sum of these achievements in money represents a million sterling to completely realise the appealing power of the great example of physical and



THE GREAT EASTERN, BUILT IN 1858.
Used for cable-laying purposes. For this work one set of boilers and one funnel between fourth and fifth masts, were removed.

mental combination, left by the great man who ended his career a few days before the close of last year.

No man it can be said ever realised the limits of time so fully as Lord Kelvin, and of no man will it probably ever be said that the presence of that limitation was more regretted by the human race. His genius was specially adapted for discovery along the lines of the abstruse. He grasped fast where few could even see anything. When towards the close of his fifty-five years of the Glasgow Professorship he was emancipated from the work of teaching his class, he continued to give a course of lectures on the properties of matter, a subject which at his ripe age (he was then seventy-seven) showed the vast range of his natural knowledge and illustrated the bold flights of his scientific imagination. In these lectures he touched upon all things in heaven and earth, discoursing of actual elements and imagining ideal ones, now asking the class to take their stand with him in space, now to go down into some hypothetical limbo of the earth's centre. It was said of him in this connection that " all matter and motion



KELVIN COMPASS.

A. B.—Quadrantal Correctors.

C.—Clinometer.

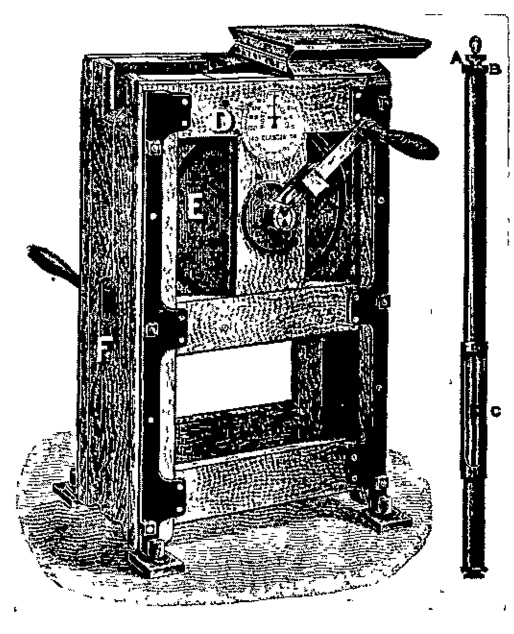
D.—Fore and Aft Magnets (½ blue, ½ red), for reversal when necessary.

were the materials with which his genius delighted to work, whether in the infinitely great or the infinitely little, in the delicate structure and dance of molecules, or the stupendous framework and race of planets." Erratic, it is conceded by his best friends, these lectures were sometimes; of their brilliancy it is unnecessary to speak; that they were instinct with the intensity of earnestness and enthusiasm no one could ever doubt who had heard them. His tremendous enterprise of character having carried him into such regions, what his genius for calculation and scientific accuracy, his grasp of principles and facts, would have done for him (where they might have, long before this, carried him into the realms of beneficial, perhaps epoch - making, discovery) it would be bootless to enquire. We may form a shrewd conjecture by considering the history of his researches in thermo-dynamics. These were without doubt his most important investigations, for though he entered every department of science, he concentrated his efforts on this one especially, taking it far beyond the point where he had first found it; reconciling the differences of the great men who had investigated before him—Carnot, Joule, Rumford, Davy, Mayer, and others, and adding of his own observation and thought so much, that he brought his theory of the conservation of energy to a point where it almost commands the assent of the whole scientific world. With his more remarkable theory of the dissipation of energy he did not get quite so far, having taken it up later in life, but he took it far enough to enable men to see of what tremendous importance were its possibilities. These things raise the question as to what the result might have been had he concentrated on those subjects (that fascinated him beyond all others, with which his genius was more fit to cope than those of men less gifted) in directions revealed by his wondrous imagination to his phenomenal power of work. But there was more practical work forcing itself upon his attention. It was of immediate requirement and of most exacting as well as absorbing character. His genius entered the world of practical invention and was to some extent lost to science: not that science was altogether neglected, as but for the scientific discoveries of Thomson, there could not have been any successful submarine telegraphy. But the great career opening out in the realm of the profound had to be abandoned.

In the latter days of his life he kept touch with the progress of the day, attending with enthusiastic interest to all achievements and weighing every speculation. For example, we had a glimpse of him the other day in these columns proposing the customary favourable resolution after the British Association had heard Sir David Gill's very fine lecture on astronomical science, in which the present position was reviewed with such fascinating force. All his life he was ever at work at something. If on shore it would be in the library of his beautiful suburban villa—the place a miracle of order, not a thing out of its place and no litter whatever, everything proclaiming the systematic clear intellect working swiftly to practical results. About him were mathematical and scientific works, a bust of Newton on the mantel, and a portrait of Faraday on the wall, books and papers and memoranda on the table in order ready for use and reference. Here he read much and arranged his ideas. But when the time came for hard thinking, he would take to what he called his " working study " near the laboratories of his college. We have a description of him in that " sanctum sanctorum "—cigar in mouth, staring into the embers of the fire, intent on some subtle process going on in his brain of analysis or calculation, or a mixture of both, until the formation of some definite conclusion, and then a few words to the amanuensis waiting at the table to give the new idea shape. Or it might be in the cabin of his yacht, the *Lalla Rookh*—on the voyage to a Mediterranean port or to Madeira—where, by the way, he first met his second wife—or in one of the lochs of the western highlands which he greatly loved to travel in, and in that cabin he always declared he could work better than anywhere else. His work in connection with submarine telegraphy had given him a taste for the sea which his profits enabled him to indulge to his heart's content.

We have no picture of him at his work among the ocean cables, but none is required to enable us to understand the leading position he speedily took in that connection. The history with which he was destined to be so conspicuously connected began without him in 1845, when the " General Oceanic Company " was registered, and Messrs. Brett, Wollaston, and Reid laid down the first cable across the English Channel in the year 1850. This line, though successfully laid, was a complete failure, injured by a trawler, and not capable by reason of its weight and unhandiness of being lifted it was lost. But the experience had proved, by means of a few signals transmitted before the failure, the error of the prevailing belief, which was that the current of electricity would, when submerged, be dissipated in the water, nothwithstanding the insulating covering of the conductor. These signals had also the effect of keeping alive the ten years' concession granted to the Messrs. Brett between England and France. In 1851 the well-known railway engineer, Crampton, fixed the type of cable—the general type of iron-wire-sheathed cable which has been, with modifications, in use ever since. A cable was made accordingly by the Gutta-percha Company, of a weight of seven tons to the mile, and laid successfully and proved everything that could have been desired.

The next place to be tried was the Irish Channel, and after three failures Sir Charles Bright laid the famous cable between Port Patrick and Donaghadee, settling the question for a longer distance and deeper water.



KELVIN DEEP-SEA SOUNDER.

A. B. C.—Sinker, with gauge and recorder at C.

D.—Indicator of wire used.

E.—Piano-wire coil.

F.—Attachment for Sinker.

British capital and enterprise next gave cables to various places: among others, Sardinia and Corsica, Balaclava and Varna—for the convenience of the allies during the Crimean war—171 miles through an average depth of 100 fathoms. An attempt to cross the Mediterranean from Corsica to Algiers failed about the same time—600 miles of cable being lost in about 800 fathoms. But two cables were successfully laid between the Italian coast and Corsica. Cables were also laid between England and Holland without much difficulty. Further trials in the Mediterranean were failures, but they accumulated experience of a valuable kind, in the matter of the machinery for paying out cable and the rate at which in deep water the cable and the steamer paying it out should respectively run. Sardinia and Malta were put in connection, and Malta and Corfu.

But all this was not ocean telegraphy. None of the experiments threw any light on the distance question or the depth; and besides very little was known of the depth of any ocean.

The first of these was engaging the attention of Professor Thomson, who, after many experiments and a thorough investigation, propounded the true theory of the subject, namely, that the speed of communication through electric cables is in inverse ratio to the square of the cable's length. Having discovered the difficulty, one strong enough to forbid the laying of ocean cables entirely, the professor set himself with characteristic determination to overcome the same. With him a difficulty was always a thing made to be overcome. The problem was to enable currents to be sent through the long lengths required in unbroken circuit, and at a speed enabling messages to be passed quickly enough in succession to be profitable commercially. The obvious things to do were to improve the material used for cables, to select only copper of the best conductivity, and to invent a new signalling apparatus. The formula having warned the electricians that the current must be of the weakest, it was Thomson's care to provide a recording machine of the most sensitive. All these matters he eventually succeeded in arranging on the basis which proved the bridge which carried ocean telegraphy from failure to commercial success. At first, however, he had only succeeded with the third when the first attempt was made to lay an Atlantic cable. The first cable was laid in August, 1865, and it was in April of the same year that Professor Thomson had perfected and patented his galvanometer, an instrument of extreme delicacy adapted both for testing purposes, especially aboard ship during cable expeditions, and for receiving signals. This was a highly sensitive modification of Gauss and Weber's very heavily constructed reflecting telegraph of 1837. In virtue of its extreme sensitiveness it had the effect of materially reducing the length of time taken by a sufficient force of electricity reaching the further end, such as was capable of actuating the indicating apparatus. This was the fore-runner of what we now term the "mirror-speaking" instrument, and "may be said to have been the means of first rendering ocean telegraphy a *fait accompli* from an electrical and commercial point of view." The opinion is that of Sir Charles Bright, who more than any other engineer contributed to the establishment of submarine telegraphy, who, in fact, took the lead in the matter from the very beginning. His testimony on the subject is absolutely final, of course. The above fact will, Sir Charles goes on in his history of submarine telegraphy to state, be better appreciated when we remember that the best instrument contemporaneous with the Thomson mirror galvanometer could scarcely receive two words per minuts, where the working of the mirror was ten to twelve words, and with a subsequent improvement this was increased to a capacity of twenty per minute. Moreover, concludes Sir Charles, it required considerably less power.

By this time the depth and character of the ocean bed between Ireland and Newfoundland had been ascertained. Instead of the certainties of 6000 and 7000 fathoms expected by most authorities on the subject, the depth was found by Lieutenant Berryman, U.S.S. *Arctic*, and Captain Dayman, H.M.S. *Cyclops*, sounding with the apparatus of Lieutenant Brooks, of the U.S.A. navy, to vary gradually from 1700 to 2400 fathoms between the two places. The demonstration that the deep water—the 6000 fathoms above referred to—did not extend to the north as had been feared, was received with general satisfaction, and made the way of the projected Altantic cable easier considerably. The chief of the U.S.A. National observatory christened the tableland then discovered "Telegraph Plateau," and thus described the same: "The bed of the sea between Ireland and Newfoundland is a plateau, which seems to have been placed there especially for the purpose of holdng a submarine telegraph and of keeping it out of the way." The problem of submarine telegraphy still was confronted with the task of facing life under 1700 to 2400 fathoms. But it was shorn of three-fourths of its most formidable dangers. The soundings moreover demonstrated the ocean bottom to be smooth and soft, covered to a certain depth with the shells of microscopic infusoria. There was no difficulty, it was clear, to be anticipated from the ocean bed.

As to the distances to be communicated through, they were the subject of experiments largely after the suggestions of Thomson. The directors of these were for the most part Sir Charles Bright and Mr. E. Whitehouse. They had 2000 miles of land wires connected, and found that they could transmit "signals" (battery key contacts, producing single impulses) satisfactorily at the rate of 210, 241, and 270 a minute.

These things led to the formation of a company in London for the promotion of Atlantic telegraphy. At the same time Mr. Cyrus Field and Professor Morse, who had been watching things from the other side of the Atlantic, managed to secure the monopoly of all the possible landing places on the American coast. The result was the formation of the first Atlantic telegraph company, by amalgamation of British and American effort. But there was a bad handicap in the shape of the term limit insisted on from the American side, which by imposing undue haste on the construction and fitting up, and on the planning of suitable gear and testing apparatus, led in reality to the failure of the first Atlantic cable laid. The two names that stand out pre-eminent among the list of leading shareholders are Pender and Thomson. Of these the former lived to become the great moving and controlling spirit of the majority of the cable systems of the world; the second, by his ingenuity and perseverance made that profitable submarine telegraphy possible.

It is hardly necessary to detail the history of the first cable that immediately followed. Enough that the British Government guaranteed £14,000 a year to the enterprise and promised men-of-war for laying purposes, that the United States Government made similar promise of shipping co-operation, that £500,000 was raised by the company, and that the cable was finally laid between Valentia Bay (Ireland) and Trinity Bay (Newfoundland) after one failure necessitating a delay of twelve months—by the U.S. frigate *Niagara* and H.M.S. *Agamemnon*, in August, 1858. The two ships steamed out each with half the cable on board to the middle of the Atlantic. Arrived there, they spliced the ends and sailed apart, paying out cable. The *Niagara* arrived at Trinity Bay on the 2nd of August, and the *Agamemnon* at Valentia Bay on the 5th, on which day communication was established between the two countries. The *Times* said: "Since the discovery of Columbus, nothing has been done in any degree comparable to the vast enlargement which has thus been given to the sphere of human activity." The excitement in Britain and America was tremendous.

It was short-lived, for the communication thus established lasted only twenty days. Thomson, who had been present on the *Agamemnon* throughout the laying operations, and had conducted the testings and general electric work, had his reasons as to the cause. It was freely alleged that Mr. Whitehouse applied too much power and destroyed the cable. Thomson, however, declared that if the cable had been properly handled it would have done its work well enough. He leaned to the theory that weak joints were the real cause of the loss of current. The public mind was discouraged, for men jumped rapidly to the conclusion that the impossibility of cable communication over such long distances and at such depths had been demonstrated. There was a counsel of despair; and advice to lay a cable at a few fathoms under the surface attached to buoys, which, besides floating the cable, would serve as places for tapping the current. We give an illustration of this proposal.

Soon after the failure of the Atlantic cable the Red Sea, Aden, and East India cable was laid in three sections of about 1000 miles in all. Its success was confined to each section, and was only temporary, while there is no record of a message sent through the whole system. This cable proving as difficult to handle for repairing purposes as the Atlantic cable, had like it to be abandoned. Thus a million to million and a half sterling had disappeared, and there was nothing to show for the money but the demonstration of the possibility of laying and working a deep-sea cable; to say nothing of the proved value of the messages sent. For example an expenditure of a few sovereigns saved the Government £50,000 in connection with the embarkation for Canada of certain regiments. For these reasons it was felt that the attempts to establish cables should be continued. But in the absence of specific information it was thought inadvisable to proceed without further consideration and study of the subject. Acting under the advice of Professor Thomson the Government appointed a "Committee of Enquiry on the Construction of Submarine Cables." The Committee took evidence from all practical men and the scientists who had any experience of telegraphy and the handling of electric cables. It sat for nearly three years, devoted its questions to the subjects of manufacture of cables and their material, their routes, the testing of them, the receiving and transmitting instruments used with them, the speed of signalling and other matters that had cropped up during the eventful trips of the cable-laying steamers.

(To be continued).

A Noiseless Winch.

The mechanical handling of goods, whether on land or sea, has hitherto been a noisy process. In a workshop the ceaseless racket prevents conversation and interferes with the clear hearing of orders; and on board ship the noise of the winches has always been regarded as a bugbear. One might, indeed, go so far as to say that the life of the passenger when cargo is being handled, is rendered unbearable by the ceaseless clang and clatter of the machine. Attempts have been made to remedy the evil, notably by the provision of electrically-driven winches. But cost, speed, and wet decks have, so far, combined to make these unremunerative investments, even when they keep going in order long enough to complete any considerable amount of work. Messrs. David Wilson and Co., of Liverpool, have been carrying out experiments for a long time past and have succeeded in producing a silent steam winch, which they have just put upon the market. This firm have had many years experience in the design and construction of this class of machinery, having built, amongst hundreds of others, the winch used for taking the 60-ton lifts out of the wrecked warship *Montagu*. The improvement in the present instance consists mainly in adapting a sprocket wheel and roller chain drive instead of the toothed gear wheels. The chain is made of stamped steel, with pins of drift steel and rollers of the best solid drawn weldless steel tubes. The chain engages on four sprockets of the smallest wheel and three-fourths of those of the main barrel wheel. The arrangement not only ensures absolute silence, but also safety. All the motions of the ordinary steam winch apply to the approved type, which can be applied single or double geared, and can be reversed as quickly as its predecessor—and silently. The improvement will prove of the greatest assistance to all winch users. Engineers are all familiar with the difficulty of repairing the ordinary gear wheels, the cutting off the broken teeth, drilling holes and inserting plugs while the work is stopped, or in freezing weather at sea. Such trouble is impossible with the new winch. An additional advantage is that, if the driving shaft of an ordinary winch becomes bent the machine has to be put out of commission, whereas with the improved pattern the winch will work even with a bent shaft. There are no teeth and pinion to carry away. If need be a new chain can be fitted in a few minutes; the defective length can be cut out at leisure and used again. Any ordinary steam winch can be converted at a small cost in a couple of days. The cost of conversion is certain to pay for itself in a single voyage in the avoiding of repairs. The weight is practically the same as an ordinary winch and the space occupied identical.

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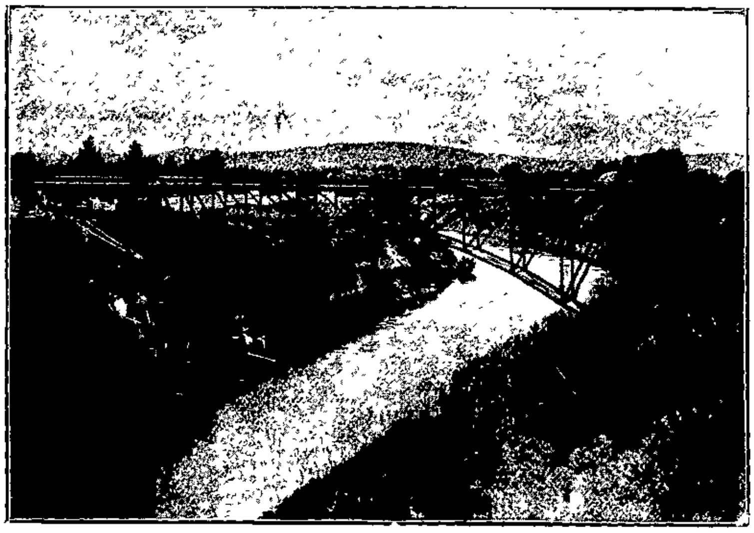
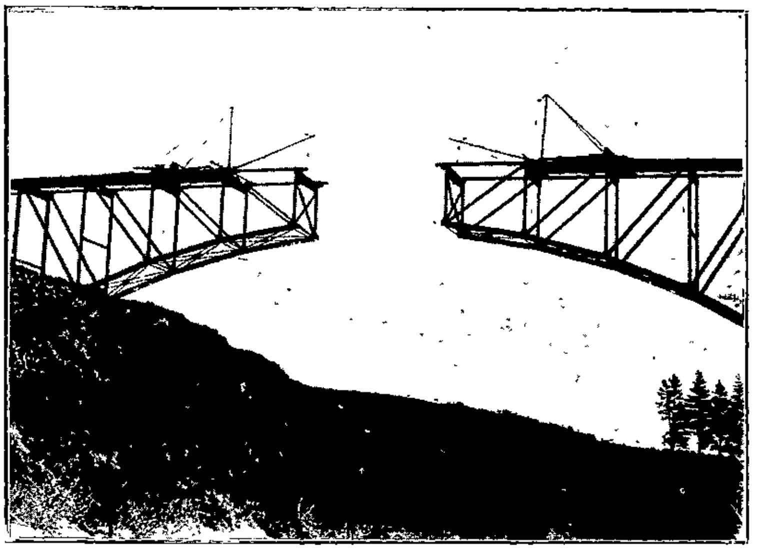
Engineering: Sea and Land

Cambridge High-Level Bridge.

The recently completed high-level steel arch bridge over the Waikato river at Cambridge, of which illustrations are here given, was built to the order of the Cambridge Borough Council by the American Bridge Co., of New York. The structure belongs to what is known as the three-hinged braced arch type, and is the first of its kind erected in New Zealand. It comprises one arch span of 290ft. between skewbacks, two 65ft. plate girder flanking spans, and one 42ft. plate girder approach span. The total length is 462ft. between abutments, with a clear height of 126ft. to hand railing above ordinary water level, while the width of deck is 17ft. between railings. The arch springs from pin connections on the concrete skewback piers 50ft. above water level of the river, with a rise of 52ft. to the crown pins at centre. The crown and skewback pins lie in an arch of 228ft. radius. This arch extends the full width of the river, and erection was effected by "cantilevering" to avoid the necessity of staying and false work, and all possible inconvenience due to floods. A double cancellation system of laced angle bars extends between the up and down stream arches, or bottom chords, in twelve panels, or bays. During the process of "cantilevering" the operation only differed from that in the construction of bridges of the cantilever design in that anchor I bars took the place of the anchor arm. The junction of the west arm, or half arch, was made after the erection of the steel end posts began, and in that time some 300 tons of steel were placed in position. The floor system is composed of an alternating arrangement of deep and shallow longitudinal I beam stringers, the deep beams spanning a panel unsupported, the intermediate or shallow stringer being supported at mid-panel length by intercostal, or secondary, floor beams attached to the deep stringers. The floor system bears on plate girder floor beams, or transoms, at every panel post, and is stiffened throughout by a simple arrangement of intersecting angle-bar wind-bracing in every panel. The spandrel members of the chords consist of vertical posts and diagonal braces, each of two-rolled channel section laced apart. The intersection of these members with the chords is covered with gusset plates, forming rigidly connected riveted joints. The shore ends of the 42 ft. approach and the 65 ft. flank spans are carried on concrete abutments, which, during the erection of the arch, acted as anchors for the half arches or cantilever arms. The thrust of the ends of the arch is taken on skewback piers extending some 15ft. into the river banks, thus having a footing on a solid sandstone formation.



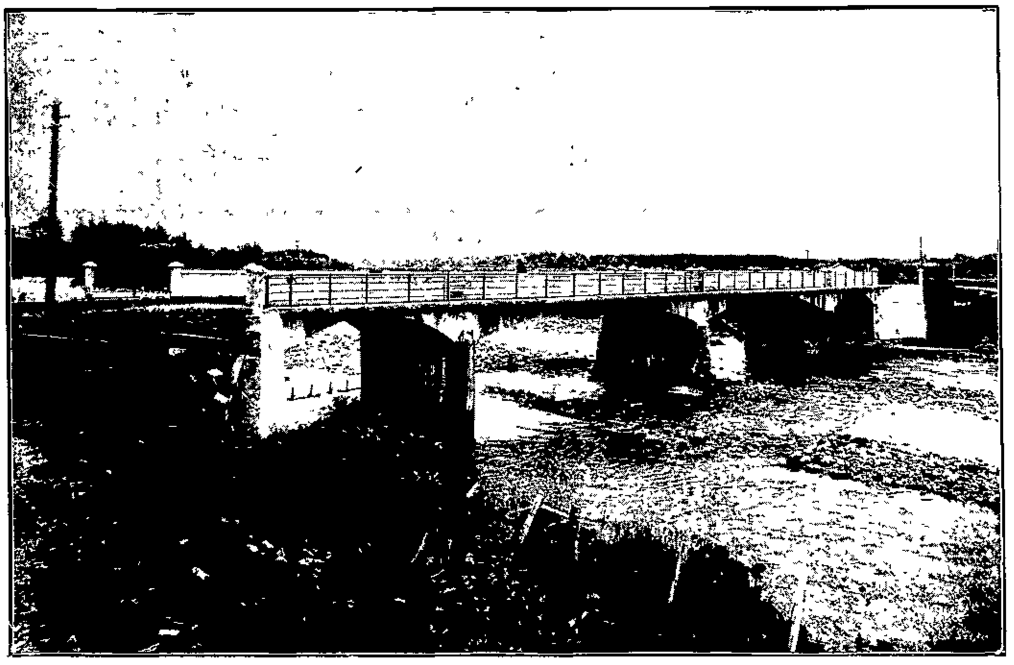
CAMBRIDGE BRIDGE: GENERAL VIEW.



CAMBRIDGE BRIDGE BEFORE THE FINAL GIRDER WAS PLACED IN POSITION.

To provide against corrosive deterioration of the steel composing the structure, the bridge has been painted throughout with a chemically combined "carbonising coating." The steel throughout is open-hearth medium steel, including the rivets and bolts, and all the work in the American shops and material tests were conducted under the careful supervision of independent inspecting engineers. The bridge is designed not only to meet the requirements of to-day, but provision has been made for the progress that comes with time; and the possibility of electric or other tram cars has not been overlooked, for the structure is stiff enough to carry cars weighing 120,000 lbs., and having a length of 70 ft. Viewed from below, the span of the arch is more apparent than from the road level, and the contour is both imposing and graceful, though, compared with the Victoria Falls bridge over the Zambesi, it is small. From an engineering point of view the fabric is an example of advanced bridge design and practice of to-day. Mr. J. E. Fulton, M.Inst.C.E., was the engineer, Mr. G. M. Fraser the contractor for the erection, and Mr. S. W. Jones resident assistant engineer. The structure is a landmark for miles around the excellent agricultural districts it unites.

CAMBRIDGE BRIDGE: THE COMPLETED ARCH.



WAIWAKAIHO TRAFFIC BRIDGE, NEW PLYMOUTH.

Ferro-Concrete Bridges in Taranaki.

