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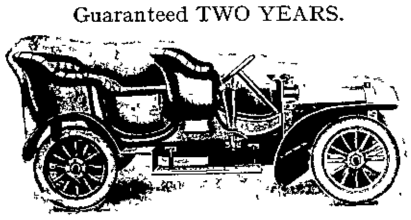

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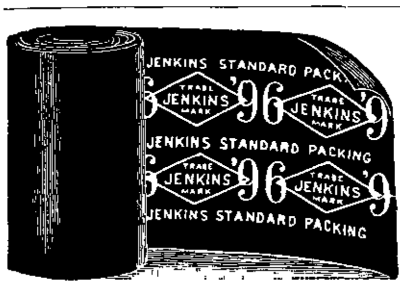

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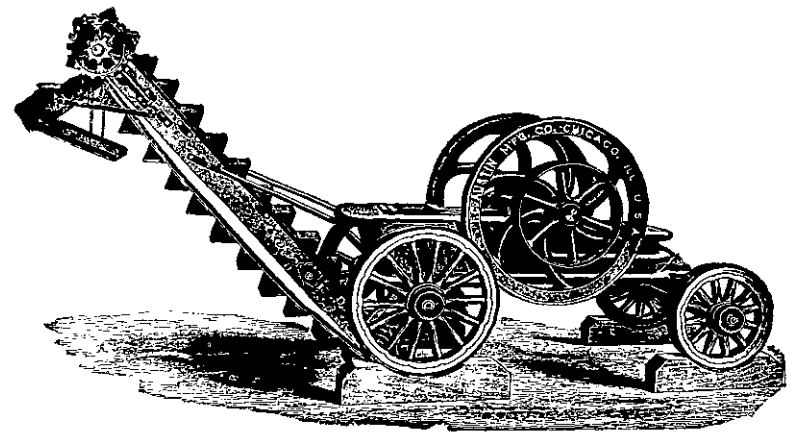

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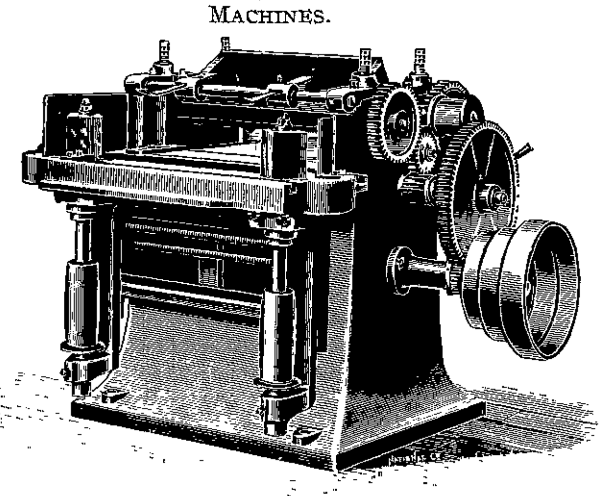

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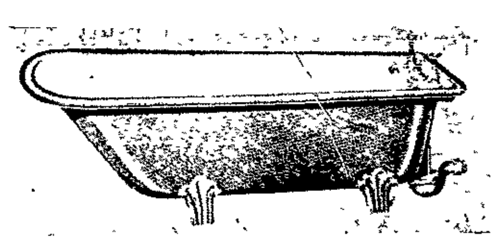

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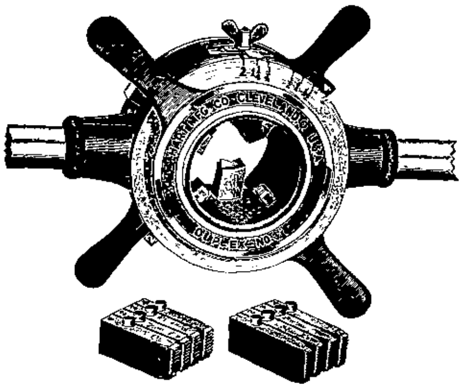

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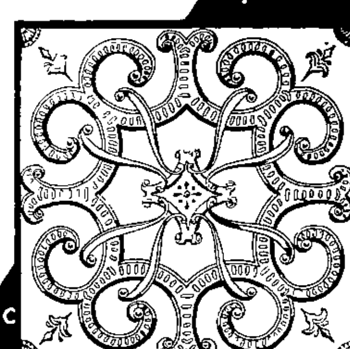

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EDITORIAL COMMENT.