About four years ago the Taranaki County Council were given power by the ratepayers to raise a loan for the purpose of re-constructing the bridges of the county. With one exception these bridges were of wood, and were in a bad state of decay. The Council began by renewing with Australian timber, on concrete abutments. These being found expensive, it was decided to rebuild in steel, and two bridges, one of 90 ft. and the other of 60 ft. span, were built at what was considered a low cost. On account of the excessive rainfall in Taranaki these two bridges quickly began to scale, and had to be scraped and painted within a year. This induced the Council to have all bridges built in concrete, and instructions were given to their engineer to prepare plans for several bridges in ferro-concrete. A bridge has been built over the Oakura river, 62 ft. span, of ribbed plate design having four reinforced ribs, or beams, with parapets and decking, reinforced with round steel bars and expanded metal, at a cost for the superstructure of £396, or £6 10s per foot length, and 8s 6d per square foot of decking; also over the Waiongona, 45 ft. arch, Piakau, 30 ft. arch, Manganui, and others. The Manganui bridge consists of three spans, one 60 ft., one 30 ft., and one 20 ft., on piers 32 feet above the river bed. This bridge is of rolled steel girders understrutted and cased in concrete. It has a fair amount of steel in it—over 16 tons—and is so designed that the girders are capable of carrying all the load as well as the concrete—in fact live and dead load—in themselves. The largest bridge constructed by the Council in ferro-concrete is that over the Waiwakaiho river, near New Plymouth, on the site of a massive puriri timber bridge, built 50 years ago, that had become unsafe for heavy traffic. This new bridge is of four spans, two of 60 ft., and two of 30 ft., on concrete abutments and three piers. The width of the bridge is 30 ft., consisting of a 21 ft. roadway and two cantilever sidewalks of 4 ft. each. The total length of the bridge is 190 ft.

The design is a combination of the Winch and Hennibique construction, the flat topped arches being broken into ribs by light wooden frames that remain embedded in the concrete. The rise in the arches is only 4 ft. 6 in., the radius of the long span arches being 96 ft., and the short spans 28 ft. The thickness of concrete at the crown of the arches is one foot six inches, and at the piers 6ft.

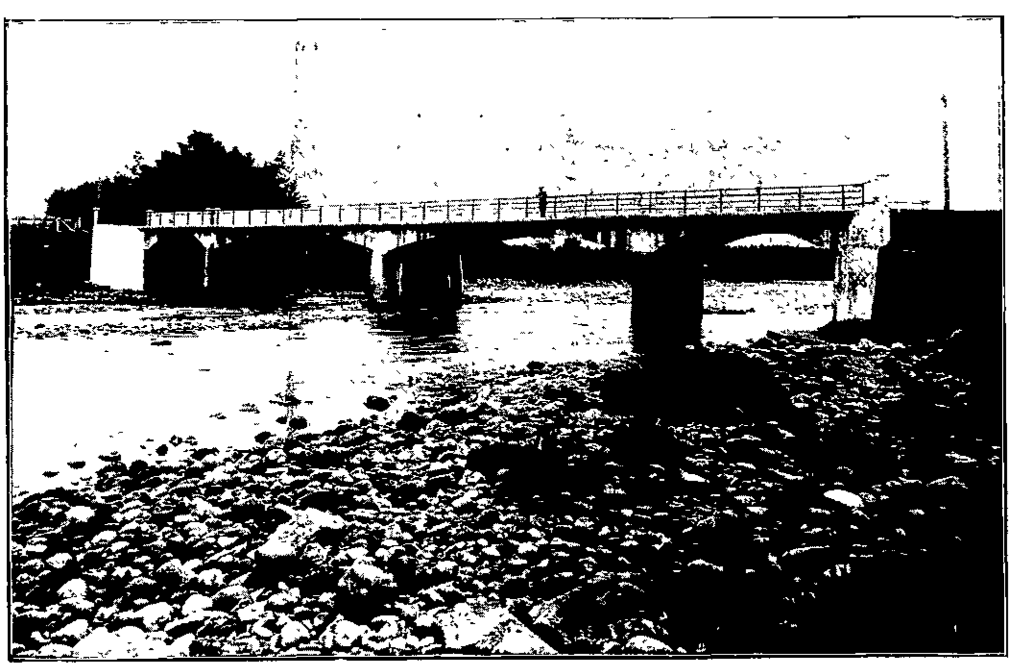
The reinforcement consists of 12 parallel rows of 40 lb. steel rails running horizontally along the whole length of the bridge, about 6in. from the floor level, and the same number of 40 lb. rails following the curve of the arches at about 6in. from their lower surface. The horizontal members are placed base downward, and those following the curves base upward, and the two are riveted together at the arch crowns. These reinforcing frames are spaced two feet apart, and are continuous from end to end of the bridge, and are connected at the abutments by steel rails. A network of rods connects the two members and laces the whole reinforcement together. The vertical rods are simply turned round other rods that run horizontally through the webs of the rails, and are very roughly put together, but the effect to the rigidity of the reinforcement is very marked. The frames are bolted to the piers and abutments with heavy iron bolts. Expanded metal was used for the bracketed footwalks.

The concrete consists of Portland cement and, principally, beach gravel in different proportions, the ring of the arch and grouting being 4 to 1, and all other parts of the bridge 6 to 1. Broken shingle taken from the river bed was used in piers and abutments, and in the heavier parts of the bridge. The concrete was made very wet, and was well spaded and rammed around the steel. The roadway is divided from the footways by parapets six inches thick of concrete reinforced with rods, and having eight posts or newels on each side, open spaces being left at the piers. The footwalks have iron railing, consisting of angle iron stanchions and gas piping rails, the top rail being 2½ in. and three others of ¾ in. This is the only exposed iron in the bridge. A nosing runs the whole length of the outer edge of footwalks, throwing the rain water back into the drains and preventing any flow over the sides.

The bridge has a very nice appearance now that it is finished, and timber centreing away, and should meet all requirements of traffic for many years. The cost of the bridge complete, with asphalt flooring, is £3500, without including the value of old piers that are used in the new construction, valued at £600, but including the cost of removing the old bridge and building a temporary bridge to carry the large amount of traffic passing over the road. These cost about £550. The cost of superstructure is estimated at £15 per foot, or 10s per square foot of floor surface.

Comparing this with steel bridges the cost is much less for ferro-concrete. The Waiongona steel bridge of 90 ft. span, 14 ft. wide, having timber decking, cost 11s 6d per square foot. and the Waipuku steel bridge, 60 ft. span, and 14 ft. wide, with timber decking, cost 13s per square foot. It should be noted that the Taranaki county is peculiarly adapted for concrete construction, having large supplies of clean stone suitable for the work, which can be procured at a fairly low cost. But considering the durability and absence of maintenance, the concrete, at a much higher cost than steel or wood, would be the cheaper. The contract for the Waiwakaiho bridge was carried out by Mr. L. G. P. Spencer, to plans and specifications prepared by the engineer to the council, Mr. John Skinner.

Of all applications of machinery for industrial purposes the manufacture of horse shoes by the use of a train of rolls and quick-working machines occupies a position that is most important in these days of strenuous life. The extensive use of horses by the citizens of various nations, has created such a demand for the shoes, that it has resulted in the building of mills that give employment to thousands of workmen and add to the wealth and comforts of the people.



ANOTHER ASPECT OF THE WAIWAKAIHO TRAFFIC BRIDGE, NEW PLYMOUTH.

The Union Engine.

The accompanying illustration depicts a large American four-masted schooner equipped with twin-screw Union 3-cylinder engines of a total of 300 h.p. running on crude oil, and a 4-h.p. electric light engine. The length of this vessel is 167ft., beam 40 ft., depth 13 ft. 4in., tonnage 567, with carrying capacity of 800,000 square feet of timber. It is well to remember that New Zealand took the lead in the Southern Hemisphere in adopting the oil engine as a motive power for such vessels. The large expanse of smooth water in the Hauraki Gulf, and elsewhere in the Dominion makes this engine an ideal type for marine propulsion for trading vessels of all sizes, as it requires only a minimum of attention, and, on account of the few working parts, a small bill for repairs.

AMERICAN SCHOONER WITH 300 H.P. UNION THREE-CYLINDER ENGINES.

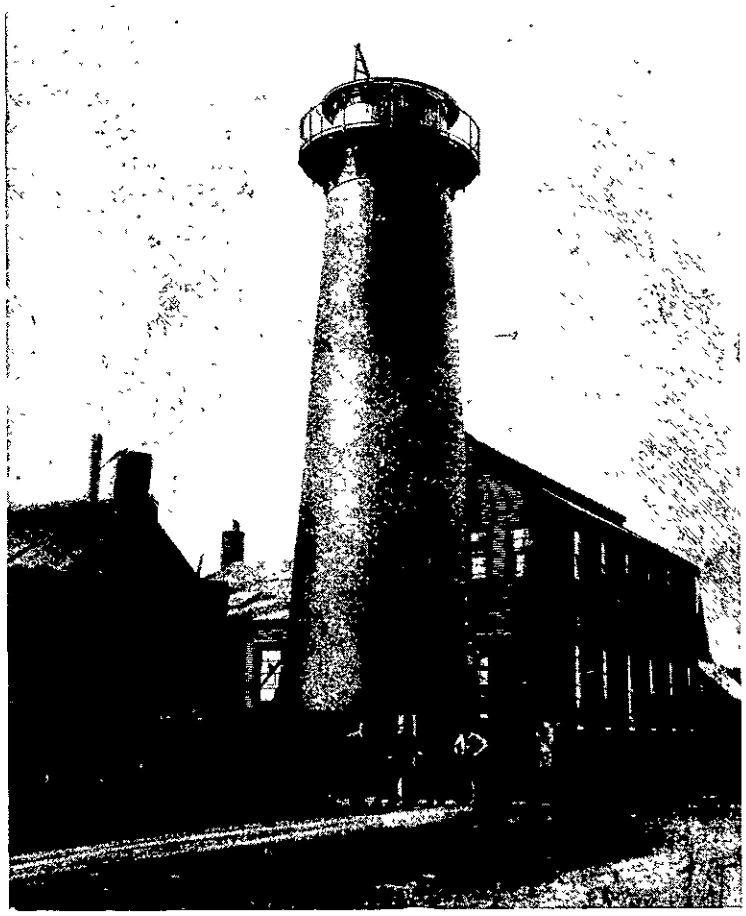
The Panama Canal.

PROGRESS OF THE WORK.

Since the American Government took the direction out of the hands of the civil engineers and placed it in those of the military engineers of the United States Army, the work has proceeded apace. It is now an old story how the first got to work after the way had been opened by the admirable arrangements of the sanitary authorities who had, by working what were universally regarded as almost miracles, made the Isthmus of Panama habitable and wholesome. Congress voted steadily millions of dollars a year, and men began to look for the work to get into shape. A vivid controversy was got up about the old question of locks *versus* a sea level. It raged with an accompaniment of denunciation and prophecy of evil, seldom equalled in intensity outside of America, and it died out and apparently was forgotten. The advocates of the level canal were, it is well to remember, for a reason that will presently appear, really advocates of the French plans, to the superiority of which they testified strongly.

As work went on it was found that the original conclusions as to the formation of the isthmus were more than confirmed, the ground proving more solid than anticipated, and the great river Chagres, the bugbear of former critics, a much maligned water power. The Gatun dam, projected for the control of this turbulent stream, was by the critics of the profession, or some of them, declared impossible, and the great Culebra cut a myth of the most colossal magnitude. The plain English of these criticisms was, "You can not get through the mountain divide, and you will never build the Gatun dam, but if you do the river will carry it away every time." It was added with a certain amount of glee that the work from the outset was subject to unexpected delays, thus falling behind the estimated time more and more.

To this it was replied on behalf of the constructors that there was no delay really; only a rather longer preparation for the actual work of construction than was at first estimated. When the civil engineers retired and the Government replaced them with their own staff selected from the U.S. army, the critics pronounced the event to be a confirmation of their worst predictions. The Government side replied that the civil engineers had been too exacting in their demands. They wanted too much *carte blanche*, and they could not get into the system of checks required, very properly, by every undertaking in which public money is expended—checks, which, we may add, are more necessary in the United States than anywhere else. The event has proved the critics wrong, at all events, as to the delay. Instead of delay, there has been a great bettering of the rate of progress, so that the Isthmian Canal Commission has asked for permission to spend eight million dollars this year more than the appropriations voted by Congress.



THE NEW CAPE CAMPBELL LIGHTHOUSE IN THE YARD OF THE BUILDERS (CHAS. JUDD, THAMES). HEIGHT 65 FEET.

The Isthmian Canal Commission makes the public statement that with the present fine organisation and at the present rate of progress, the canal can be completed more rapidly than by restraining expenditure within the appropriations which were made at the last session of Congress to continue the work until 1908. The work on the locks and dams on each terminus has been opened, and will be pushed vigorously during the year, while very little was expended at those places during the fiscal year which terminated June 30, 1907. The time of completion of the canal, says the Commission, appears to depend now upon work at Gatun, rather than upon the work of excavation, which has hitherto been generally taken as the determining feature. The progress in this direction has been faster than anticipated and the appropriation made at the last session of Congress would not be sufficient to supply the necessary plant to begin laying the concrete in the locks and dams during the next fiscal year, although progress already made indicates that such a beginning is advisable. In order to avoid reducing the force to keep within the expenditure already authorised for this fiscal year, the chairman of the Commission has recommended to the Secretary of War that the work be allowed to proceed, and that Congress be appealed to at its next session to make good any deficiency in the funds now available.

That is a fact rearing a hard head out of the chaos of hostile objurgation and predictions. Instead of delays there is unexpected rapid progress. The Gatun dam moreover, is not only proving easy of construction and safe, but by reason of the enormous increased area (170 square miles is the latest calculation) of the lake it will prove a splendid controller of the wild river that was supposed to threaten the life of the enterprise. As for the Culebra cut, it is being pushed through with a smoothness which astonishes every engineer who looks into the matter.

A recent observer says that the work on the locks has now progressed to a point at which it is possible to see something of their forms. The present indications are that the excavation will be far enough completed in about eighteen months to enable the masonry work to be put in hand. Material is being rapidly dumped on the site of the big dam; the Chagres has been diverted and dammed; and the Commission reports that suitable sand and rock for the big masonry rocks have been located, as also material for the manufacture of all the cement that may be required. It is, of course, hoped that the necessary cement may be obtained in the ordinary way at reasonable prices. But in that country of "trusts" and "corners" it is just as well that the Commission can face the position with a certainty of being able to rely upon its own resources.

A Vindication of De Lesseps.

It has been the custom to regard the old machinery left behind by the French company which failed to construct the canal as in every way bad, in design, workmanship, and efficiency. Hundreds have seen the rusting piles of scrap-iron lying in melancholy profusion all along the line of the old workings, only to condemn them unequivocally. There was a vast quantity, and the asset was considered too small to be counted of any value at all.

The news is now published that one of the old dredges which has been lying in the Rio Grande for more than twenty years has been re-built at a moderate cost, and is capable of excavating 120,000 cubic yards of material per month; as much in fact as can be removed by four of the most modern 95 ton 5-yard steam shovels. Of this resurrection from the dead of the old company, competent engineers estimate, that when it is put to service at the La Boca entrance of the canal, it will do more work than a modern dipper dredge costing £20,000.

It is pathetic to read that in the reconstruction of this derelict the various parts used were all of French construction, and were found in the tropical jungles among the abandoned material which had lain exposed to the elements for over two decades. Among the lot were three boilers in excellent condition, absolutely free from corrosion; two cylinders in good shape, and the engine in the hull could not be surpassed, says a practical authority, by modern machinery, either as to adjustment or economy of operation. All of which is attributed by practical men, who have seen with their own eyes, partly to the excellence of the material and partly to the careful management which, when the work was stopped, covered up the machinery with lead and grease. The reconstructed dredge is found to compare very favourably with an old Scotch dredge which the old canal company had in use for some years, and was abandoned as the other was, and duly re-constructed, since when she has done splendid work with a record of less than forty days out of commission for repairs in five years. When these two derelicts are at work together the effect on the progress of the work will be, say the engineers, very marked. A third dredge of French construction is in hand for re-construction, and promises to be every bit as good when put together and commissioned, with the use of French materials taken from the debris by the side of the canal. Add that the material removed by the dredges now at work is all taken out and dumped into deep water by eight self-propelled barges, and it is evident that the prestige of the veteran who built the Suez Canal can be well re-established by the work he has left behind him in the canal, which he might have made a triumph, but for the malevolence of political faction, and the dishonesty of political allies. At all events the reputation of the engineers of France will emerge with the completed Panama Canal out of the darkness of the past, cleared of the grave imputations of incompetency and carelessness.

Perhaps, also, the plan of some of the best of them for a sea-level canal may also one day be vindicated. Who knows?

A Disquieting Report.

The following cable message alludes to the above:—

"NEW YORK, January 14.

"It is reported in Washington that the Panama Canal will cost thirty million sterling above the estimates, owing to revision of plans. Even then, vessels of the Dreadnought class will be unable to pass through the canal."

This is rather loose. Is it an official report or a street rumour? Are these millions of dollars, or pounds? When were the plans revised, and why, and what plans? On the whole, consideration must be deferred for further information.

The Lubrication of Bearings.

All machine users are interested in the subject of lubrication, since it so closely effects the efficiency of the machine. The subject is fully and suggestively treated by Mr. F. H. Davies, in an article in the *Electrical World*, from which we reproduce the salient passages. The writer begins by explaining the function of the lubricant.

In any bearing the function of the lubricant is to convert rubbing into rolling friction by the intervention of the minute globules of which the lubricant is composed; consequently, in a well-lubricated bearing the metallic surfaces never actually touch one another, but are separated by a film of oil, more or less thick, according to its quality and the amount used. In the case of a bearing which is loaded in a downward direction, say to a pressure of 10lb. per square inch of area, it is obvious that the oil between the lower surfaces has to transmit an equivalent force in order to keep them apart, and it therefore follows that oil cannot be fed between these surfaces unless it is supplied at the above pressure. Now, the case in point is that of an ordinary bearing fed at the top by a drip lubricator having no mechanical arrangement to put pressure upon the oil, and the question is: How does the latter get between the lower surfaces where the oil is under a pressure of 10lb. per square inch?

The result is brought about by the property of adhesion in conjunction with the velocity with which the oil is carried round by the shaft. In the above case the shaft naturally lies on the bottom surface of the bearing, leaving a small but important crescent-shaped space at the top. The oil from the lubricator falls into this space, and spreads itself thickly over the upper surface of the shaft, adhering to it; the film between the bottom surfaces is, of course, much thinner. As the shaft rotates, the freshly fed oil is carried into the gradually narrowing space, acquiring a high velocity, and by its adhesive properties still clinging to the journal. It is now, of course, considerably compressed, and the farther it is carried the greater its pressure becomes, until finally it acquires a pressure equal to that between the lower surfaces.

The question of lubricating oils is a very important one, and by far too large a subject to be more than touched on here. The chief points to be considered in the selection of an oil are the pressure on the bearing or the size of the engine, and the temperature at which it is presumed the part to be lubricated will work. What is wanted is a fluid that possesses the lowest molecular friction, and from this point of view the thinner the oil the better. On the other hand, thin oil does not lend itself very well to what may be termed adhesive action of the bearing, and as the latter heats up it gets thinner, and consequently worse and worse in this respect. On the contrary, thick or heavy oil, owing to its greater adhesiveness, will force its way in even against the greatest pressure, but when there it is not so efficient as thin oil. It is obvious that in a case like this the idea is the happy medium, and it is at this result that most manufacturers of oils aim. In an engine or any machine it is customary to use the same oil to lubricate all the external parts. It should be remembered that while this is the only method possible in practice, it is theoretically wrong, as reciprocating bearings require a heavier oil than guides or journals, in order to reduce as much as possible the flow from top to bottom of the "brass" consequent upon the alternating impacts. It is conceivable that a greater proportion of a thin oil would be forced round to the side where there is no load than would be the case where a thick oil with its superior viscosity is used,

Grooves for Oil.

It should be noted here that it is quite as possible for a reciprocating bearing to run hot through being too slack as through being too tight. A very slack bearing will knock heavily, and the impacts of the surfaces will naturally evolve heat. In practical working, when such a case occurs, the only remedy short of tightening the bearing is to keep it over-supplied with oil, thus producing a cushion for the blow.

Guides do not need grooves if the surfaces are properly prepared; and they are certainly undesirable in bearings of reciprocating machines, where it is so essential to keep as much oil between the loaded surfaces as possible. In this case the channels only aid it to pass to the unloaded side where it is not needed. Where grooves are used, it is important that the edges should be rounded, for if they are left sharp they tend to wipe off the oil and keep it in all the channels.

Rubbing and Rolling Friction.

It may be taken as an axiom that so long as rolling friction only, as defined above, is present in a bearing there will be no appreciable heating; but the moment rubbing friction between metal and metal occurs warming up begins. This may be due to three causes: (1) Insufficient supply or poor quality of oil; (2) the presence of a foreign substance, such as grit in the bearing; or (3) badly prepared surfaces. In the first case rubbing friction will occur all round with disastrous results in a very short time; the shaft or pin expands with the heat, making matters worse, and finally becomes such a tight fit that the engine pulls up or something breaks. In the second case, rubbing friction is only set up in the small area affected by the grit; but the heat generated there soon spreads, causing the bearing to close up as before, and the result will be bad scoring of the brass, particularly in the place where the grit is present.

Another point to be remembered in regard to hot bearings is that above a certain temperature the oil chars, losing its lubricating properties. When this stage is reached, under ordinary systems of lubrication no amount of oil will cool a bearing, and the engine must be shut down.

In the Workshop.

The following are the principal kinds of hone and oil-stone from which a workman is likely to be able to make his selection—the order in which they are placed being approximately that of their abrading power; those at the top of the list being the "fastest cutting," a quality which is generally accompanied by a want of fineness in the edge produced.

1. Washita Oilstone.—A very compact white sandstone, of rather recent introduction, almost resembling Carrara marble in appearance. Although it does not greatly differ in price from Turkey stone, its much greater uniformity and slightly more rapid cutting property cause it to be in more favour with carpenters and others, with whom coarseness of edge is not an objection.
2. Turkey oilstone.—When of good quality no better substance can be employed for setting tools for which great fineness of edge is not required, since it cuts the hardest steel with avidity even when but little pressure is applied. At the same time it is of a close grain, and is not easily scratched. Unfortunately, it is very variable in quality, as it is also in colour; the latter which is called white, grey, or black being generally a veined mixture of different shades of bluish and brownish greys. Its cost is about three times that of the stone next mentioned.
3. Charnley Forest Stone.—Found near Mount Sorrel, in Leicestershire. This is the best of the British oilstones, and has long been a favourite with carpenters and others, that from the Whittle Hill Quarries, which is of grey colour, dappled or streaked with red, being considered to be the best. Till lately this has hardly been obtainable, the only representative of Charnley Forest stone being a rather inferior one with a decidedly green tint. Both of them, however, give a very fairly fine edge, but do not cut quite so rapidly or with as slight pressure as Turkey.
4. Canada Oilstone.—A very fine porous sandstone of a greyish white colour, which has been recently introduced. Being much less compact than any of the preceding stones, it is much more rapidly worn away. Its first cost, is, however, rather less than that of Charnley stone.
5. Grecian Hone.—Under this name a slaty stone is imported which is of a greenish colour, and, although said to be superior to Welsh oilstone, does not greatly differ from it in appearance.
6. Welsh Oilstone.—A hardish stone of a green colour and slaty texture, inferior to the Charnley Forest for joiners' use. In price it is about the same, as also is the Grecian hone, No. 5.
7. Arkansas Oilstone.—Cuts slowly, but is very superior to all those above mentioned for giving a fine edge to surgical instruments, &c. Although extremely costly—its price being about four times that of Turkey stone—it is extensively used for such purposes. In colour it resembles Washita oilstone, but it is of very much finer grain and wears away very slowly.
8. German Hone.—Thin slabs of a very soft yellow stone, cemented upon a rather harder but similar material of a slate-blue colour, are imported and sold under this name. The extreme softness of the former renders it almost useless for such edge-tools as we have been considering, although it is well adapted for setting razors, to which it imparts an edge of great smoothness and delicacy.

New Experimental Apparatus.

By W. ALEXANDER, A.M.I.M.E., A.M.I.C.E.

After Bacon long ago advocated so strongly the method of experiment and deduction for acquiring scientific knowledge, there was at first a slow, and, as time went on, an increasingly rapid, adoption of the method. The erroneous inverse method was well exemplified by the alchemists in their search for the means of transmuting the baser metals into gold. They pre-supposed it could be done, but their own experiments and observations showed the futility of their ideas. The flat-world, the caloric, and the calx-phlogiston theorists were in similar case. Indeed, in nearly all instances of theories

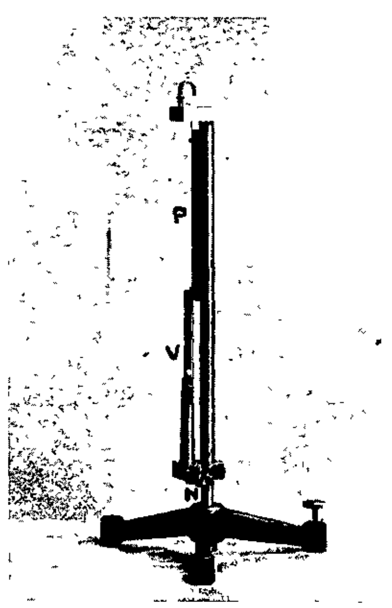


FIG. 1.

formed without sufficient experimental basis for them, theory is sooner or later proved to be wrong. So Bacon's method (in which laws, principles, and theories are derived from experiment and observation, and, in which experiment alternates with theory and both mutually assist one another) is the one that is of real service in advancing scientific knowledge; and for this reason it now reigns supreme in all branches of scientific enquiry and discovery. As indicated by splendid achievement, the most rapid and the most perfect development of the method is exhibited in the work of the late Lord Kelvin.

In the *teaching* of scientific laws and principles, this method until comparatively recently had not been applied to any extent, and it results from this fact that practical men still sneeringly refer to "academic" knowledge and teaching. But of late the tendency in teaching science is more and more to employ the methods that are in vogue in the practical scientific world. The principles and laws to be learned by the student are deduced, under the guidance of his teacher, from quantitative observation of phenomena shown by the apparatus arranged for the purpose. Even mathematics are now studied in this way, due chiefly to the initiative of Professor Perry, one of Lord Kelvin's most distinguished students. Usually the student makes experiments in the subjects that apply more directly in the work he will be engaged in in after life, but whether the subjects themselves relate to his later work or not does not matter so much as his comprehending the power of, and his ability to apply, the deductive method in connection with any branch of scientific or technical investigation he may be concerned with.

The above kind of instruction requires a considerable variety of apparatus which must not be crude and give rough results, but should be well designed to satisfy the following general requirements :—

(*a*). The phenomena to be observed, and the measurements to be made, should be vitiated as little as possible by disturbing phenomena or errors.

(*b*). Adjustments and observations should be arranged to be made quickly and easily.

(*c*). The chances of the experiment breaking down, due to mishaps to the setting or to the apparatus itself, should be reduced to a minimum.

When these conditions are fulfilled several advantages accrue :—The student's attention concentrates more on the phenomena or measurements under consideration ; his time is saved, so that he does not tire of the experiment ; and he gets over more of the subject ; and altogether he takes more interest in the work and in writing up his reports and descriptions.

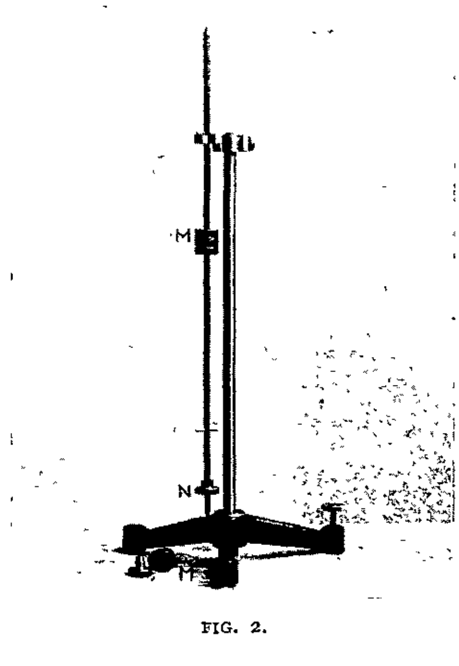


FIG. 2.

In connection with the above method of teaching, the various pieces of apparatus described below have been designed for the mechanics classes of the Wellington Technical School by the Director and myself. They have been made in the school workshops partly by the students and my assistant, Mr. Dolby. They form only a very small part of the total equipment necessary for a mechanics laboratory, but it is hoped that, due to possible outside aid, the mechanics and other classes will be soon fully provided for.

Most of the apparatus is arranged to fit on one pattern and size of stand. In this way, comparatively few stands are required. The utility of the apparatus is not lessened thereby, but is rather improved; and there are the advantages that, as regards the making of them, the material, labour, and cost are much reduced, as is the storage room required; while the convenience of handling due to lessened weight is increased.

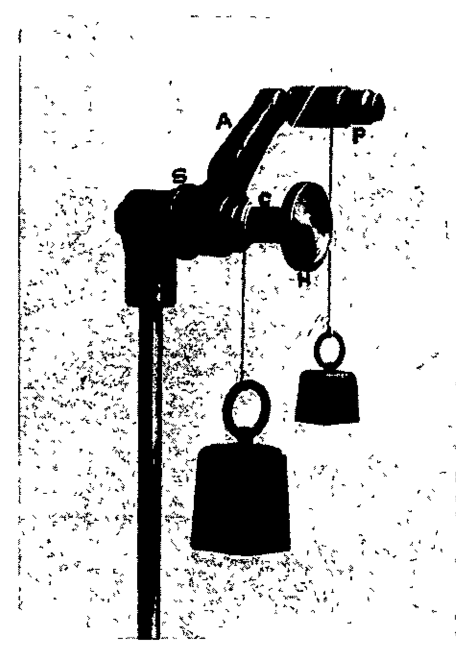


FIG. 3.

Fig. 1 shows an apparatus for studying the laws of motion of bodies falling freely under gravity.

Observations are made on the body with regard to distances fallen through and corresponding times, not while the motion is taking place, but afterwards, on the permanent and complete time and space record of the motion which the apparatus gives. *P* is a polished brass plate (about 10 inches long) that is arranged to fall vertically, against almost negligible friction, by means of the side guide wires that can be tightened when required by the milled nuts, *N*. *V*. is a vibrator making 60 double oscillations per second, and, which, at its free top end, carries a bristle that presses very lightly on the plate. The "give" of the wires allows the plate to be removed for the purpose of blackening it over a gas flame. When the plate is blackened it is suspended near the top of its fall by means of a thread. The vibrator is then started, and the plate caused to fall at the same time by burning the thread. The bright wave-trace marked on the plate by the vibrating bristle forms a permanent, continuous, and complete space-time record of the motion, and from this trace all the laws of motion of bodies falling freely, and also the gravity constant, can be deduced.

A Kater's pendulum is shown in Fig. 2. It is an instrument for the determination in absolute units of the force, or the acceleration, of gravity.

The large masses, *M*, are made in two parts and are symmetrical about their axes, so that a rotation would not affect the period of vibration. In order that the rate of swinging can be altered they are movable along the rod, and can be fixed in any position by simply screwing one portion of the mass into the other, which causes a firm grip on the rod. *N* is a smaller mass in the form of a milled nut that can be adjusted in position more sensitively than the larger masses, for the purpose of bringing the periods of vibration for both knife edges to exactly the same value. When this is accomplished, the common period is the same as that of a perfect simple pendulum of the same length as the distance between the knife edges, and a simple calculation will determine the required result.

It is intended to make as soon as possible a nearly perfect simple pendulum, and a

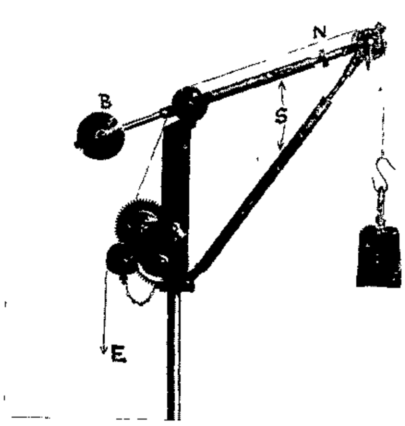


FIG. 4.

bifilar suspension pendulum, for comparing one type with another. The comparison is made by causing any pair of the three different kinds to vibrate together on the same stand.

For studying the laws of coil friction the apparatus shown in Fig. 3 has been devised. It is well known that when a belt, string, or rope, is lapped on a plain or grooved cylindrical piece the larger pull applied at one end, necessary to overcome a constant smaller force at the other end, increases with the angle of lap, more rapidly than in simple proportion. The precise manner of increase has been determined and represented in a formula, the constant of which varies with the material and form of band, and on the material and form of the surface on which the band laps. How the constant varies with the diameter of the surface and the thickness of the band I don't yet know, but this can be determined from the apparatus. This knowledge is applied every day in the correct design of belts and their corresponding plain or grooved pulleys. It also explains why a few turns of rope wound round a post on a wharf with a small pull at the free end will quickly bring to rest a large ship alongside; and explains why it is so easy to lower a heavy barrel down an incline into a cellar by means of a rope fixed at the top, passing

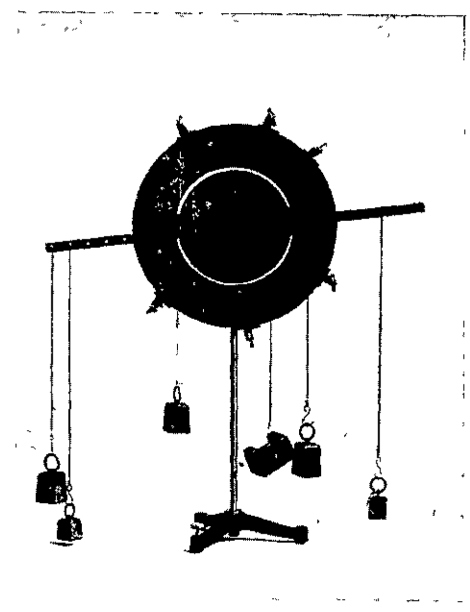


FIG 5.

round the barrel, and held in the hand; and so on.

A is a movable arm that can be fixed in any position by the milled hand-nut, *H*. *P* is an idle cylindrical pulley with ball-bearings. *C* is a changeable piece incapable of rotation, of variable diameter, with plain or grooved surface, and of any desired material. *S* is a circular piece divided in degrees. It turns with, but can be shifted relatively to, the arm when setting to zero. To set the arm for zero angle of lap, the string or band with two equal weights attached is passed over the idle pulley, and the arm is adjusted near its top position until the string just touches the friction drum, when the arm is fixed. The scale is then set to zero, which corresponds with zero angle of lap. When the arm is shifted through any angle the string laps the drum to the same extent, and the scale gives the angle exactly. The efforts necessary to pull up the constant resistence, and the corresponding angles of lap, are recorded.

A comprehensive set of experiments can be done with the apparatus, for all the variables that influence the result can be easily altered.

The experimental crane illustrated in Fig. 4 is arranged for tests of mechanical efficiency (which are typical of the tests for other machines), and for testing the truth of the stress diagrams that give the forces acting in the members

The crane with the load suspended as in the illustration gives two speed ratios—3 and 9

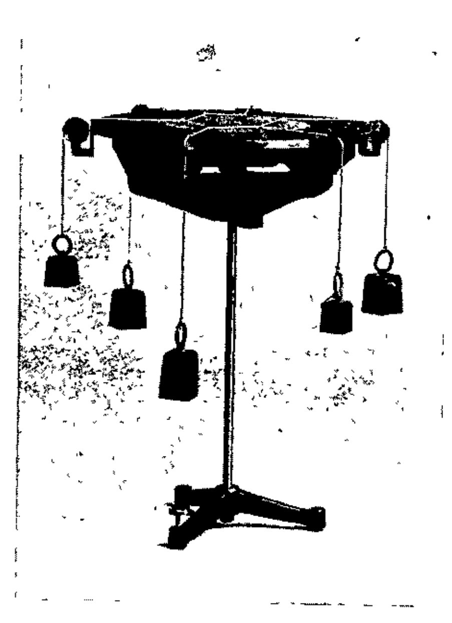


FIG. 6.

to 1. By using a pulley block another two can be got—6 and 18 to 1. Thus, four different efficiency tests can be made with varying load. In addition to the two ways just mentioned of suspending the load, it can be hung from the junction pin of jib and tie, so that for any load three different diagrams can be got for the forces exerted by the jib, tie, and string, at the pin. In order to make the test for the stresses more general, the length of the tie can be altered by means of the screw *N*.

B is a balance weight, which has the effect of rendering the jib and tie weightless in as much as their weight affects the stresses in them; *S* is the stress indicator, graduated in pounds. The effort, *E*, is applied to the lower drum while the load is transmitted to the upper drum. The pawl shown prevents the load running back when stresses are being observed. To render the crane sensitive in respect of stresses the pulleys have been made light, and large in diameter, and the pins small.

The figure explains an interesting case as regards the stress in the tie. The length of the tie has been adjusted to be the same as that of the post, so that the total stress in the string and tie bar should equal the load, 4 lbs. Now, the string itself has a force of 4 lbs., since it supports the load over a nearly frictionless pulley. Hence, the force in the tie bar should be zero, as the indicator shows.

A statics table is illustrated in Figs. 5 and 6. The centre part is mounted on ball bearings and has a number of brass sockets in it for taking the pins at the ends of the load-support

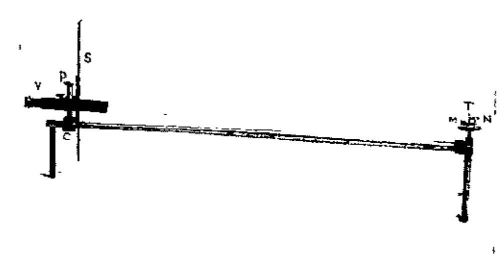


FIG. 7.

ing strings, or the pins which support the beam in Fig. 5. The beam has a number of equidistant holes of the same diameter, so that the same strings and pins can be used in loading the beam as are employed for applying the forces to the revolving part of the table when in the horizontal position. The pulleys can be placed in any position on the circumference, and can act when the table is either in the horizontal or in the vertical position.

The principles of beams can be derived by experiments such as Fig. 5 shows. The principles of moments can be studied by using the table horizontally and causing the forces to act on the revolving disc, which will take up a position of rest. The student first fixes a sheet of paper to the disc by inserting two pins in the holes The paper will rotate with the disc until the position of equilibrium is reached. Then lines are drawn on the paper to show the position of the strings. Arrows and figures are put on the lines to give the directions and magnitudes of the forces respectively. The centre point is marked, when the paper is removed, in order that the calculations can be made.

Fig. 6 shows a funicular (or string) polygon with the applied forces. The record is taken on a sheet of paper in the same way as before, and the structure and force diagrams drawn out on another sheet of paper. The results obtained experimentally and graphically are then compared.

For studying the general conditions of equilibrium of any body at rest under the action of forces in one plane, a light disc of wood of any shape, and provided with socket holes, is placed on the centre part of the table, and the forces are applied to the disc. The principles of beams can also be studied from the table in the horizontal position by using a short and light wooden beam.

In all the experiments friction can be eliminated entirely by shaking the table a little on its stand. Also, due to strings being close down to the table, errors from parallax are small. Hence it is that the apparatus gives results correct to one per cent.

In Fig. 7 is shown an optical lever for measuring small thicknesses.

V is a telescope provided with cross wires. *S* is a scale divided into tenths of an inch; *C* is a movable collar carrying screwed post, *P*, with milled head for fixing collar in any position along the horizontal rod. The telescope with scale can be clamped in any position on the post. *T* is a tripod, with its feet constrained by a point, line, and plane; it is provided with a graduated screw, *N*, and mirror, *M*. The scale is reflected from the mirror to the telescope and can be clearly seen at the same time as the cross wires when the focussing has been properly accomplished. The position of the cross wires on the scale is read off. The piece being measured is then placed under the screw, *N*, and the new reading taken. When the collar is in the position shown, the thickness is equal to the one-hundredth part of the difference in scale readings. The scale can be read to the one-fortieth part of an inch, so that the thickness is given to the one four-thousandth part.

The head, *N*, is divided into 25 parts, and one-fourth of these divisions can be estimated. The screw has 40 threads per inch. Consequently, by turning the screw so that the scale reading comes back to the original value, the thickness is given by the number of divisions turned through by the graduated head, *N*, also to the one-four-thousandth part of an inch. Thus the screw forms a check on the optical lever.

In having the collar movable the instrument is better from an educational point of view, for the student has to make out his own calculations in transferring from scale readings to thicknesses for any other position of the collar.

Legal.

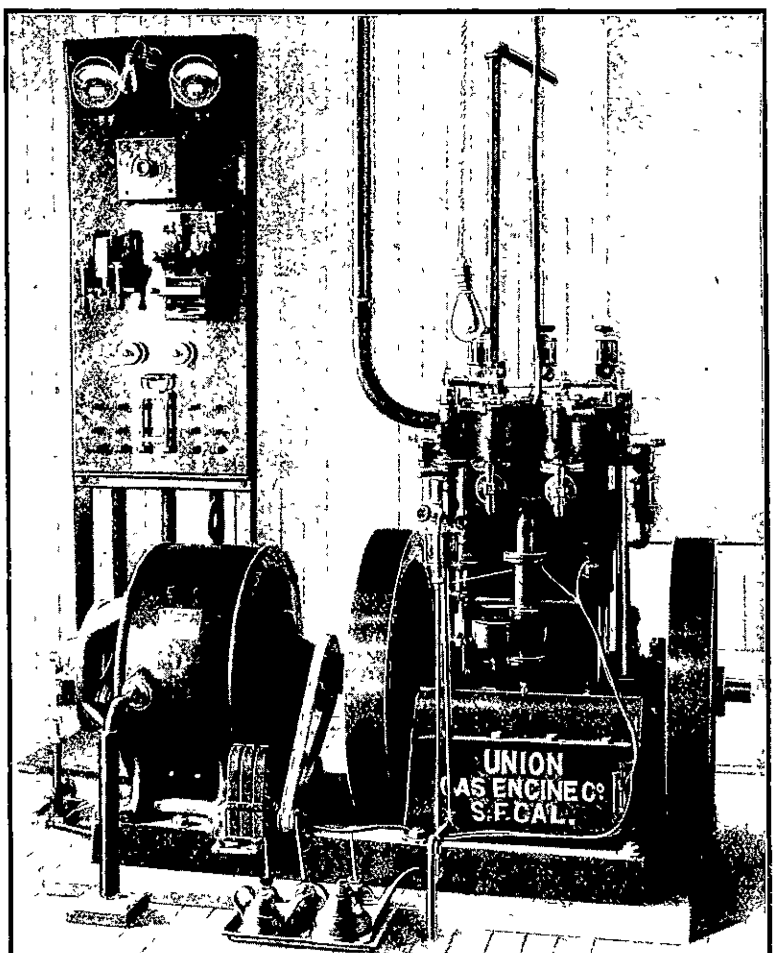
BANKRUPTCY ORDER v. DISPOSITION PROOF OF LOSS. Mr. Button was a dealer in antiques and works of art. Mr. Hairside bought goods from him and left them, and other goods bought from other art dealers with Button for safe custody. Subsequently he instructed Button to sell these goods, the value of which was about £758. Button, however, became bankrupt while the goods were in his possession, and the goods were held to be in Button's order and disposition with the consent of the true owner and passed to the trustee in bankruptcy. Hairside claimed to prove against Button's estate for £758 for damages for the non-return of the goods The trustee rejected his proof, and the rejection was upheld by Bingham, J.

Held by the Court of Appeal (reversing Bingham, J.), that Hairside should be allowed to prove for the damage sustained by him by reason of his goods not being returned to him, as they should have been according to the contract of bailment.—*In re Button,* 23 *Times L.R. p.* 422.

Electricity

Naval Wireless Telephony.

The U.S. Navy Department is supplementing wireless telegraphy on warships with wireless telephony. It was hoped that all the battleships which started in December for the Pacific would have been equipped. Telephones were installed on the *Connecticut* and *Virginia,* and communications passed between them at a distance of two miles. All those ships which were equipped with wireless telegraphy, but not wireless telephony, could distinctly hear through an ordinary telephone receiver what was said in the transmitter aboard another ship. Mr de Forrest, who is overseeing the installation, when on the *Connecticut* talked into the transmitter of the wireless telephone, and the operators on the *Kentucky* and *Illinois,* although those ships were not equipped with wireless telephones, attached telephone receivers to the wireless telegraph instrument and heard distinctly the conversational tones of Mr. de Forrest. The *Kentucky* and *Illinois* were eleven miles from the *Connecticut.*



A HANDY UNION LIGHTING SET.

The Holmes-Allen Trolley Head.

By the last American mail we received advice from Mr. Garnet B. Holmes, of Messrs. Holmes and Allen, Wellington, to the effect that their trolley head has been making a great impression in the United States, and Mr. Holmes particularly emphasises the fact that the possession of Mr. Edison's patronage had led to highly gratifying results. Mr. Holmes goes on to say that the opinions passed by every engineer met with have been very high, and that had they been in a position to manufacture he could have booked orders for thousands of heads. The same good news also hails from England, where Messrs. Barnard Brown and John Burgess, late of New Zealand, have been pushing the Holmes-Allen trolly head. These gentlemen state that they have had three satisfactory trials in Glasgow, and from their latest advice we learn that Mr. Holmes has arranged to have the heads made in Scotland and to supply them to the companies on royalty.

An Indirect but Important Danger.

A dynamo driven from a car axle is the chief part of the apparatus used for lighting railway carriages in many countries. According to the *Electrical Review,* the positive danger of drilling holes in the axle when attaching the equipment has not been realised, though it is generally understood to be inadvisable. The fact that a drilled hole will prevent the spreading of an incipient crack is well known, and often taken advantage of. But it does not seem to be as widely known that sometimes a crack may be started by a drilled hole. In any material subjected to alternating stresses cracks may appear where there is an abrupt change of sections; or where a notch has been made by a cutting tool in a turned surface. In two recently fractured axles the break occurred through the centre of shallow holes, which had been drilled to receive the point of a set screw. The diameter of the axle fractured was in each case 3¼ inches and the breaks occurred after running 15,380 and 13,900 miles respectively. The cracks were several inches from the key-seats, and at points where the stress would not be maximum. As a result of these breaks, set screws have been superseded by a pair of clamped plates gripping the axle and bolted to one another. Where axles have been drilled, however slightly, they should be carefully inspected from time to time, to discover any cracks as soon as they appear.

A patent has been granted in Germany for an invention for the manufacture of glass telephone and telegraph poles. A company has been organised and a factory for the manufacturing of glass poles has been built at Gross—Almerode, near Frankfurt. The glass mass of which the poles are made is strengthened by interlaying and intertwining with strong wire threads One of the principal advantages of these piles would be their use in tropical countries, where the wooden piles are soon destroyed by the ravages of insects and climatic influences. The poles are very cheap, costing 25s each pole of 23 feet in length. The Imperial Post Department of Germany has ordered a large supply.

Electricity in Wellington.

The work of laying down the power mains through which is conveyed the electrical energy for the use of Wellington consumers, has been going on apace, and in about another month's time the present contract will be complete, when no less than 15 miles of cable will have been laid down. When this work has been finished, an extra length of 8 miles of cable will be installed, bringing the total up to 23 miles.

The business area of the city will then be reticulated with a network of power cables. This area includes all that portion of the city bounded by the harbour on one side, Sydney street on the north, and Lambton quay, Willis street (as far as Ingestre street corner), Ingestre street, and Kent terrace on the west and south.

The present power supply is quite up to requirements so far, but it is expected that there will be a big increase in the number of connections for supply up to 500 volts, and this will be amply provided for by the extensions which are now in progress.

Altogether there are 70 consumers of energy at present connected, and a further 20 have filed applications for supply when the necessary preparations for the application of the same to plant and running gear have been completed.

The supply of energy for the month ending 30th November, 1907, reached a total of 15,926 units.

Anglo-French Exhibition.

THE LIGHTING.

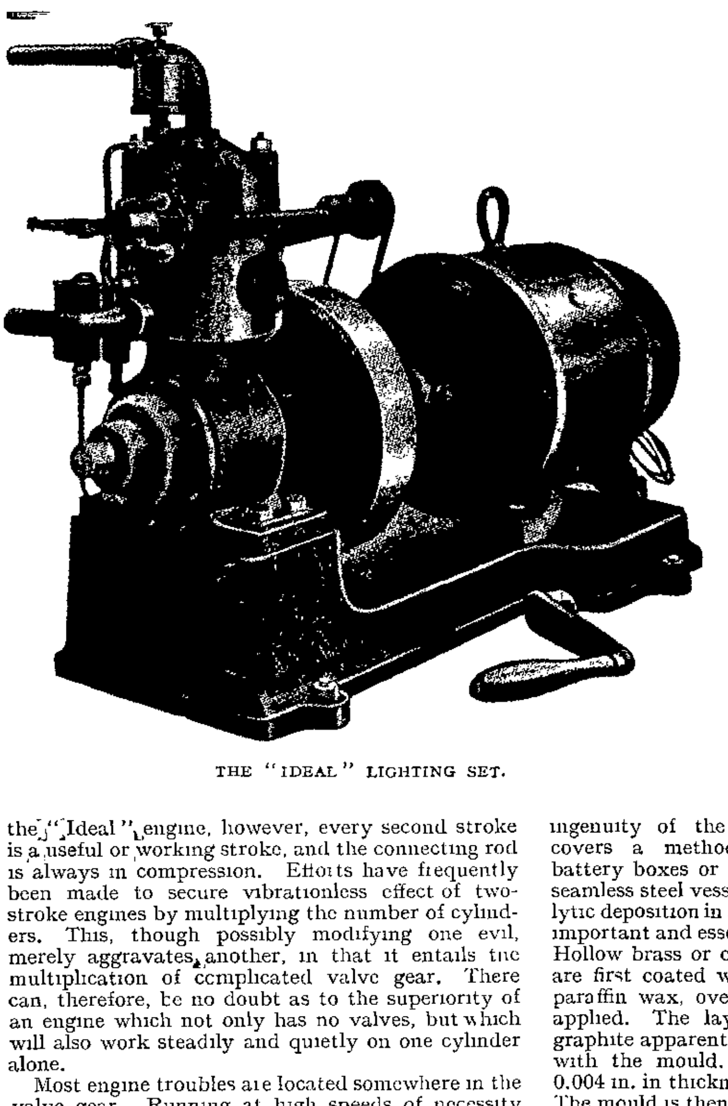
The organisers of the Anglo-French Exhibition at Shepherd's Bush have conceded the electric lighting of the exhibition to French houses. Now, the Exhibition covers 140 acres; the buildings comprise the Royal Pavilion, the Garden Club, the Palace Restaurant, and the huge machinery court; while in addition there are the main British and French sections. There are extensive gardens, and the colonial section adjoins the stadium in which quadrennial Olympic games are to be held. This vast area will be capable of seating 68,000 persons, every one of whom will have a good view of the games. There is a running track, three laps to the mile, already laid down, and a cycling track, two-and-three-quarter lap to the mile, in course of construction, and when a football match is being played, the visitors were informed that as many as 150,000 persons will be able to witness the play. A bath 1000 metres in length has been contructed in which swimming competitions will take place. Altogether there will be twenty palaces, 400 ft. long by 70 ft. wide; and it may be added that the great machinery hall will contain over 250,000 ft. of space. To have secured the contract for the electric lighting of such a vast exhibition is very suggestive of the up-to-date superiority of the method of the French electricians.