Compulsory Manufacture of Patented Articles.

THE more one thinks of the ministerial proposal for the compulsory manufacture of patented articles, the less necessity there appears for the innovation in the law Apparently it is designed to take the place of a higher protective duty and to enable the colonial manufacturer to obtain the making of all inventions for which patents may be taken out in the colony Now we believe that owing to our protective policy, practically every patent that can, with any hope of success, be manufactured within the colony is manufactured here. There is, however a class of articles the manufacture of which is obviously out of the question Of the latter a long list can be readily reeled off by any one who has some small degree of acquaintance with the subject Typewriters, Monotype and Linotype machines, boot-making machines, cash registers steel pens, printing machinery weaving machinery—these are among the first to occur to the mind as the subject matter of a large number of patents They cannot profitably be made here any more than iron-clad battleships or ocean liners, for the simple reason that the output of any factory or workshop that might be established for their production would be insufficient to justify the investment of the large amount of capital required According to the proposal of the Minister, however none of the articles on this list could enjoy, for more than four years the protection of the patent laws of the colony The rule of "No works no patent" would expose patentees, who have not available funds for patenting their inventions in all foreign countries, to the competition in the local market of imitations made in countries in which the invention is not patented Our public certainly might get articles of similar character but probably inferior quality at cheaper rates, but the only effect of the law intended to foster the industries of the colony would be the fostering of foreign industries to the prejudice of the meritorious inventor without any material gain to our working population It would clearly be a retrograde step for the legislature of this country to inflict hardships upon the world's inventors to the aggrandisement of foreign manufacturers. If there are patents which can be worked here, and which are prevented from being worked by the greed of the patentee we are not familiar with them If the Minister is better informed, he will not object to give a list of them to enable the public to adequately study this subject If, after the discussion incidental to threshing out the matter, there remain any cases of hardship to the local manufacturer and his men, which cannot be met by the present compulsory licensing clause of the Patent Act, both sides can easily join in some attempt to amend the patent law. At present the available evidence is decidedly against the proposed change The proposal appears to be based upon the assumption that the inventor is one who fattens without exertion, or has the tendency of the octopus to grasp everything within reach regardless of others. But is this so? Anyone acquainted with inventors will know that they have enough difficulties without the added risk of losing the result of their ingenuity, perhaps at the moment when their hopes are about to bear fruition.

Wellington Graving Dock.

IF the success of the Wellington graving-dock corresponds in any appreciable degree to the long struggle that preceded its authorisation, it must have a memorable career That struggle, however, may, in view of the bright future opening out before the dock, be dismissed as a mere memory, not to be revived by any financial consideration whatever Directly, the dock may not pay Nobody expects it to do that for years to come But things which are necessary and profitable do not always pay at the start, or for some years to come The railways, for example do not pay—the State policy is not to let them pay anything more than three per cent on the cost of their construction Streets and roads are neither of them in the category of things that pay directly For many years no private firm could have financed the telegraph services of this country without spelling ruin many times over in capital letters Yet all these things—and a whole category of others too numerous to mention, but which will occur so readily to the mind of experience—are of the kind that are both indispensable and most profitable in all ways but the directly remunerative fashion of the account book Thus it is with a graving-dock The prestige of the greatest distributing port in New Zealand requires one, and in the word all things else are included The comfort of the merchant marine and the safety of the King's ships are, beyond calculation, price less. Not an eye, therefore, that looks on the dock in the years to come but will lighten with pride and pleasure.

As tenders have been called for, some details of this fine work will be of interest.