For the past two and a half years two 500 k.w. vertical turbines have been in operation at Christchurch power house, and the total consumption of oil for that period was 100 gallons, the oil being returned to the supply tanks from time to time. This 100 gallons has now been drawn off and used for lubricating tramway axles, and the total loss of oil for the above-mentioned period has worked out at only 20 per cent. Repairs on these machines have also proved remarkably small, amounting to the mere replacement of three white metal bearings having an average life of twelve months, and which were re-metalled at a cost of £5.

Light in the Country.

The facility with which electric light may be applied to a hundred-and-one purposes in and around a country house appeals most strongly to those who are accustomed to the conveniences of urban life. There is no doubt, however, that a large number of those whose homes are in the country have been deterred by the cost of installation from adopting electricity, either for lighting or for supplementary purposes. Recognising the fact that a widespread demand exists for an electrical plant so designed as to fill all domestic requirements, and yet not unduly encroach upon the pocket of the average householder, the manufacturers of the "Ideal" electrical outfit have made an exhaustive study of the special conditions attaching to the electrical equipment of country houses, and the following particulars reach us from Messrs. George and Stokes, Auckland.

The "Ideal" electrical outfit is distinctive in point of—(*a*) reliability, (*b*) simplicity, (*c*) compactness, (*d*) low cost It consists of a dynamo to generate the current, an engine to drive the dynamo, a battery to store the current, and a switchboard to control it. The engine is petrol-driven, vertical, two-cycle in action, giving an impulse every revolution. The design of the engine eliminates all moving valves, the passage of the piston opening and closing the parts admitting and discharging the gases. This design may be said to entirely overcome the vibration nuisance. In almost every other make of direct-coupled plant the engine only receives an impulse one stroke out of four, and the connecting rod is alternately in tension and compression. With



THE "IDEAL" LIGHTING SET.

the "Ideal" engine, however, every second stroke is a useful or working stroke, and the connecting rod is always in compression. Efforts have frequently been made to secure vibrationless effect of two-stroke engines by multiplying the number of cylinders. This, though possibly modifying one evil, merely aggravates another, in that it entails the multiplication of complicated valve gear. There can, therefore, be no doubt as to the superiority of an engine which not only has no valves, but which will also work steadily and quietly on one cylinder alone.

Most engine troubles are located somewhere in the valve gear. Running at high speeds of necessity develops considerable wear in the relatively delicate mechanism of a valve. A little grit may lodge and hold it open or keep it shut Periodical grinding is necessary, or the valve will not bed properly. Springs lose their elasticity, and the "timing" is thrown out. The "Ideal" engines have no valves, only ports, and as long as the piston moves up and down these ports must be opened and closed. The timing is positive, because the relative position of the ports, once determined, can never be changed. The cylinders are water-cooled by thermo-syphonic circulation. Lubrication is semi-automatic. The governing is close and efficient. As the engine and dynamo are direct-coupled on the same bed plate, all belting is dispensed with, and the utmost possible compactness is thus secured, the "Ideal" sets occupying, power for power, less space than any other on the market. In addition to this, the absence of belting not only removes a danger to those working about the engine room, but also eliminates the loss in power due to belt-slip and friction—a by no means negligable quantity.

The dynamo is specially built for the work. It is so wound as to afford close regularity of voltage, the bearings are long and are fitted with continuous, or "ring" lubricators, while, in accordance with modern practice, the brushes are carbon, of ample sectional area to carry the maximum current. The "Ideal" storage batteries are, as to design and manufacture, both mechanically and chemically correct. Careful consideration has been given to the conditions under which the country house battery usually works, the plates being made of the best lead and of a section that will insure rigidity and absence of buckling. The sets are made up in the smaller outfits of 27, and in the larger sizes of 54 cells, each set consisting of glass boxes with trays, oil insulators, spray plates, non-corrosive connecting lugs, dilute acid and stands.

The switchboard is handsome and symmetrical in design, and consists of a base of polished enamelled slate framed in oak or other suitable wood. The addition to the switchboard of charge and discharge meters is strongly to be recommended, by means of which the amount of current taken out of and put into the storage battery may be determined. By making use of these meters the common fault of overdischarging the battery is obviated.

Taking the "Ideal" outfit as a whole, we must conclude that it is an immensely successful one as regards the saving in capital, outlay, and running expenses. Thus, the manufacturers are enabled to place a complete electric lighting plant within the reach of the man of moderate means. We understand that Messrs. George and Stokes, Limited, are prepared to submit full particulars, etc., of the "Ideal" outfit.

The Edison Battery.

The daily press has again been concerned as to the latest magical discovery of Mr. Edison. The long-promised battery — which is to revolutionise the motor-car industry, consign all petrol vehicles to the scrap heap, create a boom in aeroplanes and flying machines, and relegate the horse to the limited sphere of a zoological exhibit or domestic ornament, and so on—is about to be presented to the world at large. To the general public these announcements, exaggerated though they may be, are good reading, and as such sufficient; but the engineer requires facts and details.

A recent issue of the *Electrical World* contained some extracts from the many patents recently taken out by Mr. Edison in connection with his development of the new storage battery. The series of patents reveals a remarkable perfection of detail in experimental work, and affords testimony as to the sustained ingenuity of the inventor. One of the patents covers a method of making seamless steel battery boxes or cans. The manufacture of these seamless steel vessels is effected by means of electrolytic deposition in a number of steps, each of which is important and essential to the success of the process. Hollow brass or copper moulds of the proper form are first coated with an exceedingly thin layer of paraffin wax, over which a coating of graphite is applied. The layer of wax is so thin that the graphite apparently makes contact through the wax with the mould. A coating of copper of about 0.004 in. in thickness is then applied electrolytically. The mould is then removed, washed, and introduced into a second tank, where it receives an electrolytic coating of nickel about 0.001 in. thick. Then it passes into a third tank containing a neutral ferrous ammonium sulphate solution with iron anodes. Here it receives an iron coating of about 0.02 in. thickness. In order to prevent the formation of pits or holes in the deposited iron coating, which would be likely to form by the accumulation of gas bubbles thereon, and in order to secure a very smooth surface, a quantity of crushed charcoal is introduced into the solution, whereby the added material will rub over and scour the surface of the deposited metal, polish the same and wipe off any gas bubbles which may tend to accumulate. During the ironplating the mould is rapidly revolved at a speed of about 1½ r.p.s. The mould is then removed from the tank and washed in water of a temperature of about 75 deg. C., thereby melting the wax originally deposited on the mould. The deposited can is then removed from the mould and is annealed by heating it to red heat in a closed retort containing a non-oxidising atmosphere, such as hydrogen gas. After annealing, the articles are allowed to cool in the same atmosphere. Finally, the copper originally deposited on the graphite is removed by filling the can with a solution of copper nitrate and sodium nitrate and using the can as an anode against a copper cathode.

It is quite evident that in this long process, which is, of course carried ont by automatic machinery, not a single step is superfluous. The wax coating on the mould is applied to permit later an easy removal of the deposited can from the mould. The graphite coat serves for making the surface conductive. The copper coat is necessary because a nickel deposit would not stick to the graphite. The nickel is necessary on account of the caustic soda electrolyte of the battery. In depositing the iron, the use of the small particles of crushed charcoal not only serves for wiping off the gas-bubbles, but also for incorporating a small percentage of carbon with the iron. In the subsequent annealing process the iron gets the necessary strength, and on account of the small percentage of carbon incorporated with it, it is, in fact, converted into a superior product of soft steel containing almost 0.4 per cent. of carbon.

It was early recognised by Mr. Edison that in order to get high conductivity of the active mass in the little pockets of his storage battery plates, it was necessary to mix the active mass of nickel hydroxide with some material of good conductivity. Flake graphite was first used, but in the course of a long time it was found that the flake graphite undergoes a change in its contact resistance, and the capacity of the battery is thereby diminished. Mr. Edison now uses flakes of a nickel-cobalt alloy, containing, say, 60 per cent. of cobalt, and 40 per cent. of nickel.

Of the numerous patents for the production of these flakes or films it will be sufficient to describe the method revealed in the last patent. A copper cylinder with a polished nickel-plated surface is first immersed in a suitable cobalt plating bath, and while the cathode is revolved a thin film of cobalt 0.0001 in. or less in thickness is plated on the cathode. This is then washed and placed in a solution of copper sulphate containing some free acid, whereby the cobalt is caused to go into solution, and the copper is deposited as cement copper in granular, but slightly adhesive, form. The cylinder is then placed in a copper plating bath and an electro deposit of copper 0.003 in. to 0.0035 in. thick is obtained on the cement copper, while the cathode is rotated. It is then washed and introduced into a bath consisting of a mixture of chloride of cobalt and chloride of nickel, and a cobalt-nickel alloy deposit is obtained about 0.0002 in. thick. The cylinder is again washed and a second film of copper is deposited, then another film of cobalt nickel, and so on, producing electrolytically alternating layers of copper and cobalt-nickel, until a composite sheet of sufficient thickness has been obtained. This sheet is cut longitudinally off the cathode into small strips which are placed in a basket and introduced into an ammoniacal solution of copper sulphate and moved up and down in this bath. The copper is thereby dissolved, while the nickel and cobalt are not attacked, so that the desired films or flakes of cobalt nickel are obtained.

Electricity Notes.

The Eketahuna Borough Council is advertising for tenders for an electric lighting plant to be driven by producer-gas engines.

* * * * * *

Mr. F. H. Chamberlain terminates his agreement as consulting engineer to the Christchurch Tramway Board in March, and is to leave, during that month, for his home in the United States.

* * * * * *

The commencement of the long-delayed Wanganui tram scheme has now taken concrete form. Material is coming to hand freely, and there is every indication that the work will be pushed on without delay.

* * * * * *

Mr. G. S. Maben, late manager for the Wellington Electric Lighting Syndicate, left for England recently for the purpose of purchasing the necessary pumping plant for the Ross Flat gold mine. The cost of this plant will amount to between £25,000 and £30,000.

* * * * * *

The amount of electrical power used in factories, etc., in Wellington is rapidly increasing day by day, and the tramway power-house supplies to date over 1000 horse-power for motors. The laying of new power mains has just been completed, and in the near future the present output will in all probability be doubled.

The electric locomotives used in the Simplon tunnel can travel at forty-four miles an hour.

* * * * * *

Tenders have now been received by the Tourist Department for the extension of Okere power-house, the excavations for which are now well in hand. It is estimated that the new plant will cost £5000, and it should be a great advantage to Rotorua, as there is at present a considerable shortage of current.

* * * * * *

The Westport-Stockton Coal Co.'s new electrical plant is now landing, the coal cutters and cables being first to arrive. It is expected that the general plant and locomotive will reach Westport in about a month's time. The cost of the installation will amount to between £25,000 and £40,000.

* * * * * *

The cost of generating current for the Christchurch trams, where the Curtis turbine is used, has been shown to be .08 less than the cost per unit for the Wellington tramways. This demonstrates that although the Bellis engine, which is installed in Wellington, represents about the last word in reciprocating engines for electric lighting, it nevertheless does not compete with the vertical turbine.

* * * * * *

Regarding the above-mentioned 500 k.w. Curtis turbine, it is interesting to record that the machine is giving every satisfaction and shows great economy in oil and fuel. At the end of the reliability contest lately given the machine ran from Monday night to Saturday without a stop, and on an examination of the bearings being made everything was found in perfect order. This once more illustrates the efficiency of the vertical type of turbine with water footstep bearings.

* * * * * *

Two Babcock and Wilcox boilers are being installed on the site of the new electric lighting station in Wellington, which will shortly be seen in course of construction. It is intended to equip this new power-house with a turbo-generating set of 1500 k.w., and in all probability the 500 k.w. Curtis set, at present in the old building, will be removed to the new one, together with the majority of the best engines still amongst the remnants of the old Gulcher station. A modern switchboard is also to be installed in the new station, which should be able to deal with heavy peak loads during winter time.

* * * * * *

We note with interest the proposed electric tramway scheme for the Hutt and Petone, Wellington, which, should it mature, will transform a purely rural district into two active suburbs. The residents feel that the want of cheap transit is, and has been for years, the only retarding influence in the advancement of the district. The estimated cost of the whole scheme is set down at £80,000. This is considered ample for a tram system of ten and a half miles, and would also include electric lighting for the two boroughs. The cost of the tramways is estimated at £6000 per mile; £8000 would be needed for the electric light; while contingencies would have to be provided for, thus bringing the total up to the £80,000. The promoters of the scheme are prepared to guarantee for a period of ten years any loss up to £20,000. The revenue to cover running expenses is based on the assumption that there would be a traffic of 4000 fares at an average of 2d each per diem. It would appear from a casual glance at the proposal that it is a good one, but the question whether the taxpayers can stand a further loading comes very seriously into the deliberations of thoughtful people. The more practicable scheme appears to us to be that the Government should remove the embargo they have placed on through tram traffic from the Hutt to Wellington, on account of the existence of the railway, and render possible an interurban service for the Hutt and Petone districts connected with a main line running from Wellington right up to Silverstream. It is proposed under the present scheme that eight cars and four trailers should form the rolling stock, and that the line be operated by a producer-gas plant. The electric lighting for the districts would no doubt be a great improvement on existing conditions, and it would be easy to secure at the outset at least a thousand subscribers.

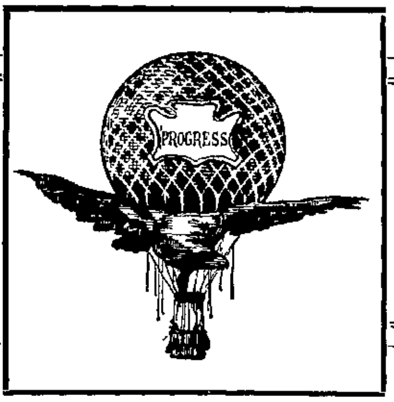
Probably the largest exposed deposit of cinnabar, or quicksilver ore, is that forming the mountain from which the town of Black Butte, Oregon, derives its name. There is a vein 400 feet wide, which has been opened for more than a mile along the mountain, at a depth of 1,000 feet below the crest. In Europe the chief mines are at Almaden in Spain, and at Idria in Austria, a town twenty-eight miles from Trieste. The process of obtaining mercury is called distillation.

The Limit of the Human Equation.

On 17th June Governor Hughes, of New York, approved the bill of Senator Page amending the penal code so as to make it a misdemeanour for any railroad to permit "any employee engaged in or connected with the movement of any train to remain on duty more than sixteen consecutive hours, or to require or permit any such employee who has been on duty sixteen consecutive hours to go on duty without having had at least ten hours off duty, or to require or permit any such employee who has been on duty sixteen hours in the aggregate in any twenty-four-hour period to continue on duty, or to go on duty, without having had at least eight hours off duty, within such twenty-four-hour period; except when, by casualty occurring after such employee has started on his trip, or by unknown casualty occurring before he started on his trip, and except when, by accident, or unexpected delay of train scheduled to make connection with the train on which such employee is serving, he is prevented from reaching his terminal."

Evidence exists that a work similar to the famous Simplon tunnel, but on a smaller scale, was executed some 24 centuries ago. Owing to the bad state of the water-supply of Jerusalem, says the *Iron Age*, the king ordered a reservoir to be made at the gates of the city, to which water was to be brought from various springs. The Shiloh tunnel, by means of which water was brought down from a source to the east of Jerusalem and poured into the pool of Siloam, was 1080 feet long, and in a straight line. It has been learned that work was commenced at both ends of the tunnel, and the direction altered a number of times. The floor of the tunnel is finished with great care. The width varies from 1.9 to 3 feet and the height from 3 to 9 feet. There is much speculation as to how these engineers gauged their direction so well as to be able to recognise and correct errors in alignment, as was certainly done.

The *Mohawk*, ocean-going torpedo boat destroyer, built by Messrs. J. Samuel White and Co., Limited. East Cowes. Isle of Wight, for the navy, ran an official trial on the Maplin Mile on Tuesday, 5th November, obtaining a mean speed of 34.3 knots. This is 1.3 knot in excess of the contract speed of 33 knots, which, considering the high basis speed, is a most remarkable result. The oil-fuel consumption was very satisfactory. The following are the principal particulars of the ship —Length, 270 ft.; displacement, 800 tons; armament, 3 12-pr. q.f. guns; 2 18 in. revolving torpedo tubes; speed to be maintained on a six-hours' full-power trial, 33 knots; radius of action at economical speeds, 1500 nautical miles. The vessel is propelled by turbine machinery, comprising five turbines (three ahead and two astern), driving three shafts and propellers, built by Messrs. J. S White and Co., Limited, under license from the Parsons Marine Steam Turbine Company, the power of the machinery being about 14,500 i.h.p. The steam is supplied by six water-tube boilers, each of about 2400 h.p., of the White-Forster type, made by the same firm. These boilers are fired by liquid fuel on a system which has been experimented with successfully by the Admiralty for some years. No coal storage is provided in the vessel, and she will rely entirely on the liquid fuel installation. The official speed trial took place on Friday, and was very successful. The mean speed obtained on the mile was 34.5 knots, and on a continuous six hours' run 34.25 knots.



The Mastery of the Air.

A Record of the Achievements of Science in the Realm of Aerial Navigation.

A Pronounced Success.

On the 15th of January of the current year the people of the Dominion read in their morning papers a most suggestive and important statement :—

London, January 4.

" M. Henri Farman has won the Deutsch Archdeacon prize (£2000) with his æroplane, which covered 1100 yards in 88 seconds.

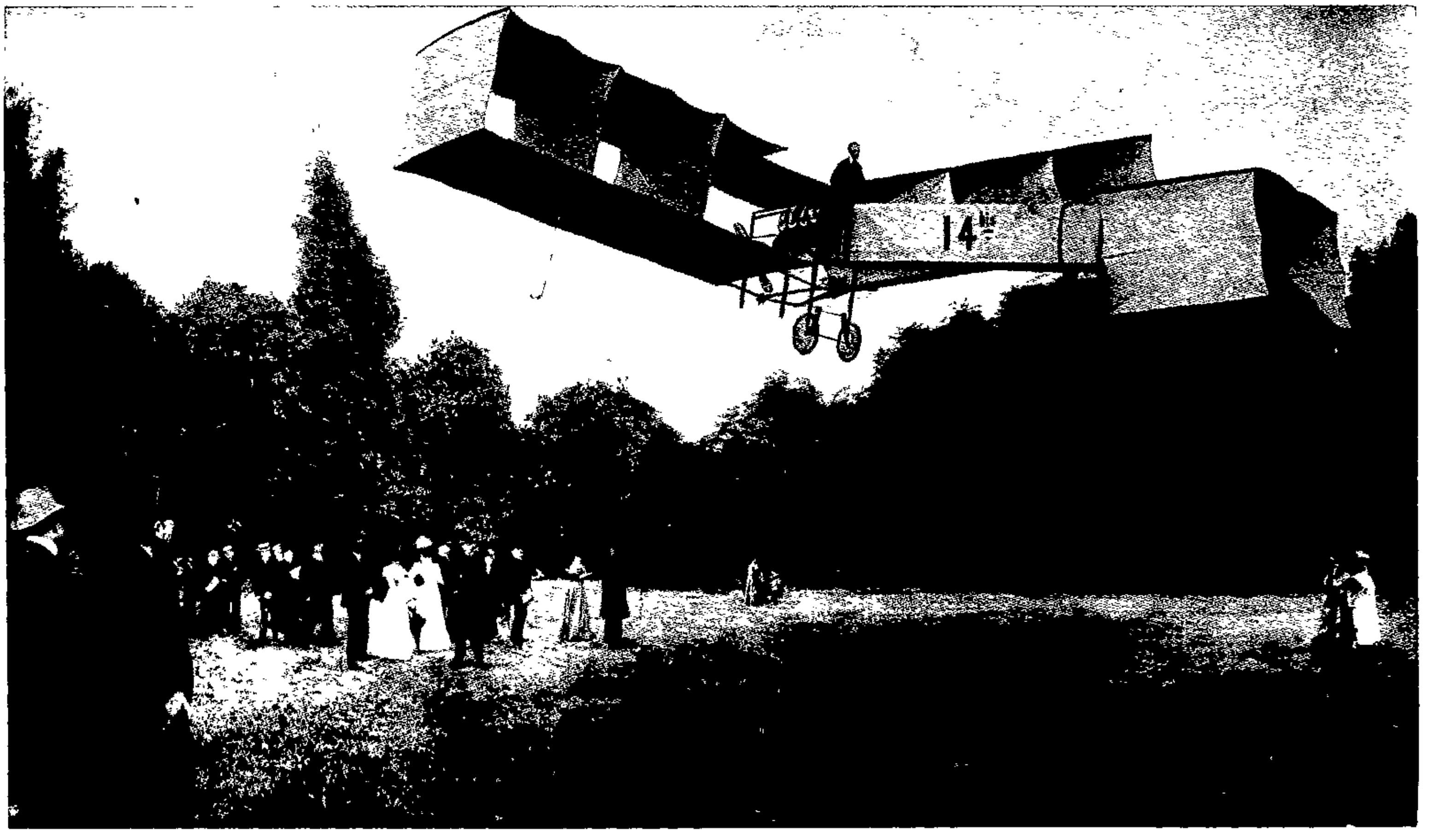
" The æroplane described a circular course, through goals, and came back amid great cheering. M. Farman then repeated the performance."

In the evening the newspapers further stated that the machine alighted with the easy grace of a bird.

M. Farman's machine, which is built of wood, aluminium, canvas, and steel wires, is in some ways like M. Santos Dumont's first æroplane, and is composed of two wings which are like a huge box kite, with the vertical partitions removed, connected with a tail which is similar to, but slightly smaller than, the wings. The motor, which is placed in front between the two wings, develops 50 horse-power.

Our illustration shows Santos Dumont's " 14, Bis " in its famous flight. With the above description it is not very difficult to form from the picture a good idea of Farman's æroplane.

The next thing we shall probably hear will be that M. Farman is to try and win the *Daily Mail* prize of £10,000 for the first successful flight from London to Manchester.



M. SANTOS DUMONT'S " NO. 14, BIS," FLYING AT PARIS, NOVEMBER 1906.
The Farman Æroplane is described as of somewhat similar shape, with differences mentioned in the text.

Here we have the four primary conditions of flight fulfilled. First, a machine that can raise itself off the ground without outside help ; second, that has propelling power ; third, that is steerable ; fourth, that can be brought to the ground easily. The course was 1100 yards, the pace 25.5 miles per hour, and the trip was repeated as easily as a singer on the concert platform takes an " encore."

We know that this beats the record of M. Santos Dumont, who, towards the end of 1906, flew 250 yards in the Bois de Boulogne with his famous " No. 14, Bis."

We have heard nothing about the weather conditions during the flight, and without that knowledge it is not possible to come to any definite conclusion as to the future. What is certain, however, is that flight of the bird order has been accomplished at last by man. Will man fly always like the birds ? That is the question for the future. We know how it was said : " Santos Dumont has flown. Everybody will fly." A year later one man has flown. The rest are still looking upward.

The Theory of Aviation.

[By Peter Ellis].

The problem of ærial flight has been aptly termed " The Mastery of the Air." Without the atmosphere such flight would be impossible, for while air offers resistance and motion, it also provides one of the essential things, such as the solid earth offers support to our railways and the sea to ships. Of course to perform ærial flight we must expend force, and force is not force when nothing is overcome. The main resistance to motion in the air is the product of the same eternal force, *i.e.*, gravity, which we overcome in locomotion over the earth and sea. It is quite evident we must first ascend from the earth into the air before we can traverse it, or as we say, " fly," but it is not necessary to rise vertically nor to great heights ; indeed, that is impossible with æroplanes or " heavier-than-air " machines, because of the great power required and consequent excessive weight. We may, however, rise on the bosom of the air *at an angle*, say an angle of 1 in 10. One-tenth of the power will then suffice (neglecting of course minor resistances), that is to say, we shall perform 10 feet of incline movement to gain one foot vertical, following that great fundamental law in mechanics that what is gained in power is lost in time," or in engineering parlance the principle of virtual velocities. Here comes in the crux upon which the "heavier than air" machine depends for success; *we must keep moving*, the engine power effecting the incline movement upward, and gravity (the stored engine power) the incline movement downward, the resultant being an ultimate horizontal movement from place to place. The æroplanes must of necessity have sufficient area to act on the air and be skilfully handled. One small error would cause disaster, as an error on the part of a coachdriver on the edge of a precipice would precipitate ruin. According to experiments on the pressure of air on sails, the area of æroplane necessary is well within practicable limits for light loads, say a man machine, and engine, provided sufficient incline speed is maintained. There is one very important fact to remember in this connection, *i.e.*, gravity is a constant, and acts in a ceaseless unvarying direction. This fact can be made use of in steering, and but for this fact we should have nothing to lay hold of in the air as an *abutment*—to use a comparison—just as a ship could not steer against the wind but for the denser medium—water—against which of course the rudder acts. Once in the air, say at a height of 500 feet (which with a movement on an incline of 1 in 10, takes 5000 feet of motion to attain) the planes may be set to descend, say, 50 feet, the engine being slowed or stopped, the descent will take place through 500 feet of incline, the planes being then changed for upward motion and the engine power again exerted, whereby the 50 feet is regained through another 500 feet of upward incline motion, the resultant being nearly 1000 feet of horizontal motion. The manipulation of planes, engine, steering, etc., will require marvellous skill and dexterity which can only be obtained by long practice and probably at the cost of many lives; for to learn to fly even with the best possible appliances will probably be the hardest task ever essayed by man—so much depends on that sub-consciousnes which is only born of experience. It will be seen that the principle I have sketched out is one of undulations through the air, a series of movements neither vertical nor horizontal, but diagonal, curving reversely upward and downward like the flight of a goldfinch. Gales and strong air-currents will also have to be negotiated, and this is where the æroplane is likely to supersede the gas bag. With the æroplane, air-currents can be utilised as power to assist the engine-power, it being all a matter of setting the planes, steering, etc., *a la* the larger kind of "fowls of the air" already stated, and we have gravity always acting in an absolutely certain and unvarying direction. Nice adjustments there must be, which time and experience only can suggest, and after all when the stress and turmoil has evolved the successful machine, I opine that it will be exceedingly simple and the usual outburst will be heard, "who would have thought it, why was not so simple a machine invented before." Having several other pressing inventions on hand, I can do no more now than point the way to those who have opportunity to experiment and plod on with this interesting problem. Failure after failure is still before us, but I feel sure that out of it all will come the commercially-successful air-car. Should any readers of PROGRESS desire to see my rough sketches of my ideal, I will hand them to the publisher for future publication.

The sun yields about 300,000 times as much light as does the moon at its full.

Recapitulation.

Theory.

The above is the general theory every where accepted, and it has been very clearly stated by Mr. Ellis. A more extended statement with some interesting detail was given recently by that enthusiastic and capable student of æronautics, Major Baden Powell, of the English service, in the course of a lecture delivered before the Society of Fine Arts. From the lecture we take the following extracts.

Ten or fifteen years ago authorities writing on the subject stated that if it were only possible to make engines so light as to weigh but 10 lbs. per horse-power, there would be no difficulty in constructing a flying machine. A few years later, petrol engines were made of such a weight. To-day they are made, and on the market, weighing no more than 2½ lbs. per horse-power

Sceptics used to say that it would be impossible to raise a large apparatus off the ground by engines and propellers. To-day this has been accomplished, not once, but on many different occasions. They also urged that, once in the air, it would be impossible to balance the machine in steady flight. Now although this has proved somewhat of a stumbling block, we hear of men maintaining themselves for half an hour at a time in mid-air, while being propelled along at a great speed. Many have declared the landing would be a difficulty, but, without even considering these recent flights, we know that thousands of glides have been made with man-carrying gliding machines that have almost always ended satisfactorily.

Chanute, summarizing the conclusions of many experimenters, has shown that the formula of Duchemin, $P = 2P^1 \sin a \div (1 + 3\sin^2 a)$, is probably about correct, as the proportion between P, the pressure on an inclined surface, and P^1 that on the surface, if placed perpendicular, a being the angle of inclination on the surface.

Practice.

The æronouts who claim to have got the most out of the æroplane as above referred to are the Brothers Wright, of Dayton, Ohio, U.S.A. Their claim is on record as follows. The æroplane was motor-driven and weighed 925 lbs. :—

1905	Flight.	Time.
Sept. 26—11 1/8	miles	18 mins. 9 secs.
,, 29—12	,,	19 ,, 55 ,,
,, 30—12	,,	17 ,, 15 ,,
Oct. 3—15⅓	,,	25 ,, 5 ,,
,, 4—20¾	,,	33 ,, 17 ,,
,, 5—25 1/5	,,	38 ,, 3 ,,

The Wrights have not appeared since, and Santos Dumont has come to grief with an æroplane designed to eclipse the feats of the famous "No. 14 bis." Here is the *Times* account :—

"M. Santos Dumont on Nov. 15 made an attempt to win the Deutsch-Archdeacon Aerial Navigation Prize on the manœuvring grounds at Issy-les-Moulineaux. There was not a breath of air to hinder the trial, when M. Santos Dumont had his apparatus taken to the starting point, and took a run of about 50 metres for the flight. The motor was started, but the æroplane passed the two flags which marked the spot at which the flight was to begin without rising from the ground. M. Santos Dumont stopped his engine and returned to the starting point. The second attempt was slightly more successful, for at the precise moment of passing between the flags the æronaut brought the front plane into use and the machine at once rose easily to a height of nearly five metres. A false step on the part of the æronaut, however, brought it back to earth after covering about 50 metres. The airship fell to the ground somewhat heavily, but suffered no damage. M. Santos Dumont continued his attempts, but could not travel more than short distances."

Question.

This failure, together with the reticence of the Brothers Wright and of their successors or representatives, made one doubt whether the æroplane after all is the right kind of flier. These doubts were voiced as far back as August last by two officers in the Greek service, who strongly condemned the æroplane as a proved failure, by reason of the unsolved difficulty of rising, and advocated the horizontal screw as the only effective power for lifting purposes. They thus represented the school—a rather numerous one—which has pinned its faith on the horizontal screw propeller as a means of overcoming the force of gravity. This was the principle advocated by Jules Verne in his celebrated story of the "Clipper of the Clouds." The objection by the opponents of this theory is that the lifting power of the screws must be more or less destroyed when the propelling screws are brought into action : and there are besides doubts as to the efficiency of screw propellers for lifting purposes. With regard to the latter point M. Dufaux, of Paris, demonstrated in 1905 in one experiment on a small scale that the lifting power of a horizontal screw was about 17 lbs. per unit h.p.

It is upon this question that light is thrown by the paper of the two Greek officers above alluded to—Lieutenant Tsoucalas of the navy, and Lieutenan Vlahavas of the artillery. The paper was read by the former at the meeting in July of the French *Academie des Sciences*, and published in the *Comptes Rendus*. In this paper, which supplies a comparative study of æroplanes and bladed air propellers (helicopters) the authors made a comparison between the two modes of attacking the problem relating to the movement of bodies heavier than air. The investigation is based absolutely upon mathematical analysis of the fact. After having calculated the most favourable inclination for the surfaces of the æroplanes, they condemned the æroplane since it presents no advantage in any way as compared with the screw. Indeed, in the most favourable position for the æroplane, but one not practically possible, the screw will give with one third of the work needed for the æroplane the same amount of sustentation. Finally, the authors, making use in all cases of analysis, contend that the theory relied upon hitherto by experimenters with æroplanes must be rejected, since in effect it conducts to perpetual motion. They thus claim to demolish a theory which until now has been accepted as axiomatic, and having shown this to be so, there remains no advantage whatever in the use of the æroplane. All future attempts should henceforth, therefore, they urge, be made with the screw or with other systems, based on direct action. The authors say the introduction of æroplanes with their imagined advantages, has given a wrong direction to the efforts of experimenters who desired to attack the problem of the movements of bodies heavier than air, and these have been encouraged by the apparent success of certain recent but fallacious tests. In fact, they add, a careful analysis of these experiments leads to the conclusion that these results have not been in the nature of flight, but were due to a leap in the air.

It remains to be seen whether M Farman's machine is to be included in the above general condemnation, but for all that, it has flown.

The Future of the Large Marine Gas Engine.

The eminent marine engineer, F. E. Elgar, in a paper recently read before the Engineering Conference at the Institute of Civil Engineers, London, dealt fully with this interesting subject, the most important part of which, perhaps, was an able recapitulation of the characteristics of efficiency, safety, and economy, which are indispensable if this type of engine is to succeed in the larger sphere so ardently desired by its advocates. He said:—

1. The engine must be reversible.
2. It must be capable of being quickly stopped and started, either ahead or astern.
3 It must be capable of being promptly accelerated to any speed between dead slow and full speed, and of being kept steadily at the required speed for any length of time. "Dead slow" ought not to be faster than one-quarter of full speed, and should be less in very fast vessels.
4. It must be capable of running continuously for long distances, with but short intervals between the runs, without risk of stoppage and breakdown.
5 It must be capable of working well in rough as well as smooth water, or in seaway in which the variable immersion of the propeller causes fluctuating resistance.
6. All working parts must be readily accessible for overhauling, and all working parts must be capable of being promptly and easily adjusted.
7. The engine must be economical in fuel, especially at its ordinary working speed.
8. It must be compact, light in weight, and well balanced, so as not to cause vibration.
9. It must not involve any risk of accumulation of gas in the ship, such as to form an explosive mixture.
10. Above all it must be capable of using a fuel whose supply at a moderate price is practically unlimited, and can be readily obtained in any part of the world a ship might visit.

Referring to published plans for installing gas and oil machinery in 16,000-ton battleships, Mr. Elgar maintains that "this exists at present in imagination only." "It is impossible" he continues "for any one to judge by what has been achieved up to the present in this direction, what weight or space or what consumption of fuel would be required for the internal combustion engines of great power, that might, perhaps, ultimately be made to fulfil the onerous requirements of marine work. Engineers and metallurgists may by working together succeed some day in overcoming the difficulties of producing large cylinders which will stand the high impulses and great and rapid vibrations of temperature that occur with internal combustion, but until this is accomplished no great step ahead has been taken."

On this the *Iron Age* remarks —

There are those who will be inclined to consider this view extreme. Many installations of large internal combustion engines have been successful ashore. It is natural to be credulous that in the future engineers may solve the problems of any new branch of engineering. Many times in the past a few years have sufficed to contradict the most distinguished disbelievers.

Another paper read at the conference told of the progress made with the marine steam turbine, which has grown in its application from the tiny *Turbinia* of 1894, to the gigantic *Lusitania* and *Dreadnought* of to-day. A curve showing the total horse-power of steam turbines applied to marine propulsion has its beginning at zero in 1896, and its end at 390,000 horse-power in 1906. It is doubtful if many engineers at the advent of the *Turbinia* expected a turbine-propelled *Lusitania* within 10 years. Repeated instances of the sort have bred a confidence in the world's engineering genius, that warrants hope for great ships propelled by combustion engines in the comparatively near future, and cheaply, perhaps with crude oil, perhaps with alcohol or other clean fuel.

Yet Mr. Elgar's list of qualifications that the engine must possess is by no means unreasonable. It would be difficult to eliminate one of them. Some of the problems have not been nearly worked out in their application in a large sense, and others will require a good deal of advancement before they are completely solved, even for small powers. In large ships the engines must be as safe and sure and economical as the reciprocating engine or the turbine. The large power unit installed on unyielding, immovable foundations in a stationary power plant is surrounded by very difficult problems from those the marine engineer must face in applying the same type of engine to a large vessel. His difficulties are fully as great as those encountered in the development of the steam engines and perhaps they are greater, because of the nature of the fuel and of its application to the engine. Great progress has been made with the marine combustion engine, but few will dispute that it is still in comparative infancy. The question is, how soon will it reach the maturity of an accepted type of engine for large ships.?

Water in Anthracite Mines

The quantity of water delivered to the surface per minute is of interest as an evidence of the great expense entailed upon the anthracite companies in connection with the mining and preparation of anthracite for market. An average of the amount of water pumped per minute during the last six years is about 445,000 gallons, which amounts to 233,892,000,000 gallons per year, or 870,000,000 tons. In addition to the pumps used for unwatering the mines, there are many bailing plants used, and while the Department of Mines has not gathered the data for these bailing plants, such data as have been published show that probably 50,000,000 tons of water per year is bailed from the anthracite mines. During this period there has therefore been raised about 15 tons of water through the year for every ton of coal brought to the surface, the average production during the year in question having been 60,721,590 tons per year. In order to take care of the water during times of excessive rainfall, it is necessary to have a pumping capacity of practically double the average amount pumped. As is well known, in certain regions at certain times of the year even this capacity is not sufficient to keep the mines unwatered, hence it is fair to assume that at certain times at least 30 to 50 tons of water are being brought to the surface for every ton of coal raised.—*Mines and Minerals.*

There are now 150,000 acres devoted to rubber in Ceylon, an increase of 47,000 acres in one year.

* * * * * *

In the Baltic Sea more wrecks occur than in any other part of the world, the average being one wreck a day all the year round.

Correspondence.

CANCER AND ITS CURE.

On the above important subject, which has lately been the cause of much discussion in connection with a system of alleged cure practised by the well-known Dr. Beard, we have to thank Dr. G. Hamilton Rowlands for a letter, from which we take the following cogent extracts :—

"The discovery of an actual cure for cancer would be the event of the century, and every medical journal would be full of it, and every medical man would be roused to extreme enthusiasm. Honours of every description would be heaped on the lucky discoverer, whoever he was and wherever he hailed from. There have been so many so-called "cures;" the "three electricities" of that arch-quack Count Mattei, to the many instances where an honest and scientific man has been led by enthusiasm, by coincidences of the *vis medicatrix naturæ*, or by a combination of these causes into a genuine belief that he has solved the great problem. It should be needless to state the fact that any method that is backed by anything like sound evidence will be given a fair trial at one of the London hospitals. Even the Mattei treatment, though it carried no scientific weight, purely on account of the faith reposed in it by dupes of all classes, was given a trial, and it will be remembered that it was not until it was proved that the "three electricities" consisted solely of three bottles of coloured water that the faith of its devotees was shattered. Not, indeed, until the Count had amassed a large fortune. There are some, no doubt, who think there was something of genius in the very boldness and simplicity of the fraud; genius, however, grossly misapplied in false pretence and robbery in victimising suffering humanity.

"With regard to Dr. Beard's pancreatic treatment it is not suggested that Dr. Beard is a charlatan or that the advocates of his treatment are other than honestly convicted. They believe what we are all so anxious to believe, and in the heat of their enthusiasm cool, calm, scientific judgment melts away.

"Is it to be imagined that the medical man, who of all people, except its actual victims, is most intimately acquainted with the ruthless, relentless and agonising ravages of the cancer scourge, who almost daily witnesses the pathetic, the heart-rending, the hopeless struggle, and has to stand by in painful impotence (his means of help being limited almost entirely to the morphia syringe), would not welcome from any source any remedy that would place in his hands a weapon to fight the most terrible evil that human flesh is heir to? No sane person can calmly think such a thing of a profession that is devoted to the relief of suffering; whose history contains many monuments of noble self-sacrifice in the cause of duty, whose ranks contain many, it may be obscure (they do not advertise), of the type that has been immortalised in the Dr. William MacLure, of Ian MacLaren. Nor is it possible that the medical profession would subscribe to and tolerate their leading journals if they showed illiberality of thought or unfairness in their views.

"Unfortunately, Dr. Beard's pancreatic treatment, having been subjected to a fair trial at the Middlesex hospital and by the workers of the Imperial Cancer Research Fund, has proved a complete failure. It is moribund."

Architecture and Building.

NOTES.

Two brick shops are nearing completion on Lambton quay. Contractors, W. H. Edwards and Son.

* * * * * *

Additions to shop in Kent Terrace for Mr. Saville are in course of erection. Contractors, W. H. Edwards and Son.

* * * * * *

Three cottages are in course of erection at Miramar. Architect, W. Gray Young; contractor, J. Moffat.

* * * * * *

Alterations and repairs to the Working Men's Club, Petone, are in course of erection. Contractors, Lowin and Bull.

* * * * * *

An ambulance shed and pay office is in course of erection at Petone for the Petone Borough Council. Contractors, Lowin and Bull.

* * * * * *

The contract has been let for additions, etc., to the Convent of the Sacred Heart. Island Bay. Contract price, £557. Architect, John S. Swan; contractors, Humphries Bros.

* * * * * *

Smith and Smith have signed the contract for repairs and painting to a residence in Grant road. Architect, John S. Swan.

* * * * * *

A seven-roomed residence is about to be erected in Brougham street, Wellington. Architect, W. Gray Young; contractors, Eade Bros.

* * * * * *

A tender has been accepted. and the work is now in progress, for erecting handsome office fittings and furniture for the United Insurance Co. Architect, E. W. G. Coleridge; contractors, Jorgenson Bros. and Johann.

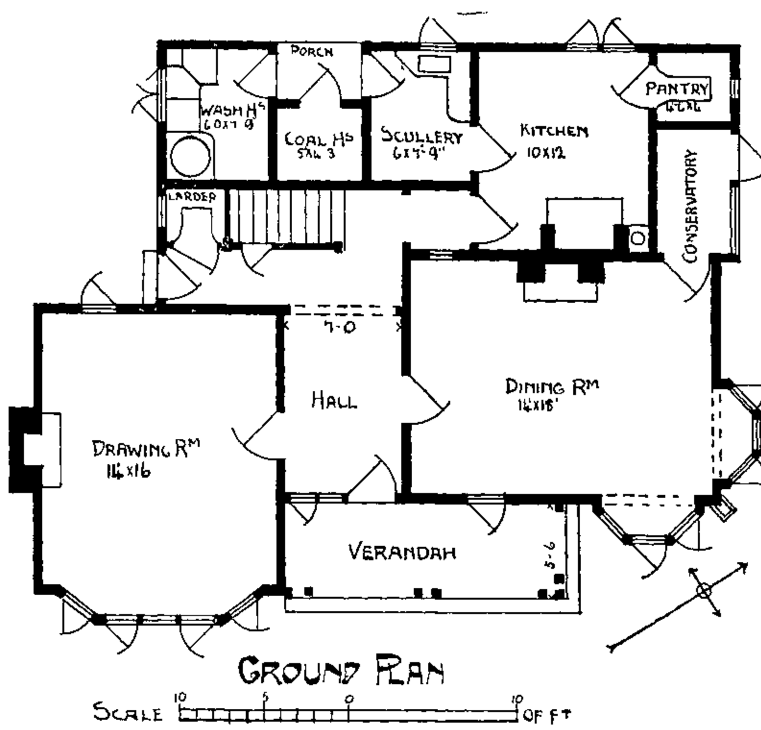
* * * * * *

John S. Swan, architect, Wellington, has completed designs for a brick and concrete church at Wellington. The style of the building will be early English Gothic. The outside walls are to be finished with pressed brick and compo. dressings, while the roof will be open timber covered with patent roofing slates.

* * * * * *

A striking example of the progressiveness of Masterton business establishments is furnished by the new fine premises just completed in Queen street, and known as the Exchange Buildings. The structure occupies 66ft. frontage to Queen street, and extends nearly 150ft. in depth to Cricket street. The style of design adopted by the architect is Romanesque, and its graceful arches, with columned balconette and centre feature, have a very pleasing effect. Inside, the arrangements are just as comprehensive, modern and artistic as the exterior is imposing. The frontal portion of the ground floor consists of one double shop, and two single shops with ante-rooms, all provided with the most modern fittings, show windows, offices, etc.; the ceilings are stamped steel, by Briscoe and Co., of Wellington. The main entrance, 9ft. wide, is in the centre of the frontage, and there are splendid show windows on each side. This entrance opens on the main hall, the feature of which is a grand staircase leading to the upper storey. Off this main hall is an up-to-date tea-room and lounge, and at the rear of the building are several large and well-lighted sample rooms. On the first-floor landing, which is lighted by an octagonal-shaped ceiling light, several corridors lead to offices (the latter being provided with strong rooms), meeting-room and photographic studio, all well-lighted and ventilated, with ample provision for lavatories. etc. The building is intended for letting purposes, and already several of the offices and the two smaller shops have been let. The structure has been erected to the order of Mr. J. L. Murray, of Masterton. Architect, James Bennie, Wellington, contractor, John Hunter; clerk of works, Mr. Rose. (See page 134.)

A residence has just been completed in Cargill street, Dunedin. The situation is very commanding, overlooking the town and harbour. The building is of timber, the lower part being painted white, while the upper is reddish brown, the effect produced being very striking and pleasing. Asbestos cement slates have been used for the roof, as Marseilles tiles, in the opinion of the designer, are too heavy in appearance for a wooden building The interior, as the ground plan shows, has been very compactly planned, so as to give the maximum amount of convenience with a minimum of space. Pulp plaster has been successfully used on the walls, so that the paper could be put on at once. The first floor consists of four bed-rooms, bath-room, lavatory, and linen closets. etc. Architect, Basil Hooper; contractors, Bundell and Watkins.



GROUND PLAN OF RESIDENCE, CARGILL STREET, DUNEDIN.
[*Basil Hooper, A R.I B.A., Architect.*]

The tender of Saunders Bros., at £8200, has been accepted for the erection of Messrs. Hannah and Co.'s new boot factory of four storeys in brick at the rear of Mr. Robert Hannah's building in Cuba street. Architects, Penty and Blake.

RESIDENCE, CARGILL STREET, DUNEDIN [*Basil Hooper, A.R.I.B.A., Architect.*]

OLD-WORLD ARCHITECTURE.

VII.

Our illustrations to-day are concerned with two characteristic specimens of the minor architectural monuments of old time. In these days of water powers and drainage schemes, wells are thought to be signs of a civic state of affairs but little removed from the ignorance of primitive barbarism. There was a time, however, in the history of the world when they played an important part in the affairs of mankind. The well was the source of water, and in fortified towns could not, like the water supply brought by aqueducts from afar, be cut off at will by an enemy intent on siege operations. Before that, in the more primitive state of society, the well, as the permanent source of water, was held to be sacred, and the cult of benevolent rural deities had, in many countries, grown up around them; indeed, the great necessary element — water — with its many valuable properties, was sacred in most eyes; a feeling to which many rivers of the world, notably the Ganges, to this day owe the retention of the belief in the holy character of their waters. The sentiment was acknowledged all over mediæval Europe, and nowhere more so than in "Merrie England," in several counties of which the custom of "well dressings"— the offering of floral tributes—remained in force to a late period. These were specially famous in Derbyshire, Staffordshire, Westmoreland and Lancashire. "Christianity," remarks a recent chronicler, "substituted a saint's name for that of the local deity of heathenism, but the water worship continued as undiluted as the crystal fountain which had first claimed the gratitude of men." In the course of time, springs in certain parts were found to possess healing properties, and about many of these legends grew up, more circumstantial than truthful, but commanding the belief of all and sundry. Of these some are famous still, and even at this date enjoy the patronage of many believers. For example, in St. Bede's well, at Jarrow, weakly children are dipped and crooked pins are offered in propitiation; at St. Helen's, in Lancashire, cloth is offered. Several wells in Scotland are famous for the alleged cure of skin diseases; the well of St. Dwynen, in the Isle of Anglesey, is said to be good against love sickness; at Sefton, in Lancashire, there is a well into which maids threw pins in order to find out the date of their marriages and to test the faith of their lovers, and there are wells of special interest now for husbands and wives. Others are in vogue only on particular days of the year, such as the well of Trinity Gask, in Perthshire, which used to be sought, not so long ago, on the first Sunday of June every year, and the well of St. Anthony, at Maybloe, to which ailing children always used to be brought on the first Sunday of May. Other wells, again, were of miraculous origin, like the well of Holywell, which is said to have sprung up in St. Beuno's church at the place where the head of the martyr St. Winifred rolled when struck off by Caradoc, the persecutor of Christians.

WELL AT CHARNAI, ALSACE. [*Original Photo. by Mr. C. Dillworth Fox.*]

As it was in England, so was it also on the continent of Europe. All over Germany there are wells and fountains, as there are over France, Italy, and the Low Countries. In Alsace they are particularly numerous. It is, therefore, not to be wondered at that the architects and sculptors of the middle ages lavished their art upon the adornment of the wells of their time.

The first of our illustrations represents the well of the old Alsatian town of Charnai, not far from Thann. We noted, in a recent issue, the fine church of St. Theobald, of the latter town. It will be seen that at the back of the Charnai well is a church similar in character, very suggestive of the vast influence exercised on the taste of these regions by the fine cathedral of Strasbourg, of which this is the third considerable imitation we have come across in views of this not large region contributed by our Mr. Dillworth Fox to these pages. The design takes us back to the days of the Roman occupation indubitably, with its massive canopy and deeply-cut entablatures, and its combination of relieving Ionic columns. The figures were probably added in later times. Evidently this was a well of the ordinary sort, without any pretensions to the odour of sanctity, and not owing anything to the healing art—just the place where the women assembled at regular hours through the day to draw the domestic water supply and engage in social gossip.

There are medicinal waters in the neighbourhood, at Wesserling, some ten miles away, at the source of the River Moselle, the depot of the waters being the last object seen by the traveller before his train disappears into the railway tunnel leading into Alsace from the Vosges on his way eastwards. These waters are probably part of the system which further down the Upper Moselle valley has been famous as a bathing resort since the days of the Romans, the remains of whose bathing establishments are to be seen still in good preservation. These are the springs of Plombieres, containing carbonate, sulphate, and muriate of soda. They are, for the most part, thermal. Plombieres was a great place of resort during the time of the Second Empire.

The other illustration shows the old fountain at Wells. The design belongs to the early Gothic, and the fabric has not been too well treated by the wasting fingers of time. This is not the well of St. Anthony, which is not far from the town of Wells. It is simply an ancient fountain, about which the gossips of this historic city used to assemble in olden times, making picturesque grouping around the old basin. The details of the design are lost, but the elegance and harmony of the conception remain for the guidance of all ages. In these two illustrations, the superior harmony, grace and beauty of the Gothic are very striking.

A new caretaker's house for the Woodville Jockey Club has just been completed. The house contains six rooms and offices. Contract price, £322 10s. Architect, Reginald G. Craig, Woodville; contractors, Hambling and Rabone, Woodville.

The Condition of St. Paul's Cathedral.