The length of the centre line inside the coping is to be 683 ft., and on the bottom 671 ft. as measured from the face-line of the concrete retaining wall on the seaface. The breadth of entrance at the coping will be 84 ft, while 22 ft. down below high-water mark the breadth will be 80 ft. The coping level is to be 8 ft. above high water, and the sills of the entrance 32½ ft. below high-water for a width of 59 ft. The level of the finished bottom of the dock is to be 2 ft. below the sill level along the centre of the dock, and 2 ft. 6 in at the sides Inside the coping a width of 106 ft will be provided except at the caisson stops, where it is to be 84 ft. The caissons are to be 10 ft. in thickness and be placed respectively at 10 ft, 40 ft. 190 ft., and 300 ft. from the seaward outside face of the work. The southern end of the dock will be built in segmental form.

It is proposed to construct the dock, firstly by driving temporary piles to carry the staging to command the area of the dock, pumping station culverts, and the sea wall, to clear out the area and pump the culverts from all mud and spoil down to a uniform depth and hard formation The area has already been dredged by the "Whakarin" to approximately the right depth The next step will be to enclose the area, to be covered by concrete, in temporary timber casings supported from the staging piles When each casing is cleared out a better concrete will be deposited to cover the whole bottom area A similar course will be followed for the plumbing-house and the culverts leading therefrom. On that concrete foundation will then be erected other casings so as to form the walls of the dock. The concrete placed in the casings will form the rough first cast of the dock. When the casings are removed the next step will be to fill all round the rough concrete dock, so formed with clay fillings, to pump out and staunch from any leaks that might exist in the pumping-house, so as to enable the board to erect permanent pumping machinery A coffer-dam across the mouth of the dock entrance follows

It is probable that the pumping-out of the first cast of the dock will show a considerable quantity of leakage and runs of water which will have to be all staunched back so as to make the first cast dry or approximately so The rough dock will by that time be in existence, and in it will be built the final face-work containing the altar steps, the caisson steps and all the work of the final dock The reclamation will then have to be completed and the cofferdam removed The present contract which has to be completed by 31st December, 1910 does not include the pumping machinery nor the floating caisson, which will be subject to subsequent contracts.

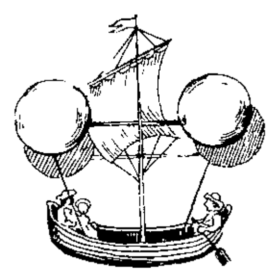
The Mastery of the Air.

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

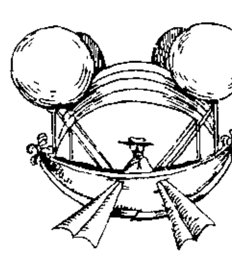
Part I.

According to one of the most successful aeronauts of our time, the air has been waiting since the advent of man on the earth to transport airships of his contrivance through boundless space, with the speed and grace of a bird, "in the open firmament of Heaven." This is one of the Brothers Wright, of Dayton, Ohio, who claims that he has discovered the secret of constructing the proper kind of airship. The more famous Santos Dumont makes the same claim. In a contrivance of his own he actually did fly through the air in the open firmament of heaven a distance of 235 yards, in the presence of a large number of spectators, at the rate of some ten yards per second, or 20.5 miles per hour. In a burst of triumph this aeronaut declared, immediately after his remarkable performance, that he saw his way to building a machine which would fly a hundred miles with as much ease as his present combination of box kites accomplished the few yards of flight which constitute the accepted present record. Dumont has made up his mind that the method of harnessing the air has been discovered and is now waiting only to be developed. He is not alone.