At a meeting of the Roya Institute of British Architects recently held, Mr. Mervyn Macartney, F.R.I.B.A., surveyor to the fabric of St. Paul's Cathedral, read a paper on "The Present Condition of St. Paul's Cathedral." Mr. Macartney said that the main points of weakness in the building—that was to say, the parts which had shown, and on the slightest disturbance would show again, signs of settlement and movement—were the dome, the south transept, and the western towers and portico. The settlement of the dome, which had largely occurred during the progress of the building, showed that in spite of the care with which Wren spread the weight, the centre of the great mass had sunk, and was now severed from the surrounding masses. The south transept had suffered in addition to the dislocation of the parts abutting on the dome by the tendency of the front of it to move outwards. The walls of this facade had moved outwards, and had sunk slightly to the east and west. This showed itself in the south window arch, and in the upper part of the transept. With regard to the west front, two tendencies were found to be at work, the one arising from the other. The two towers were out of the perpendicular, the one to the north and the other to the south, and the portico, which had been said to be the only flimsy piece of construction in the Cathedral, had followed the direction of the towers, and, in addition, had moved westwards. After much repair and renewal, the portico had been restored to its original state. Assuming that existing conditions could be maintained, it might be said to be safe. But the secret of its weakness had been learned while providing for its strength, and it was seen how dependent it was on the western towers, and how they in turn stood or fell by the maintenance unimpaired of the ground on which they were built. The average depth of the foundations was 4ft. 6in. below the crypt floor, which was 6ft. below the ground level north and south, and the footings of the walls consisted of three 12in. courses of stone, with a projection of about 2ft. In no case had these shown signs of insufficiency, nor had any organic weakness been discovered in the structure itself. Where the walls had been opened for one reason or another they had been found to be perfectly well constructed. In conclusion, Mr. Macartney showed diagrams of the borings recently made, and said that all observations tended to prove that the danger to the Cathedral came from sub-

OLD FOUNTAIN AT WELLS. [*Original photo. by Mr. C. Dillworth Fox.*]

terraneau, or atmospheric, influences. Interference with the subsoil was clearly not contemplated by Wren, and without it they might even now reduce the Cathedral's danger to a minimum.

NOTES.

The foundations for the new Civil Service Club are now completed, and the building will be finished within contract time. Contract price, £10,000.

INTERIOR OF MR. CACHEMAILLE'S HOUSE.

The contract for additions and alterations to a shop, dwelling, and residence on Upland road, Kelburne, has just been let. Architect, W. Gray Young; contractor, F. Luckins.

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Two charming cottages are to be erected at Goldie's Brae, Wellington, for Mrs. Woodward, with tiled roofs and jarrah interior finishing work. Inglenooks with seats by the fireplaces will be features of the designs. Architect, J. Chapman Taylor.

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A dwelling is to be erected for Mr. J. Thompson, at Kelburne, Wellington. The house is to contain six rooms and numerous cupboards, etc. It will be finished with jarrah on the inside, and will have many new and interesting features. Architect, J. Chapman Taylor

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Hambling and Raebone have commenced their contract for Mr. Leigh's new house in Woodville. Accommodation is provided for dining-room, drawing-room, three bed-rooms, kitchen, large hall, bath-room, store, and wash-house. Contract price £453. The roof is being covered with "Calmons" asbestos slates, the first of this material to be used in the district. Architect, Reginald G. Craig, of Woodville.

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The following contracts are being carried through by J. C. Maddison, F.R.I.B.A., under the supervision of T J. Youelle:—Windsor Palace Hotel, cost £25,000, shop in Cuba street, Wellington, cost £2000; large residence at Rata for Mrs. Hammond, cost £10,000; additions to Mrs. Seddon's house, Wellington, cost £3000; alterations for Messrs Davis and Clater; meat works at Ngahauranga, cost £8000.

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In designing a residence for Mr Cachemaille on Wellington Terrace, the architect has endeavoured to show that harmony and not discord should exist between a habitation and its surroundings, and also how utility may be combined with the artistic to produce that satisfaction which can never be achieved by display alone. All the interior woodwork, including the entrance porch, is finished in picked heart of rimu, with the exception of the drawing-room and dining-room, which are painted ivory white. The landing of which we show a view has the walls papered with brown paper, which gives a pleasing effect. A delightful view of the harbour is seen from the small window shown through the doorway. The domestic offices are treated appropriately on original lines, and every convenience has been provided to minimise work, for in this age domestic help has become a problem to be faced by architects as well as housewives. Architect, E. Coleridge; contractors, Campbell and Burke.

The Woodville Jockey Club have considerably improved their enclosure by forming concrete steps at each side of the grandstand. The steps are worked on the curve from a 6 ft. to 28 ft. radius, having a 2 ft. tread and 6 in. rise. The steps are finished in cement and oxide of iron, the red tint being a pleasant contrast against the turf, as well as obviating the glare that would occur from a white surface. The work was carried out by Fred. Holder, and completed in time for the summer meeting. Architect, Reginald G. Craig, Woodville.

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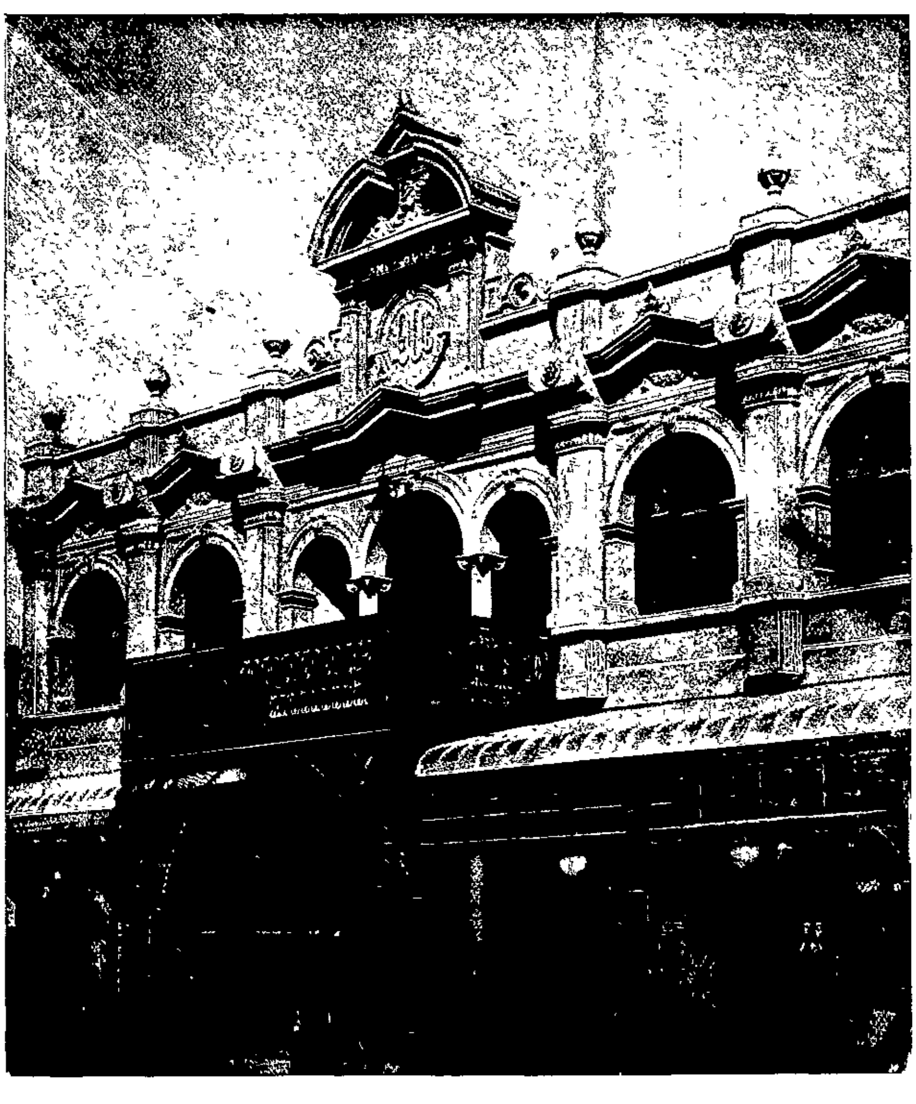
A fine town residence has just been completed in Pahiatua for Mr. J. O'Shurey-Lilly, solicitor. The outside walls of this dwelling are finished with 4 in. weather boarding, feather-edged, the roof being covered with "Malthoid." One of the principal features of the interior is the octagonal hall, finished in 3 in. V-joined heart of rimu lining, and oiled, the ceiling being carried up 3 ft. above ordinary ceiling level, diagonally lined and finished in the form of a star with half-round beads. The dining-room fireplace is built with Peter Hutson's small pressed bricks, the over-mantel being carried to the ceiling, which is deeply panelled by the joists being exposed. Ample provision is made for presses and cupboards, the angles formed in the hall being utilised. The scheme of decoration is carried out in deep toned ingrains with wide friezes. The doors are furnished with antique bronze furniture, the gas fittings matching same. Tank accommodation is provided for the roof water, the borough supply being used as an auxiliary. The joinery work was supplied by the Palmerston Sash and Door Factory. The carpentry work was carried out by T. Hewat; plumbing, J. W. Mills and Company; decorating, J. Smith; bricklaying, J. Nicholls; architect, Reginald G. Craig, Woodville.

Dangers of Concrete.

A valuable paper was read recently before the Western Society of Engineers by Dr. Michaelis. After dealing sharply with the prevailing exaggerations of previous expectation and subsequent criticism, the author insisted that the best way to establish confidence in this modern building material would be to minimise the danger of failure by establishing proper building ordinances, which would compel the contractor to handle the material in the prescribed way, and to make proper tests of it while the building is in course of construction. The principles governing modern concrete construction are thoroughly understood by comparatively few; and this explains the divergence of opinion on many points pertaining to this branch of the building industry. While some engineers are careful to specify concrete of ample strength, others blame such "over-cautious" builders for making use of an excessive factor of safety. In reply to the statement frequently made by engineers that cement is not sufficiently uniform at present, and that if it could be so manufactured as to give as uniform results as steel, it would be possible for the engineer to reduce the larger factor of safety now demanded for concrete over that required for steel, the author of the paper answers that such a statement is entirely without foundation. Steel is a well-defined chemical compound rolled into the desired shape, while concrete is the sum of a number of factors. The calculation of a steel girder and that of a reinforced concrete girder can never be based on equal safety factors, no matter how much the properties of cement may be improved in the future; and it will not be improved in the future for the reason that we have arrived at the limits of its good qualities. In the opinion of Dr. Michaelis, the author of the paper, failures of concrete steel can be materially lessened, if not entirely prevented, by making it compulsory to use concrete of specified proportion of crushed stone, sand, and cement, and to use the proper kind of reinforcement in each case, and the necessary amount of it. Certain standard rules should



EXCHANGE BUILDINGS, MASTERTON. [*J. Bennie, Architect, Wellington.*]

be laid down by a Board of Building Examiners and certain types of reinforcing material should be excluded where they are not in their proper place. Moreover, the erection of the building should be accompanied by continuous tests of the concrete that goes into the construction, and the builder should be compelled to inform himself of the strength of each column, girder, beam, and floor slab before striking the forms and placing the load upon them.

Concrete Foundations.

Concrete piles are being used to replace timber piles in a large number of modern factories and other large buildings in America, and, to a less extent, in this country also. The reason is that concrete has the advantage of permanence and immunity from decay, while at the same time being comparatively cheap.

In wet or filled-in areas where the ground water level is more than 6 ft. below the surface of the ground, and the character of the soil is such that it is necessary to go still deeper for a suitable bearing stratum, a concrete pile foundation (says *Carpentry and Building*) is much cheaper than any other type of construction. Under these conditions a solid masonry pier on a timber pile foundation would require, first, an excavation to below water level properly sheeted and braced. Second, driving of piles and cutting them off below the water level. Third, would be capping of the piles and building the solid pier to grade. Fourth, continuance of pumping through most of the operation. Fifth, backfilling the excavation. The whole constituting a long, tedious operation, lasting several days for each pier. In contrast to this, a pier of simplex concrete piles is built from the surface of the ground, no excavation being necessary except for the cap itself. An extra heavy pile-driver, especially equipped for this work, drives a hollow steel form of suitable length, 16 in. in diameter, and equipped with a special driving point to resistance. A small batch of 1 2 4 Portland cement concrete is then dropped into the steel form, which form is raised about a foot by a pulling arrangement attached to the leads, and a heavy rammer dropped on the concrete. The effect of this impact is to open the jaws of the driving point and force the concrete out of the pipe and into the adjoining soil. Another batch of concrete is then inserted, the form raised a short distance, and the concrete rammed. These operations are repeated until the form has been raised above the ground, and the space it occupied in the ground has been filled with concrete.

The time taken to instal one pile may run from fifteen minutes to one hour, depending on circumstances. Twenty-eight piles 20 ft. long were driven, on a recent contract, by one machine in six hours. Thus a four-pile pier to support 120 tons can readily be built in one half a day, as against the time (several days) required by the other method. The Simplex concrete pile thus formed of the same diameter throughout acts as a column, and also develops a very great skin friction from the extreme roughness of its exterior surface caused by the ramming of the concrete into the surrounding material. The use of the Simplex concrete piles is increasing, not only in New York, but all over the States, and some installations have been made in England, Germany, and France. In some of the foundations built on Simplex concrete piles in New York City, the Building Department tested the piles with a loading of pig-iron amounting to 50 tons per pile without any settlement. In practice the piles are designed to carry 30 tons each.

Exhibition at St. Petersburg.

The Russian Imperial Technical Society is preparing for an International Exhibition in December, 1908, of modern appliances for heating and lighting. The object of this Exhibition, which will last about two months, is to show the actual state of these appliances to the public and to determine their relative value. A congress of specialists will meet at the time of the Exhibition to study certain questions appertaining thereto.

The Exhibition will comprise: Appliances for gas lighting, petrol, acetylene, gasoline, electricity, etc.; portable heating appliances of all kinds; various appliances for security against accidents caused by these methods of heating and lighting; lastly, measurement instruments, meters, indicators, etc., for gas and electricity.

If the exhibitors so desire the objects exposed may be submitted to the decision of a jury composed, partly, of persons elected by themselves. Medals issued by the State, as well as medals and diplomas of honour, issued by the *Societe Technique* and others, will be awarded to the best appliances shown. The list of the members of the jury and the prizes they will award will be submitted for ratification to the Minister of Commerce and Industry.

Articles sent to the Exhibition will enjoy a special tariff on the German, French, Austrian and Belgian railways. The same special tariff will rule on their return. Customs duties, which will have to be paid on the passing of the goods, will be refunded on their return, provided the return is made within one month after the close of the Exposition.

In addition to the congress mentioned above, the *Societe Imperiale Technique Russe* intends to organise at the exhibition a series of technical and scientific conferences on the subjects of lighting and heating, accompanied by experiments and demonstrations.

The capital expended by the London County Council up to the end of March in the provision of accommodation for the working classes amounted to £2,498,000, and housing has been erected for 41,602 persons. The sinking fund accumulated was £95,173, an increase on the previous year of £16,662. The gross rental for the year was £157,000, and the amount irrecoverable was only £396, or about 0.25 per cent. Loss of income from empties, however, amounted to £14,988, or 9.55 per cent. of the gross rental, against 9.45 in the previous year. But a large portion of this loss was in respect to dwellings which the Council was under statutory obligation to erect in order to provide for population displaced by improvements.

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Mr. William Woodward, F.R.I.B.A., has been calling attention to the nuisance arising from the dust raised by housebreakers engaged in the demolition of old buildings. This could be avoided if the contractors would use water sprinklers during the demolition and clearing away of the *debris*, and Mr. Woodward proposes that the L.C.C. and other authorities should follow the example of the City Corporation in making such precautions against dust compulsory. The Corporation of London, he points out, have appreciated the mischief which arises from dust, and in the by-laws, clauses 3 and 4, they have made it an absolute condition that suitable screens or mats and the constant use of water shall be provided during the demolition of buildings in the city

Correspondence.

The Arthur's Pass Road.

(TO THE EDITOR.)

SIR,—In your issue of 2nd December I notice a letter from Mr. G. Thornton, denying that my father, Mr. Edward Dobson, made the road over Arthur's Pass. Mr. Thornton says:

"Now, as I was the Acting Provincial Engineer "for the Government at the time, *viz.*, April, 1865 "and the whole road from its initiation to com "pletion placed in my hands to lay out and con "struct, I most emphatically deny that Mr. E "Dobson made the road over the Pass."

Further on he says:

"Mr. Dobson explained what he proposed "doing in the Bealey Gorge, but gave no sugges- "tion for a road over Arthur's Pass and down "the Otira Gorge; the latter was the key to the "whole question and required a vast amount of "consideration."

I emphatically say that the above statements are false, and that the following documentary evidence which I quote will prove them to be so:—

Among the reports and letters published by the Provincial Government in 1865 is the following report, written by my father, dated 15th May, 1865, entitled, "Report to the Secretary for Public Works upon the practicability of Constructing a Bridle Road through the Gorge of the Otira, etc." This report contains complete detailed plans of the road, as surveyed through the Bealey and Otira Gorges, and over the Pass; complete specifications and priced-out schedule of the work to be done in constructing a road from the Bealey river bed over the Pass and down the Otira to the lower Gorge—a distance of some 4 miles 20 chains, and included with this report is the contract signed by John Smith, contractor, and approved by E. Dobson on behalf of the Provincial Government of Canterbury, under instructions from His Honour the Superintendent, dated 14th March, 1865.

In a letter dated 11th April, 1862, Mr. E. Dobson wrote to the Secretary for Public Works —

"I think you will be pleased with the road I am "laying out. I have cut a 4-ft. wide track at a "trotting gradient from the foot of the Pass "across the saddle, and am going down the Otira "riverbed as fast as thirty good axemen can cut "their way through the dense scrub."

Further on he writes

"Through the Otira Gorge there will be about "90 chains of rock cutting, but no real difficulty "about the whole matter, provided the necessary "funds can be obtained."

When these works had all been put in hand Mr. Thornton was placed in charge. Mr. E. Dobson was granted a gratuity of £100 (in addition to his salary) for the report and work done in connection with this matter. The report itself was a unique production, and contained forty illustrations and an appendix. It attracted considerable attention in Europe, and was the cause of Mr. Dobson being elected a corresponding member of the Imperial Geological Society, of Vienna. I think that should settle the question of the Pass.

Now, with regard to the completion of the road: In a report signed by Mr. E. Dobson, Provincial Engineer, and dated 22nd October, 1866 writing of the Christchurch-Hokitika road, the report says:

"The road has been begun as a bridle road, has "been finished as a dray road, and opened in "March, 1866, the work on the Otira road being "under the Superintendence of Messrs. W. and E "Blake and Mr. Aitken."

The report goes on to say:

"Mr. E. Blake will be continued in charge of "the road,"

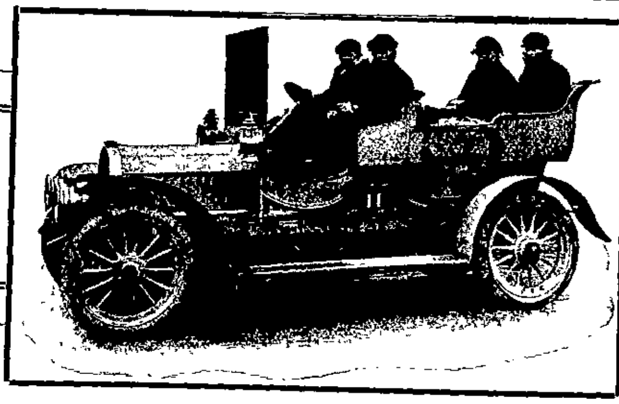
the services of the other gentlemen being utilised elsewhere. From this it is evident that Mr. Dobson was in charge of the work at the time of its completion.

In the *Lyttelton Times* of 5th February, 1869, in enumerating the public works executed by Mr. E Dobson, amongst other works it says:

"The West Coast road, passing over two snowy "ranges, was his work, and was opened for traffic "within a year of its commencement."

The public documents I have quoted from can be seen by anyone who cares to look up the matter, and I contend they distinctly prove the truth of my statements and the error of those made by Mr. Thornton. In the foregoing I use the word "made" in the engineering sense, *viz.*, of the work done by the engineer who surveys, sets out, and lets the contracts, and not of the contractor who actually does the work, or the assistant engineer who supervises it.—

I am, etc., A. DUDLEY DOBSON,
City Surveyor, Christchurch

Motors.  Motoring.

MOTOR NOTES.

The first Government motor omnibus line in Austria has been opened for service between Neumarkt and Predazzo in Southern Tyrol. Two 'buses are now used, of 28 horse-power each, and built by the Austrian Daimler works. They seat seventeen persons, and are fitted with light canopy tops

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The French automobile exports for the first six months of the current year were valued at 78,869,000 francs, or about 10,000,000 francs more than for the same period last year. The imports of automobiles into France increased very slightly during this period.

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The total output of petroleum in the Prussian province of Hanover in 1906 was 59,196 metric tons, worth £187,000. In Bavaria the whole production was only 131 tons, worth £600.

Reliability Trials.

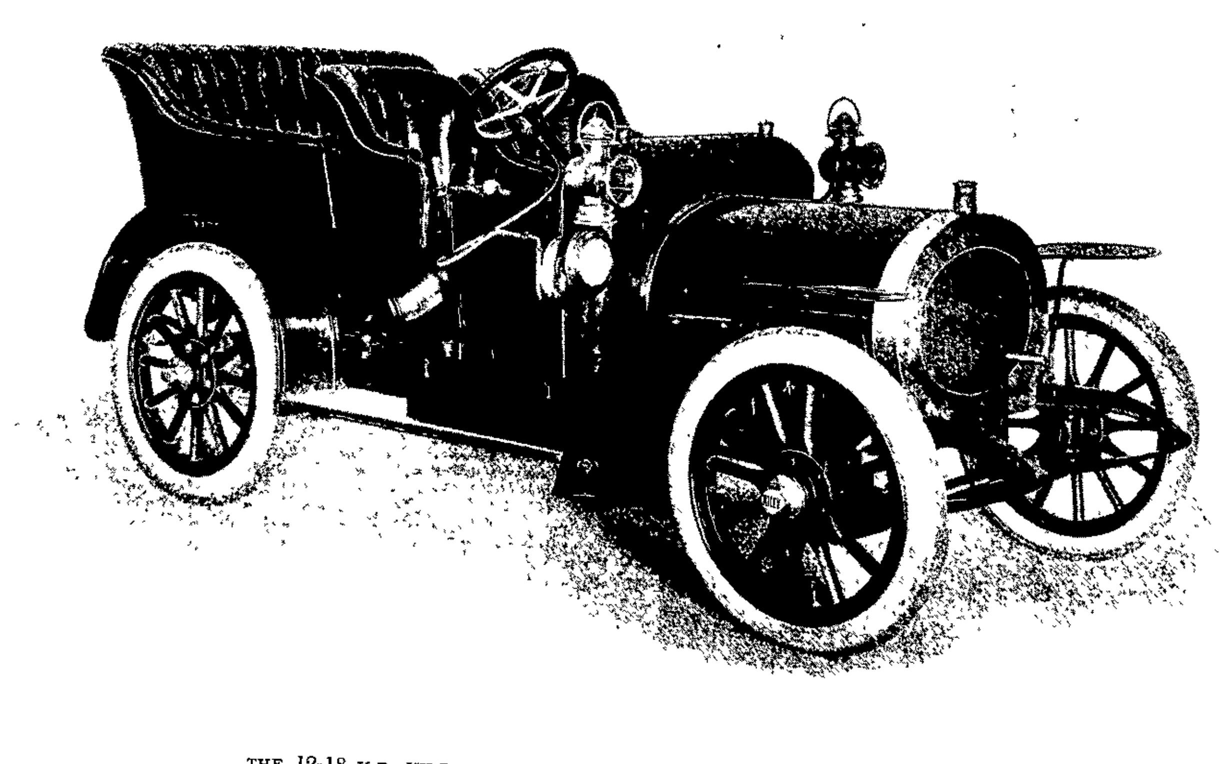
CHRISTCHURCH TO DUNEDIN.

PETROL CONSUMPTION TEST.