A large number of believers are offering prizes for the encouragement of that development. The *Daily Mail* offers a prize of £10,000 for the first successful flight from London to Manchester, 183 miles; there is the Archdeacon prize of £2000 for flights of distances over half a mile; the Paris prize of £10,000—the offer of the *Matin* newspaper increased by public subscription to the larger figure—for a flight from London to Paris; the prizes of the Adams Motor Manufacturing Company and the *Autocar* journal respectively, of £2000 and £500 to the winner of the *Daily Mail* prize if the machine or the motor-petrol are made in Britain. In addition, there are the Salomon and Howard de Walden prizes for flying machines of the heavier-than-air type; the *Daily Graphic*'s prize of £1000 for a flight of more than a mile with one or more human passengers; and the two Challenge Cups known as the Gordon-Bennett International, and the Hedges-Butler. These make a substantial aggregate of encouragement. They are not the first offer, however, nor the largest yet made, for there was an offer of $200,000—£40,000—during the St. Louis Exposition, of which $100,000 was for the best airship—safe, manageable, and fast. The faith of these believers of the recent past and the present is expressed by the *Figaro* newspaper in perfervid terms: "What a triumph! A month ago Santos flew ten yards. A fortnight ago he flew seventy. Yesterday he flew still further and enthusiasm knew no bounds. The air is truly conquered. Santos has flown. Everybody will fly." With all these believers the only questions are: how soon shall we fly, and shall it be with machines that are heavier than air or with those that are lighter?

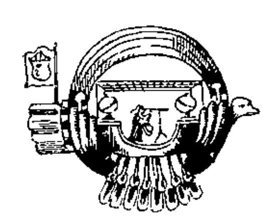


LARA'S QUADRUPLE COPPER BALLOON 1670.



LARA'S 1678

A MAN FLYING (FROM FAUSTUS VERONTIUS) 1695.



BARTHOLOMEW LAUREAT'S IDEA 1709.

THE ANTIQUITY OF THE PROBLEM.

From the earliest ages man has dreamt of the conquest of the air by boldest flight. In the dawn of history, before the setting of fable, Daedalus was believed to have accomplished the feat. Shut up in the Island of Crete, where he had constructed for King Minos the famous Labyrinth, this cunning workman fashioned for himself and his son Icarus each a pair of wings, with which they started to fly over the Ægean to a country of safety. The father arrived, but the son, being ambitious, neglected the paternal advice not to approach too near the sun, which would assuredly melt the wax with which his wings were fastened to his body, soared aloft, and met the fate against which he had been warned. Succeeding ages have forgotten the part of the story referring to the successful flight of the sire, preferring to perpetuate the second as a warning against the ambition which leads men to attempt great enterprises without considering adequately the strength they possess or the means they should provide for carrying them out. Throughout the ages that have succeeded Icarus has furnished the point for every tale of vaulting ambition that overleaped itself. Practical people explained the story of the flying, which they saw to be unthinkable, by substitution; they pointed to the fact that in the days of Daedalus the art of sailing over the water was as unknown as that of flying through the air; they declared that the great inventor invented the sail, applied it to the nearest canoe and got away in safety, losing his son on the voyage by some accident, which in the first sailing voyage on record was not by any means difficult to imagine. Daedalus was the great builder and architect of his time; the creator he was of the two arts, the inheritor of the fame of all the artists who had preceded him, but for lack of records had been forgotten. He was credited with the making of everything wonderful known in his day. All statues of the gods of special excellence were called by his name—Daedala—nothing was regarded as impossible to him. In time the myth of the wings was resolved into the fact of the sail; and the name of Icarus remained alone of the story for the encouragement of inventors to keep on the right track.