The following are the results of the petrol consumption test held on the second day of the trial. The table shows the weight of the loaded car in tons, the amount of petrol consumed in gallons and the number of "ton miles" run per gallon. The cars are given in order of merit —

	Tons weight.	Gallons.	Tons miles per gal.
E. Dorman's 20 h.p. Rover (Owner)	1.623	5 39	38.84
Adams Ltd.'s 15 h.p. Talbot (R. M. Macdonald) ..	1.656	6.22	34.34
J. Peacock's 15 h.p. Enfield (J. F. Best)	1 485	6.18	30.99
Adams Ltd.'s 15 h.p. Talbot (F. N. Adams) ..	1.725	7.25	30.69
W. E. Mills's 12-16 h.p. Talbot (Owner)	1.501	6.53	29.65
D. Matson's 15 h.p. Talbot (Owner)	1.712	8.67	25.46
E. F. J. Grigg's 20-22 h.p. Dennis (Owner) ..	1.890	10.21	23 87
W. K. Macdonald's 15 h.p. Darracq (Owner) ..	1.363	7 42	23.69
Adams Ltd.' 22 h.p. Minerva (A. Kerr)	1.645	9.03	23.50
D. Crozier's 30 h.p. Cadillac (Owner)	1.823	10 14	23.19
Adams Ltd.'s 12-16 h.p. Talbot (H. T. Adams) ..	1.401	7.92	22.81
Cooke, Howlison and Co's 7-9 h.p Stuart (Clarke) ..	.862	5.00	22.24
Dr. Neeley's 16 h.p. Reo (Owner)	1.117	6.50	22 16
Skeates & Bockaert's 30-40 h.p. Darracq (E. Bockaert)	2.020	11.82	22 04
J. S. Hawkes & Co.'s 20 h.p. Alldays (A. F. Collins) ..	1.C34	9.71	21.70
R. English's 10-12 h.p. Stuart (Owner)	1.052	4.71	29.25
A. Mtoen's 15 h.p. Humber (Owner)	1.535	6.78	29.20
Mrs. E. Bockaert's 8-10 h.p. Darracq (Owner) ..	·756	3.42	28.51
G. A. M. Macdonald's 9 h.p. De Dion (Owner) ..	1.078	4.92	28.26
Jones and Sons' 18-24 h.p. Siddeley (J. F. Hammersley)	1.692	7.57	27.51
Dr. Thacker's 16-20 h.p. Argyll (L. B. Young) ..	1.803	8.57	27.14
D. Wood's 14 h p. Dennis (Owner)	1.584	7.53	27.13
T. Y. Wardrop's 14-16 h.p. Argyll (Owner) ..	1.434	6.92	26.73
P. L. Hallenstein' 20-28 h.p. Darracq (Owner) ..	1.785	8.64	26.65
A. J. Toxward's 6 h p. Siddeley (Owner) ..	.789	3.89	26.16
Dexter & Crozier's 10 h.p. Cadillac (W. Felton) ..	1.079	6.50	21.41
Dr. Finch's 15 h.p. Humber (Owner)	1.535	9.50	20.84
M. Steed's 8 h.p. Reo (Owner)	.818	5.21	20 24
Skeates & Bockaert's 10 12 h.p. Darracq (H. Rollinson)	1.257	8.21	19.75
A. G. Nalder's 10-12 h.p. Stuart (Owner) ..	1.166	7 78	19.33
J. S. Hawkes & Co.'s 10 h.p. Alldays (Mitchell) ..	.985	7.50	16.87
W. E. Thompson's 15 h.p. Ford (Owner) ..	.703	7.53	12.04

The mileage run on the day was 129, and the method of calculation adopted is to multiply the weight of the car in tons by the number of miles, and to divide the product by the number of gallons of petrol consumed. This gives the "ton miles" travelled by the car for each gallon of petrol.



THE 12-18 H.P. VIBRATIONLESS RILEY CAR. [*Photo. by courtesy of Messrs. Trengrove and Petherick.*]

The total number of motor vehicles of all kinds, including cycles, which are licensed in the United Kingdom is 119,618, of which 61,617 are pleasure cars, 4124 are commercial and heavy motors, and 53,877 are motor cycles. These figures show that nearly 16,000 more pleasure cars were registered in 1907 than in 1906. There are altogether 205,606 driving licenses in operation.

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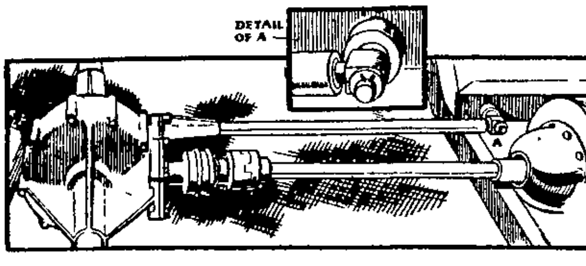
About 500 drivers of motor taximeter cabs in Paris went on strike recently. They complain that they are no longer able to make more than 8 to 10 francs per day, and are also dissatisfied with the rule of the company according to which they are made responsible for accidents caused by them. The company owning the cabs explain that the reduction in the earnings of drivers is due partly to the dead season now on, and partly to the multiplication of motor cabs, the number of which in Paris has now passed the 1000 mark.

Speaking of the test after the results were announced, Mr. R. M. Macdonald said that the performances of the leading cars were remarkably good. The Rover was well known to be very economical, and he was not at all surprised to find it occupying first place on the list. The conditions of speed on the second day's run gave an advantage, as it happened, to any car direct-driven on a gear

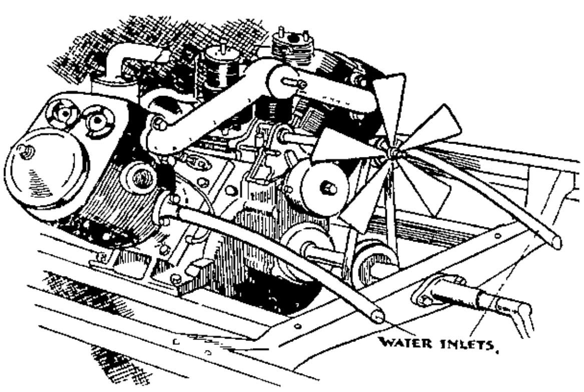


THE RILEY PROPELLER SHAFT,
(which can be quickly dismounted) and Side Torque R d. The latter is hinged to frame, and can also be moved around pin attached to hinge.

lower than the highest, because the most economical running is on the direct-driving gear. That, doubtless, had some bearing on the success of the Rover, the speed demanded enabling it to run largely on its third gear. But even so, it was a noteworthy performance, seeing that the result was better than that achieved in the last Scottish reliability trials.

Judge's Opinion.

Interviewed after the announcement of the awards Mr. A. Cleave, of Auckland, said that the trials had been an emphatic success. It had been suggested that the speed was too slow. "I don't believe in faster speeds," said Mr. Cleave. "If the limit had



THE RILEY TWO-CYLINDER ENGINE,
Thermo-syphon water circulation, with separate pipes to each cylinder, mechanical lubrication, and piston throttle.

been reduced, there would have been little speed contests along the road. Britishers are always keen competitors, and we should have had friendly little trials whenever two or three cars got together on a journey." What struck him particularly in this outing, Mr. Cleave added, was the enthusiastic reception accorded to the motorists all along the route. Cherries, lollies, and flowers had been thrown into the cars. The country people turned out in crowds to cheer the competitors, and even little children waited by the roadside to smile and wave their tiny hands. Coming from the North Island, he had been impressed too by the uniform courtesy shown by drivers of other vehicles. A farmer would pull his trap aside to save a car from running on to rough metal, and the motorists for their part, always showed consideration for horse traffic. The principal value of such trials was to demonstrate the rapidity, reliability, and safety of the modern method of locomotion. Canterbury was the chief centre of motoring in the Dominion, and the North Island would never progress at the same rate, although in Hawke's Bay there were already very many enthusiasts. "This is going to be a big industry," concluded Mr. Cleave, "especially from the commercial point of view. Touring will be only a small side of it. Whenever I see a big well-appointed stable I reflect that sooner or later it will have to go out of business, because motoring is the more economical method of progression, and is obviously more satisfactory to the community from a health point of view."

Mr. S. A. Luxford, of Palmerston North, commenting on the trials, said that it would be impossible to pick out a better stretch of road in New Zealand for such a test than that chosen by the Canterbury Association. From Christchurch to Timaru there was a long, straight run, with obstacles like water races every half mile to prevent anything in the shape "of scorching." The undulating country south of Timaru provided enjoyable travelling, and in the last fifteen miles there was a good hill climb to Dunedin. The run back to Timaru was a repetition of the second day's, and the return to Christchurch by way of Rakaia Gorge supplied another fairly severe test. The road on the last day in parts reminded him very strongly of some of the stretches on the route between Auckland and Wellington, chosen for the North Island trials twelve months ago. He had expected that a good proportion of the cars would come through successfully, in view of the improvements that had been made during the past four or five years. The engines were now very near perfection, and the fact that 95 per cent. of the competing cars had returned from the five hundred mile run close to the appointed time and in good condition was proof of their reliability. There were really very few stoppages, and these, except in the cases of two cars, would not have occurred in ordinary touring, because the necessary adjustments would have been made at the ordinary stopping places. The cars were not touched, except in the matter of oiling, from the time they left Christchurch until they got back. The arrangements made for housing them were perfect, and it was impossible for anyone to touch a screw without the fact being noted. He was greatly pleased with the running of the small cars. The performance of the 10 h.p. Cadillac was, to his mind, wonderful, and he doubted whether anything better had ever been done in the Dominion. The management, Mr. Luxford concluded, was excellent, and had the full confidence of the competitors.

Farm for an Automobile.

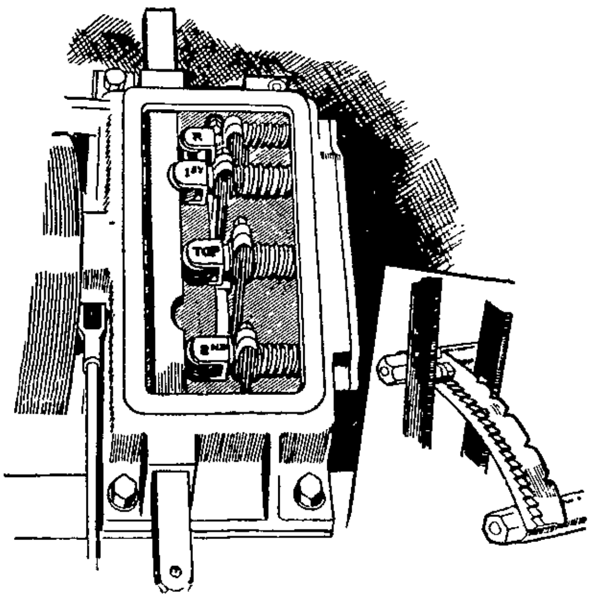
William N. Guilford, a farmer of Spencer, Mass., recently decided to yield to the entreaties of his good housekeeper, Mrs. Mabel Thompson, for an automobile. Cash was scarce, but the young man's acres broad, so he advertised he would sell his fine farm to purchase a motor car. The overseers of the poor, however, had a different idea of it. They felt that if Guilford were permitted to dispose of his property for such a purpose, he would become a charge on the county. Therefore they applied for a guardian for him. The conservator appointed by the court decided to let the sale of the property go on, but the proceeds were not spent for an automobile.

Business Change.

It was announced at the last annual dinner of the Darracq Co. that Mr. A. Morris Thomson had resigned his position as general manager of Argyll Motors, Limited, and had joined the Darracq Company's staff.

Arguments For and Against the Use of Automobiles.

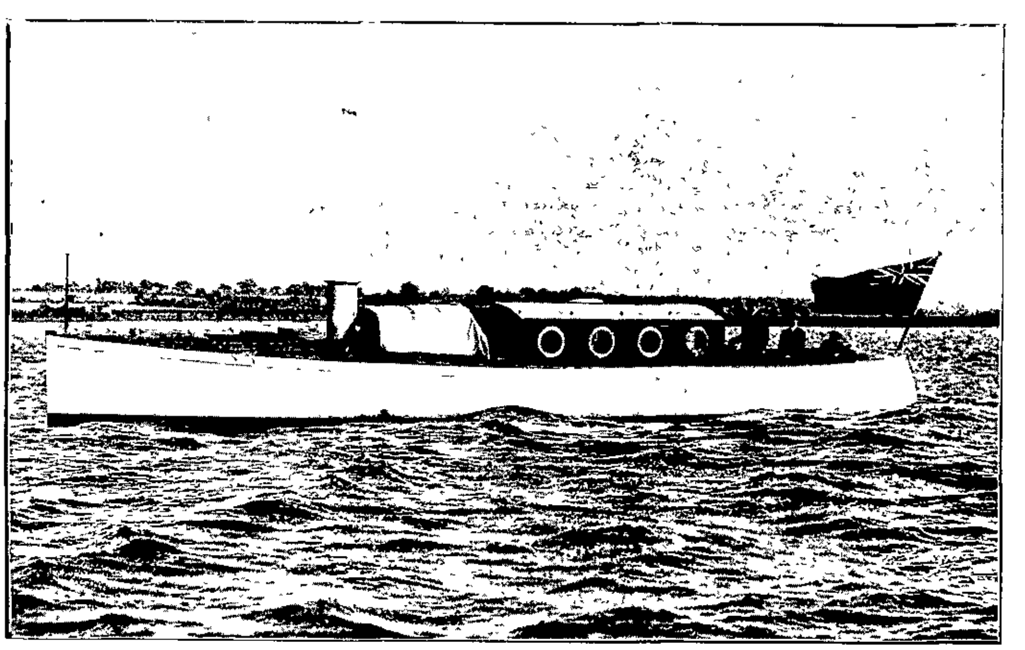
The use of automobiles by surgeons has been condemned by numerous persons for two principal reasons, first, that if the surgeon drives the car himself the vibrations are likely to make his hands unsteady; and second, that the car must surely be a means of collecting germs from the street which would be transmitted to the person of the physician. Both of these arguments have recently been attacked by Dr. Fieux of Bordeaux, France, who claims that the trembling of the hands will only be developed in persons of such high strung nervous temperament as to make them unfit for professional service at all. In regard to the second cricitism, he



THE RILEY CHANGE-SPEED GEAR BOX,
With change-bar passing across top of box, engaging rollers and controller springs. The smaller illustration represents single quadrant for brake and change levers.

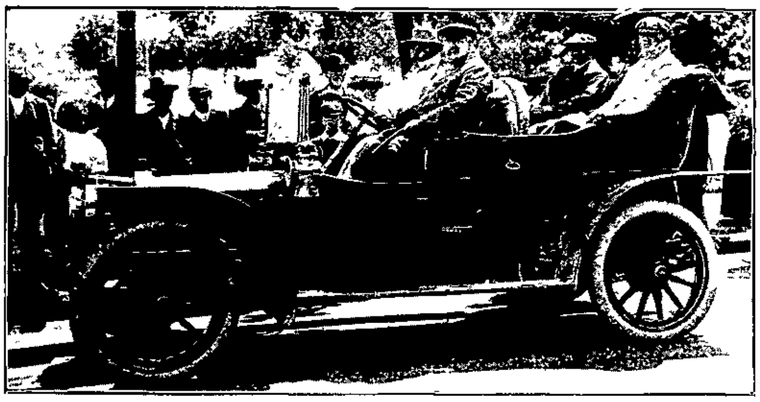
says that the tests of the dust found under the hood of an automobile showed an utter absence of micro-organisms of any form. His explanation of this fact is that the heat given off by the motor destroys the germs which would otherwise be found there. For this reason it will be seen that instead of spreading germs the automobile is really a disinfecting agent.

A prominent French physician, Dr. Legendre, has been giving his views on the hygienic effects of motoring. "Auto-exercise," he says, "has improved cases of emphysema, nervous asthma, chlorosis, certain alimentary affections, including gastralgia, anorexia, and chronic constipation. I would urge the avoidance of automobile journeys by patients suffering from varicose veins, epilepsy, alcoholism, and obesity. In certain forms of heart disease, too, auto-exercise is to be avoided, as with such patients the results may prove serious."

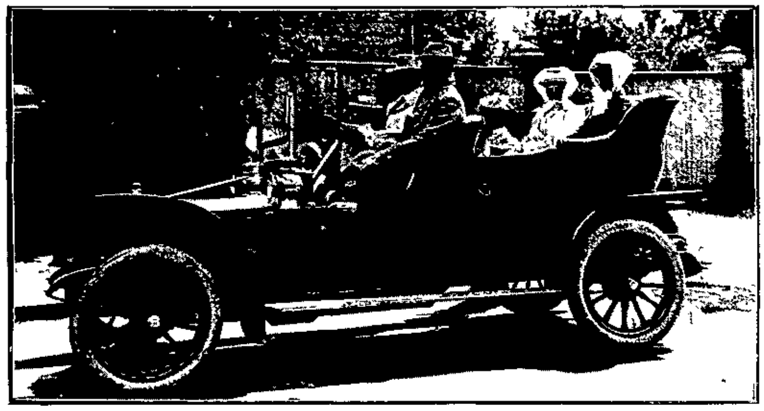


SIR T LIPTON'S LATEST MOTOR BOAT, FITTED WITH BRITANNIA ENGINE OF 60 H.P.

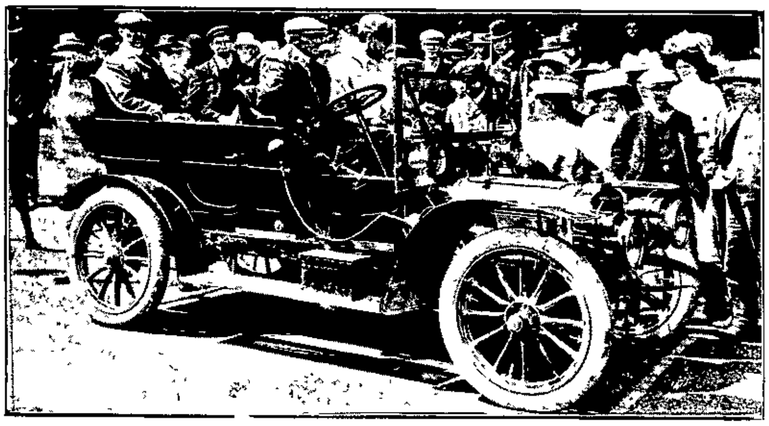
CANTERBURY RELIABILITY TRIALS.



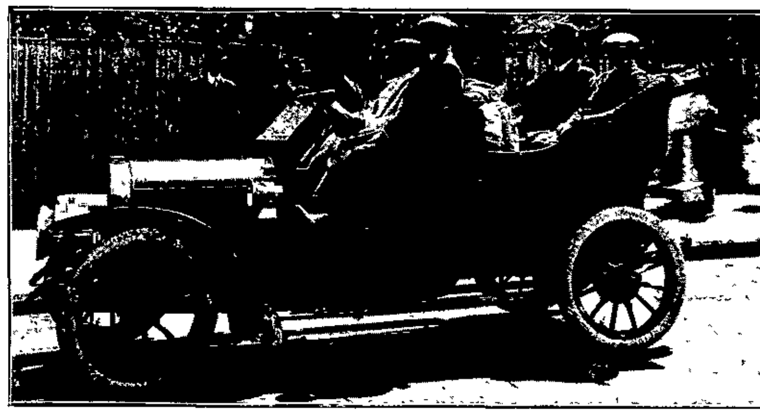
(1) MR. F. N. ADAMS' 15 H.P. TALBOT.



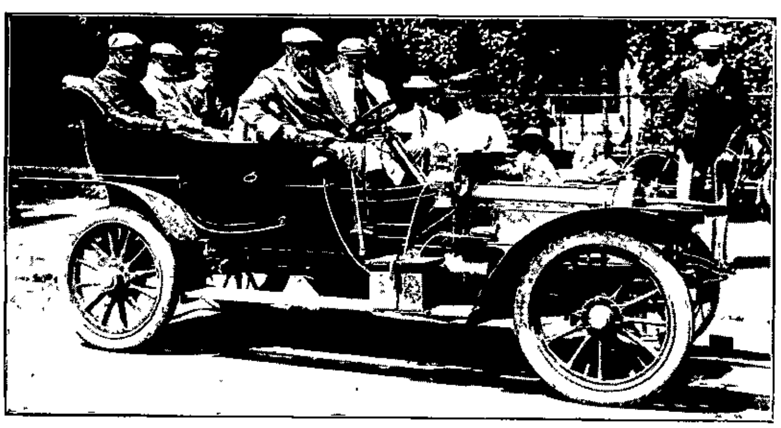
(5) MR. W. E. MILLS' 12-16 H.P. TALBOT.



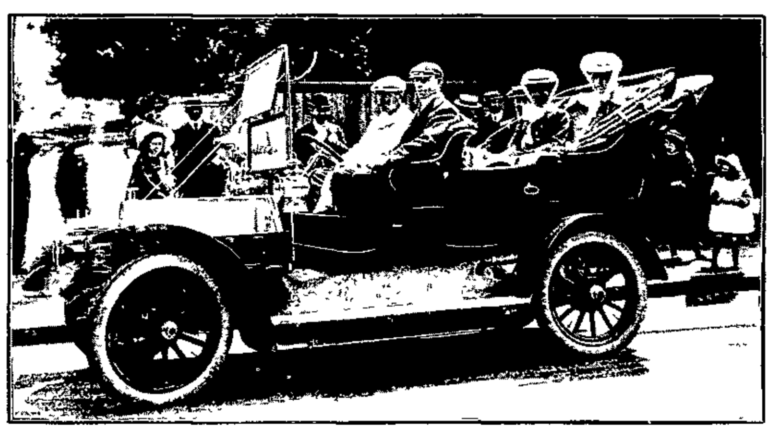
(2) MR. H. T. ADAMS' 12-16 H.P. TALBOT.



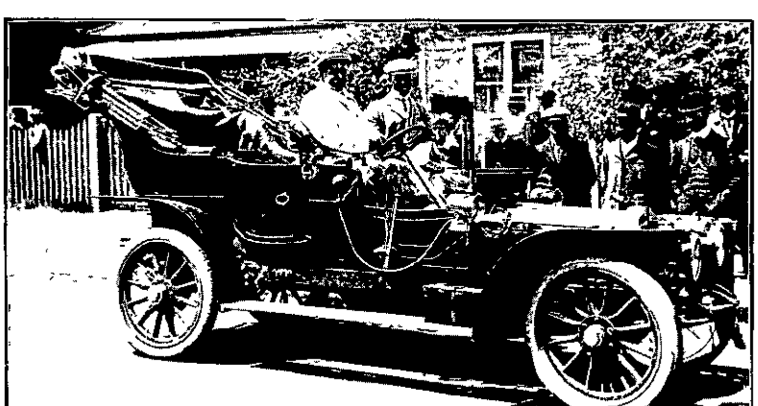
(6) ADAMS, LTD., 22 H.P. MINERVA. [*Driver, A. Kerr.*]



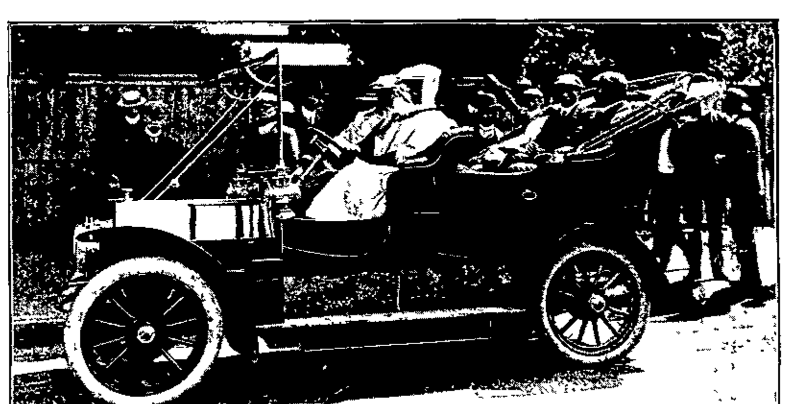
(3) MR. R. M. MACDONALD'S 15 H.P. TALBOT.



(7) DR. FINCH'S 15 H.P. HUMBER.



(4) MR. DAVID MATSON'S 15 H.P. TALBOT.



(8) MR. A. MORTEN'S 15 H.P. HUMBER.

Some of the Contestants in the Recent Competition.

December 27th to 31st, 1907.

Four Days' Reliability Trials.

Promoted by The Canterbury Automobile Association.

Reliability trials for motor cars have now become annual fixtures in Canterbury. These excellent competitions, which perhaps demonstrate the worth of a car to a fuller extent than any other means of test, are universally popular, and the Canterbury Automobile Association, one of the most progressive bodies of its kind in New Zealand, takes control each year and carries out the arduous task of organisation to the entire satisfaction of all concerned. The course of the trial, which was run on the 27th, 28th, 30th and 31st of December, 1907, was laid from Christchurch to Dunedin, returning *via* Rakaia Gorge, a total distance of 503 miles.

CONDITIONS OF TRIAL.—The trial was arranged in two classes, one for small cars under 12 h.p., and one for large cars over 12 h p. In the small car section seven cars started and six finished. In the large car section 28 started and 26 finished. The maximum number of marks for a non-stop trip was 1000, less deductions for stoppages on the road or any other reason. Each car carried a Club observer, who had to report all stops. The observers were changed every day, and the judges' awards made on the observers' reports, together with the inspection of the cars by the judges on arrival at Christchurch

(1). OPEN CLASS.—Mr. F. N. Adams' 15 h.p. 4 cylinder "Talbot" car (Royal Automobile Club rating 20 h.p.). Automobile Club observer (first day), Mr. George Payling, Mayor of Christchurch. The following is the judges' report:—First day, non-stop; second day, non-stop; third day, non-stop; fourth day, non-stop. Maximum marks, 1000 for non-stop run. On examining the car on arrival at Christchurch, the judges deducted one mark owing to the small leather belt which drives the radiator fan being off This car was driven about 175 miles without the fan running, which proves the remarkable efficiency of the "Talbot" radiator as compared to other makes, the water being quite cool in the radiator when the car arrived at Christchurch. Total marks, 999. Awarded second prize and silver medal This car was awarded fifth place in the petrol consumption test, and came through without any stoppages for tyre troubles. We can supply from stock at once "Talbot" cars same as illustrated. Prices and catalogue on application.

(2). OPEN CLASS.—Mr. H. T. Adams' 12-16 h.p. 4-cylinder "Talbot" car (Royal Automobile Club rating, 18 h.p.). Automobile Club observer (first day), Mr. Benson. The following is the judges' report:—First day non-stop; second day, 10 seconds missing gear on hill near Kartigi; third day, non-stop; fourth day, 5 minutes in water-race near Mayfield. Stoppage owing to water on plugs. Awarded 994 marks. This car is two years old, having been driven over 50,000 miles. The car came through the trial without any mechanical or tyre troubles, and the stops were not due to any fault in the car, and for all practical purposes the run was non-stop so far as machinery defects were concerned. We can supply from stock at once "Talbot" cars same as illustrated. Prices and catalogues on application.

(3). OPEN CLASS.—15 h.p. gold medal 4-cylinder "Talbot" car (Royal Automobile Club rating, 20 h.p.), driven by Mr. R. M. Macdonald. Automobile Club observer (first day), Mr. H. A. Soanes. The following is the judges' report:—First day, non-stop, second day, non-stop; third day, non-stop; fourth day, non-stop. Maximum marks, 1000. Awarded first prize and gold medal. In the petrol consumption test this car gained third place with 20 miles to the gallon. This car came through without any stoppages for tyre troubles. We can supply from stock at once "Talbot" cars same as illustrated. Prices and catalogues on application.

(4). PRIVATE OWNERS' CLASS.—Mr. David Matson's gold medal 15 h.p. 4-cylinder "Talbot" car (Royal Automobile Club rating, 20 h.p.). Car entered and driven by owner. Automobile club observer (first day), Mr R. McCready. The following is the judge's report —First day, non-stop; second day, non-stop; third day, non-stop, fourth day, non-stop. Maximum marks, 1000. Awarded first prize and gold medal. This car came through without any stoppage for tyre troubles. We can supply from stock at once "Talbot" cars, same as illustrated. Prices and catalogues on application.

(5) PRIVATE OWNERS' CLASS —Mr W. E. Mills' gold medal 12-16 h.p., 4-cylinder "Talbot" car (Royal Automobile Club rating, 18 h.p.). Car entered and driven by owner. Automobile Club observer (first day), Mr R. Thompson. The following is the judges' report —First day, non-stop; second day, non-stop; third day, non-stop; fourth day, non-stop. Maximum marks, 1000. Awarded first prize and gold medal. The car was awarded sixth place in the petrol consumption test, and came through without any stoppages for tyre troubles. The "Talbot" driven by Mr Mills is about a year old, and is the same car on which he won the Duvauchelles Bay trial on 9th May, 1907. We can supply from stock at once "Talbot" cars same as illustrated. Prices and catalogues on application.

(6) OPEN CLASS —Adams Limited, 22 h.p. 4-cylinder "Minerva" car (Royal Automobile Club rating 30 h.p.). Driven by Mr. A. Kerr. Automobile Club observer (first day) Mr. N. Richardson. The following is the judges' report:—First day, non-stop; second day, non-stop; third day, stopped 3 seconds owing to changing gear, 6 miles out of Timaru; fourth day, non-stop. Total 999 marks. This car came through without any stoppages for tyre troubles. The above car is for sale. Immediate delivery can be given. Prices and full particulars on application.

(7). PRIVATE OWNERS' CLASS.—Dr. Finch's 15 h.p. 4-cylinder "Humber" car. (Royal Automobile Club rating 26½ h.p.). Entered and driven by owner. Automobile Club observer (first day) Mr. J. Peacock. The following is the judges' report —First day, non-stop; second day, non-stop; third day, 15 seconds missed gear on hill and 2½ minutes adjusting tremblers on coil; fourth day, stopped 1 hour 46 minutes 24 seconds, coil troubles. This car had no mechanical or tyre troubles the stoppages being entirely due to the electrical coil. We can supply from stock at once "Humber" cars same as illustrated. Prices and catalogues on application.

(8). PRIVATE OWNERS' CLASS.—Mr. A. Morten's (President of the Canterbury Automobile Association) 15 h.p. 4-cylinder "Humber" car (Royal Automobile Club's rating 26½ h.p.). Entered and driven by owner. Automobile Club observer (first day), Mr. J. Temple. The judges' report is as follows.—First day, non-stop; second day, stopped 3 minutes changing gear on a hill; third day, stopped 19 minutes 25 seconds cleaning dirt out of carburetter fourth day stopped 2½ minutes owing to crossing water race on the deep side. Awarded 927 marks. This car came through without any stoppages for tyre troubles. We can supply from stock at once "Humber" cars same as illustrated. Prices and catalogues on application.

(9). Mr. David Matson's gold medal "Talbot" car is shown coming down the Rakaia Gorge on the last day of the trials, 31st December 1907. Grade about 1 in 5.

The team of eight cars (large class only) as illustrated, with observers, started on the first day from Christchurch to compete in the reliability trial of 503 miles. These cars came through the trip most successfully, none of them having any mechanical or tyre troubles, the stoppages in all cases being due to missing gears on hills, stoppages in water races, and petrol troubles.

ADAMS LIMITED, late Adams Star Cycle Co., 138-140 High street, CHRISTCHURCH.

Sole agents in New Zealand for "Talbot," "Napier," "Humber," "Swift," and "Minerva" cars.

Depots at—Mercer street, Wellington; The Avenue, Wanganui; The Square, Palmerston North; Stafford street, Timaru.—[Advt.]

Few people stop to think that the right rear tyre on a car wears much more rapidly than the left. Look at the one that has run 1500 miles or more, and compare its condition with that of the left tyre. You will find that the former is worn more, and that it has more cuts than the left. The reason is not far to seek, particularly in a district where macadam abounds As the crown of the road is higher than either side, and as cars must keep to the right, there is consequently more weight and driving strain on the right tyre and wheel, with resultant increased wear. The obvious remedy is to transfer the right rear tyre to the left wheel and *vice versa* after a certain distance, which will depend on the wearing qualities of your tyres. Finally put the rear wheel tyres on the front wheels (shifting them from right to left at the proper time), and change the front tyres to the rear wheels, shifting them also in due season.

(9) MR. DAVID MATSON'S TALBOT CAR COMING DOWN THE RAKAIA GORGE

Applications for Patents.

The following list of applications for Patents, filed in New Zealand during the month ending 20th January, has been specially prepared for Progress:

23760—W. Cusick, Koroit, Vic.: Means for assisting child to walk.
23761—G. P. Van Wye, New York, U.S.A.: Vacuum insulated bottle and casing.
23762—The Deutsche Gasgluhlich Aktiengesellschaft, Berlin, Ger.: Gas-mantle.
23763—W. Steele, Mamuku. Shaft attachment for engines and trucks, etc.
23764—A. Soderling, Bodie, U.S.A.: Ore-eatment.
23765—J. R. Patterson, Wellington: Actuating machine sheep-shears.
23766—J. Leahy, Sydney, N.S.W.: Sheep-shearing machine.
23767—D. Lewers and F. S. Greer, Sydney, N.S.W.: Rabbit-trap.
23768—G. C. Munns, Auckland: Lawn, etc. sprayer.
23769—C. H. J. Genet, Christchurch: Fastening bicycle-pump to frame.
23770—A. Smaill, jun., Dunedin: Milking machinery.
23771—J. P. Rasmussen, Riverton: Electrical insulating composition.
23772—G. and C. Hoskins, Limited, Sydney, N.S.W.: Up-setting the edges of rolled metal plates.
23773—T. Firth, Wellington: Washing machine.
23774—J. Thomson, Gladstone: Tyre.
23775—J. Slater, Coolgardie, W. Aust.: traffic signal-flag.
23776—E. J. Chilton, Masterton: Preventing candles from guttering.
23777—R. M. Smith, Auckland: Drainage junction and vent pipe.
23778—E. J. Graveson, Christchurch: Disinfecting and washing fluid.
23779—F. S. Stace and H. J. Whitelaw, Woodville: Race-starting machine attachment.
23780—Seay International Ice and Refrigeration Machinery Company, Philadelphia, U.S.A.: Production of ice and cold.
23781—W. J. L. Morton, Adelaide, S. Aust.: Winding or unwinding wool, etc.
23782—H. M. Hardy, Unley, S. Aust.: Means for securing sash-cords.
23783—H. C. Newton and A. G. M. Michell, Melbourne, Vic.: Apparatus for use in connection with check cipher systems.
23784—W. J. Crossley and T. Rigby, Manchester Eng.: Manufacture of producer-gas.
23785—F. Sara, Yelverton, Eng.: Animal trap.
23786—J. Betty, Masterton: Dust, draught, and rain excluder.
23787—W. Clark, Christchurch: Soles of gum boots, etc.
23788—C. C. Bullock, Sydney, N.S.W.: Automatically closing one-way gate.
23789—E. Henshall, Papanui: Friction hoist.
23790—F. J. Cox, London, Eng.: Carburetter.
23791—F. Oakden, Dunedin: Reinforced concrete pole.
23792—R. H. Johnson, Dunedin: Wire strainer.
23793—F. Tonks, Wellington: Chimney.
23794—R. H. Skipwith, Christchurch: Reinforced concrete flooring.
23795—N. de Latour, Gisborne: Backband fastening for harness.
23796—A. S. Ford, Coromandel: Preventing tobacco from getting into lid of tin.
23797—A. L. J. Tait, Dunedin: Envelope-opener.
23798—A. L. J. Tait, Dunedin: Pot-cleaner.
23799—R. C. Gardiner, Johnsonville: Incandescent gas-burner.
23800—H. M. Levinge, Okato: Altazimuth instrument.
23801—J. W. Mardon, Wellington, and G. Hudson, Wanganui: Railway crossing alarm.
23802—R. Muir, Auckland: Chair.
23803—R. H. Johnson, Ravensbourne: Washing board.
23804—J. W. Mardon, Wellington, and G. W. Hudson, Wanganui: Signal-wire adjuster.
23805—J. McHalick, Takapau: Road-making implement.
23806—J. Dewhirst, Hokitika: School slate.
23807—S. Campbell and J. S. Gribbon, Romsey, Vic.: Bucket support.
23808—W. J. Dunlop, Marshlands: Fire grate.
23809—H. P. Mortensen and N. P. Nielsen, Palmerston North: Liquefying milk-froth.
23810—J. W. Sutton, Brisbane, Queensland: Oil vaporiser, etc.
23811—United Shoe Machinery Company, Paterson, U.S.A.: Inseam - trimming machine. (*A. Bates*).
23812—D. Roberts, Grantham, Eng.: Internal combustion engine.
23813—D. Roberts, Grantham, Eng.: Internal combustion engine.
23814—The American Linen Company, New Haven, U.S.A.: Flax machine. (*C. G. Cooke*).
23815—A. Zabriskie, Paterson, U.S.A.: Fibre preparing machine.
23816—R. N. R. Lindsay, Auckland: Metal shears.
23817—R. Millis, Dunedin: Fibre machine.
23818—J. Fisher, Dunedin: Brace.
23819—The Karsam Soap Company, Limited, London, Eng.: Soap manufacture. (*M. R. A. Samuel and A. A. Lockwood*).
23820—Sir W. Palmer, Bart., London, Eng., and F. E. Blackmore, Reading, Eng.: Dough-working, etc., apparatus.
23821—F. Delsie, Christchurch: Bicycle.
23822—H. Spear, Wellington: Spectacles.
23823—H. J. Cunnington and R. C. Bishop, Christchurch: Cotton reel.
23824—Joseph Baker and Sons, Limited, London, Eng.: Dough-dividing machine. (*J. Burns*).
23825—J. C. L. Campbell, Achalader, Scotland: Fruit preserving.
23826—H. L. Finnis, Napier: Docking and branding iron.
23827—R. Dixon and R. S. Watson, Islington: Apparatus for mixing depilatory solutions.
23828—J. Clegg, Christchurch: Go-cart cover.
23829—P. Browne, Waikino: Centrifugal thickening and separating machine.
23830—F. Giblin, Castlecliff: Boiler solution.
23831—J. Humphreys and W. Willis, Napier: Draught, etc. excluder.
23832—T. J. Cahill, Auckland: Brake-gear.
23833—G. Norris, Dartmore: Tyre protector.
23834—P. S. O'Neill, Kokiri: Boiler tube and tube plates.
23835—J. T. Renshaw, Dunedin; Boot jack.
23836—J. V. M. Risberg, Sodertelje, Sweden: Emulsifying, etc., milk.
23837—J. T. Hunter, Wellington: Type composing and distributing machine. Linotype and Machinery, Limited.
23838—J. F. Friend and E. H. Friend, Annandale, N.S.W.: Turbine.
23839—J. H. Muir and J. D. Muir, East Brunswick, Vic.: Elevator.
23840—R. J. Fry, Carlton, Vic.: Horse-shoe-making machine.
23841—A. Peddie, W. E. Pitt, and D. M. Fea, Dunedin: Railway-carriage ventilator.
23842—E. N. Waters, Melbourne, Vic.: Manufacture of sodium-sulphate-reduction products.
23843—J. N. Caught, St. Kilda, Vic.: Marine engine.
23844—J. C. Drewet, Auckland: Fibre dresser.
23845—A. E. Bent, St. Kilda, Vic., and G. W. Stewart, East Melbourne, Vic.: One-rail-railway carriage and track.
23846—P. Cody, Ngahauranga: Railroad tipping wagon.
23847—P. O. von Hartitzsch, Wellington: Trolly pole retriever.
23848—J. H. Beamish, Auckland: Ventilating buildings.
23849—C. F. Overton, Clydevale; Clip twister for attaching cyclone droppers.
23850—R. M. Smith, Coal Creek Flat: Baled goods indicator.
23851—H. R. Radford, Waimauku: Egg carrier.
23852—Monotype Machine (Colonial Patents) Syndicate, Limited, London, Eng.: Record strip composing machine.
23853—Monotype Machine (Colonial Patents) Syndicate, Limited, London, Eng.: Perforating machine.
23854—W. T. Johnson, Wellington: Weather stop for windows.
23855—S. A. Bradley, Merrigum, Vic.: Fixing colour of fruit, etc.
23856—S. A. Bradley, Merrigum, Vic.: Composition for treatment of tomatoes.
23857—S. A. Bradley, Merrigum, Vic.: Packing crate for fruit.
23858—A. J. Roycroft, Waihi: Fire alarm and locality indicator.
23859—F. C. Mundt, Schoeneberg, Ger., and P. Kruger, Charlottenburg, Ger.: Nitrogen compound manufacture.
23860—F. P. Rudder, Derby, Eng.: Furnace.
23861—V. G. Smith, Copenhagen, Denmark: Butter washing.
23862—G. C. Chadwick, Melbourne, Vic.: Loading coal from vessels, etc.
23863—G. McNab, Wellington: Tilting casks.
23864—T. J. Wilson, Nelson: Soap saver.
23865—J. H. Beamish, Auckland: Roofing.
23866—J. C. Benn, Sydney, N.S.W.: Extension ladder.
23867—A. Hedley, Dunedin: Salvage gear.
23868—C. T. Williams, Dunedin: Window sash hanging.
23869—J. A. Barker, Masterton; Clothes line.
23870—J. Hope, Rangitukia: Trap nest.
23871—J. Ford, Dunedin: Convertible perambulator.
23872—A. F. Hadecke, Rangiora: Threshing machine.
23873—H. D. Mudie, Ballarat, Vic.: Gold saving appliance.
23874—A. D. Wilson, Stellensbosch, Cape Colony: Separating minerals, etc.
23875—F. W. Cullimore, Christchurch: Billiard table.
23876—F. R. Simmonds and W. Seifert, Takapau: Catching flax from stripper.

1908.

23877—J. A. Boyd, Wellington; Parlour skittles.
23878—J. A. Boyd, Wellington: Step ladder.
23879—The Swiftsure Syndicate, Limited, Liverpool, Eng.: Separation of butter from cream or milk.
23880—W. C. Johnson, Sussex, Eng.: Water distributor.
23881—Houlder Bros. and Co., Limited, London, Eng., and G. Anderson, Shirley, Eng.: Storing of chilled meat, etc.
23882—W. S. Simpson, London, Eng.: Uniting or welding metals.
23883—R. Klinger, Gumpoldskirchen, Austria: Stuffing box and like packing.
23884—B. W. Benn, Meeniyan, Vic.: Milking apparatus.
23885—E. S. Baldwin and H. H. Rayward, Wellington: Cutter for sheep shearing.
23886—T. Mitchell and W. Binns, Melbourne, Vic.: Dust arresting and allaying medium.
23887—J. L. Cloudsley, jun., Surrey, Eng.: Gas-meter.
23888—C. A. Parsons, Newcastle-on-Tyne, Eng.: Machine for shaping turbine blades.
23889—J. T. Tuck, Christchurch: Locking bolt nuts in position.
23890—H. Macintosh and G. H. Baylis, Wellington: Ornamental fan for advertising, etc.
23891—R. Brown, jun., Ilford, Eng.: Stoppering bottles.
23892—F. H. Trevellian, Wellington: Cash register.
23893—J. T. Muir, Wanganui: Butter pounder and packer.
23894—F. A. Alcock, Melbourne, Vic.: Billiard table.
23895—O. L. Ahrens and P. A. Schmitt, Hamburg, Ger., and C. Molse and K. A. M. Wepfer, Bremen, Ger.: Meat-preserving process.
23896—A. H. Kortland, Richmond River, N.S.W.: Farm, etc., gate.
23897—F. W. Payne, Dunedin: Lifting water by power obtained from running water.
23898—T. T. Cole, Dunedin: Fire escape door bolt.
23899—United Shoe Machinery Company, Paterson, U.S.A.: Heel-building machine.
23900—F. R. Simmonds and W. Seifert, Takapau, Trueing-up beater-bar of flax strippers.
23901—H. Thorne and T. J. Littlewood, Melbourne, Vic.: Footwear.
23902—H. C. Thomsen, Waingawa: Threshing cocksfoot, etc., seed.
23903—W. Maddison, Gisborne: Sleeping accommodation for railway carriages.
23904—R. M. Maunder, Palmerston North: Curtain pole suspender.
23905—M. U. Schoop, Paris, France: Soldering or welding aluminium.
23906—J. R. Park, Dunedin: Regulation electric potential.
23907—T. Aitken, Balclutha: Lime and manure distributor.
23908—W. E. Hughes, Wellington: Sprouting bracket.
23909—A. H. Cotton, Rawene: Toy.
23910—W. J. Mann, Auckland: Formation of ferro-concrete pile to facilitate driving.
23911—R. Cairns, Auckland: Interchangeable double-ended electrical plug.
23912—J. B. Grove, Wellington: Tread-holder for tyres.
23913—H. Herrenschmidt, Paris, France: Manufacture of electric conducting products.
23914—C. B. Mann, Wellington: Notice plate for post office letter box.
23915—United Shoe Machinery Company, Paterson, U.S.A.: Lasting machine.
23916—A. J. Smith, Cardiff, Wales: Lubrication of axle boxes.
23917—R. F. Carey, London, Eng.: Mechanism for opening and closing doors.
23918—R. M. and A. Maunder, Palmerston North: Cool chamber or provision safe.
23919—W. J. Roebuck, Opoho: Adjustable foot for ladders.
23920—T. C. Smiley, Dunedin: Adjusting vehicle seats.
23921—W. Ward and A. L. Jennings, Napier: Flush for cisterns.
23922—P. H. Shailer, Auckland, and W. Sully Teddington, Eng.: Automatic coupling.
23923—J. Anderson, R. H. Free, and W. H. Hampton Wellington: Cramp.

A Problem of Re-building.

FOR the first time in our history a proposal has been made for the construction of public works without permanent addition to the public debt. A large proportion of the latter is reproductive, it is true, the railways paying the larger proportion of the interest on their construction cost, the settlers who borrow from the "Advances" office, repaying principal and interest by a given time, and the Crown tenants under the Land for Settlement policy doing the same thing for the moneys borrowed for the purchase of their holdings from the original proprietors. But every pound spent on public buildings was, after the practice of providing for a sinking fund was stopped, a permanent addition to the aggregate indebtedness of the Dominion. The proposal of the Prime Minister is to provide a fund for the construction of all the new buildings required to bring the public convenience up to the requirements of a more extended period than we have yet gone through. He claims that if the site on Lambton quay, on which the big wooden departmental offices now stand, were cleared of those buildings and let on lease, the rents would in sixty years repay the principal moneys and meet all the interest and incidental charges. Thus, we should have a new Government House, a new Parliament House, and new Departmental Offices costing together between £150,000 and £200,000, without permanent addition to the Dominion debt. This represents a salutary principle which is alone good enough to entitle the Prime Minister's proposal to the most serious consideration. If the finance of this scheme is sound, there can be no objection to its immediate acceptance, not only for the present case, but for all analogous cases. The soundness being demonstrated, the year's surplus of the Consolidated Revenue could start the work, the cost of which would be repaid in due course of development by the Lambton Quay rents. It is a question for business advice and actuarial calculation. If the Prime Minister's proposal eventually gives us these great buildings, and an unbroken building fund as well, the result will be a good tradition of self-reliance.

From the ratepayers' point of view it cannot be said that the housing policy of the London County Council has been unsatisfactory. Taking dwellings alone, the income has exceeded expenditure, including repayment of loans and interest, by £2,466. After paying for all repairs up to date, there is a sum of £35,576 credited to the repairs and renewals account, and the amounts paid for sinking-fund interest have been £95,172. But there are many who will think that, in view of the vital importance of providing decent houses for the poorer classes, the housing operations of the Council would still have justified themselves had the financial result been far less satisfactory.

PURCHASERS of Real Estate, either Houses, Sections or Farms, should apply to H. Ernest Leighton, 7 Featherston Street, or Hutt, who has the finest selection on the market.

NOTICE TO ADVERTISERS.

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

Speaking of the Olympia show of 1907, admittedly the largest and most representative ever held in Britain, *The Times* says :—It must be admitted this exhibition comes at rather a critical moment in the history of the British industry. Buyers have learned caution, have acquired the prudent habit o demanding extended trial and explicit guarantee; which habit is *anathema maranatha* to the plausible seller of ricketty combinations looking more or less like motor cars. But to the makers of really sound and trustworthy cars this is a matter, not for anxiety, but for congratulation. If, as is likely, the next twelve months should witness the collapse of a good many weak houses, this will be no calamity for the public, other than the shareholders, and a positive advantage for the strong and honest establishments which survive.

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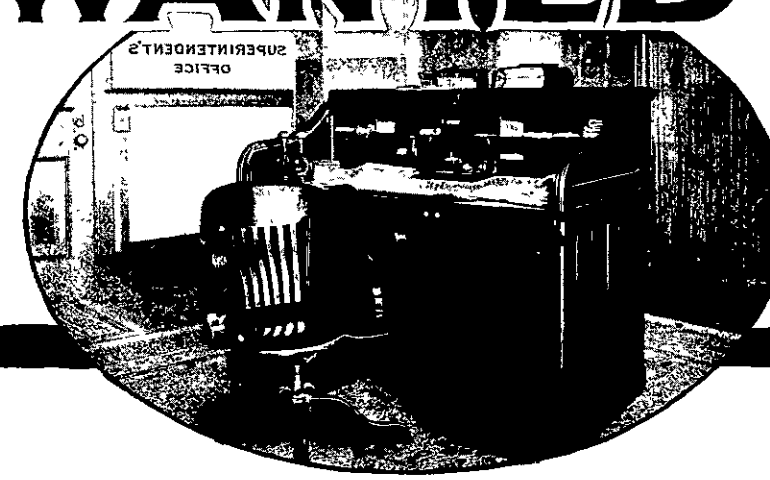

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The Care of the Teeth.

[By H. M. Kilgour].

" What causes the teeth to decay ?" and " Why do they decay so rapidly ? " are questions which every dentist is repeatedly asked, and we can only reply that the trouble is caused by neglect or inability to keep the teeth perfectly clean. Decay must begin on the outside surfaces of the teeth, and is caused by particles of food becoming lodged about the teeth and allowed to remain there unnoticed and unmolested. Obviously, then, the only way to prevent the trouble is to take every precaution to keep the mouth and the teeth in a thorough state of cleanliness. All teeth are not alike in strength of structure, and consequently when the weaker ones are attacked by decay the disease makes more rapid progress than in teeth composed of stronger material. The necessity of a free use of tooth-brush and powder cannot be too strongly impressed upon children, and every parent should see that his children make a regular habit of cleaning their teeth at least twice a day—morning and evening. The habit once acquired will be a lasting one, and be of the utmost benefit and importance to the children as they grow up. From the age of six years onwards it is always a good thing for children to be taken to a dentist at regular intervals—say of three or four months—to have a thorough and systematic examination of their teeth made, and any defects that are then discovered can be speedily remedied. I might suggest that a simple tooth-powder of the following *formula* would be a very good one.

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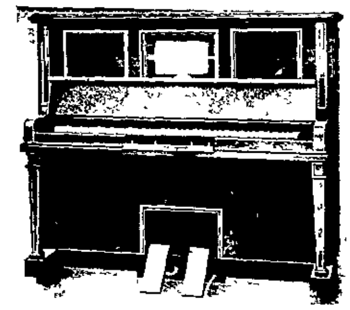
Every note of the Player has an independent action, allowing any defect to be remedied with the greatest possible facility.



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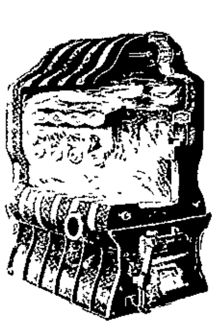

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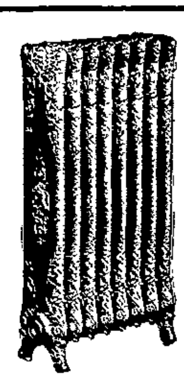

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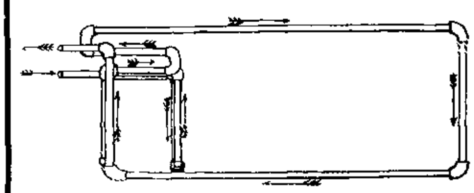

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