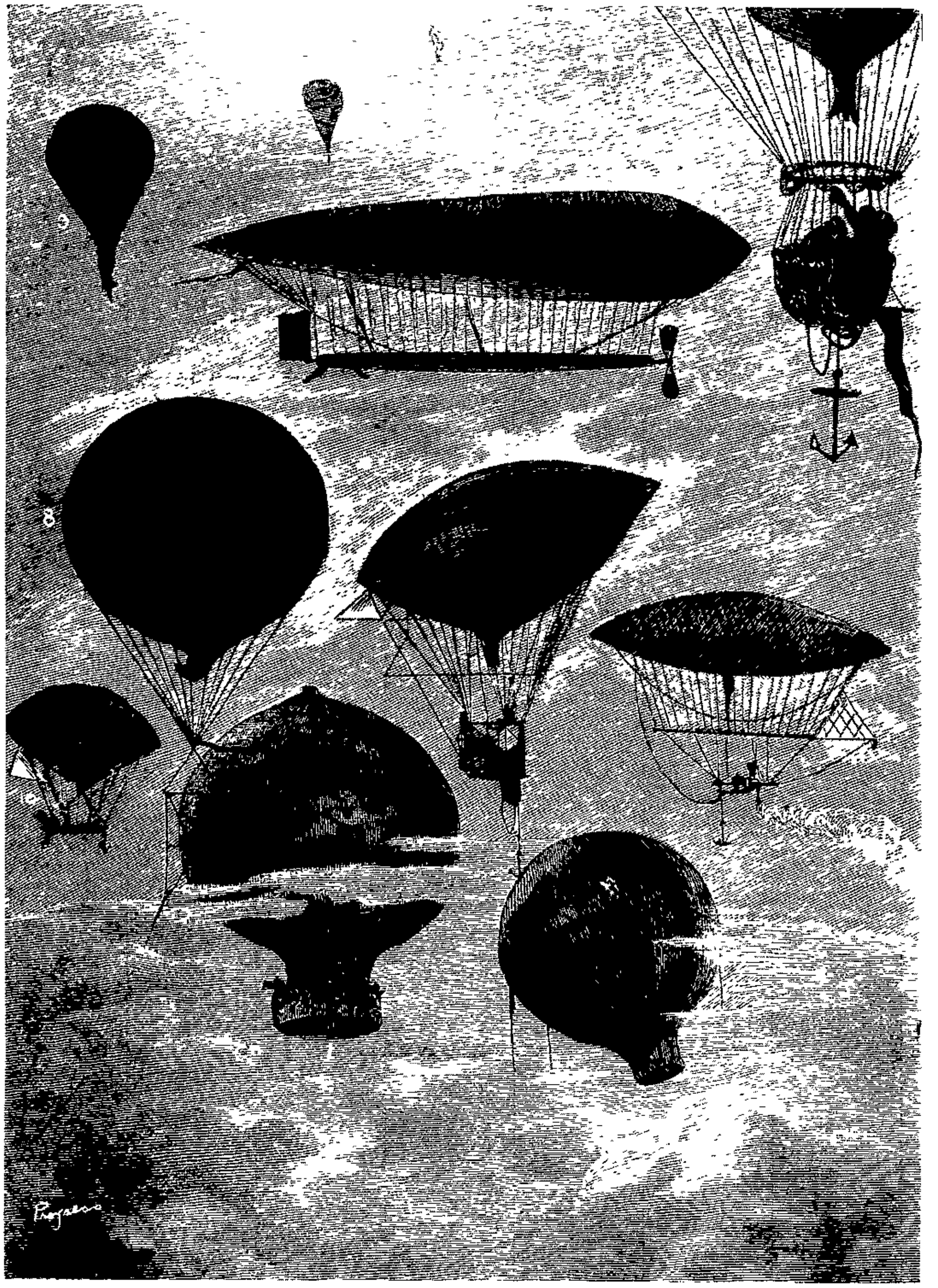
They needed some encouragement of the practical kind. Antiquity and the Middle Ages are full of their endeavours to solve the problem of the air. From Archytas of Tarentum to the great Leonardo da Vinci some of the greatest intellects of mankind were devoted to the solution of this fascinating problem of flying through the air. The first named, who was eminent as geometrician and astronomer, was famous also throughout antiquity for the flying pigeon which he constructed, which probably was some kind of kite flown with a string. Which reminds us that the amusement of flying kites was not unknown to the ancients. In addition, there were many who said they had seen men fly with wings of their own construction through the air. But in the absence of information there can be no discussion of their testimony, and the only possibility is that something of the principle of the parachute must have been suspected by those who had watched the leaps of the flying squirrel, which have in our day been measured up to forty feet. But they could not have made much progress, for so late as the seventeenth century there is the instance of an exhibitor who, descending from a great height in a machine much like a parachute of our time, broke his leg by falling into a barge moored on the Seine. As he did not seem to have any conception of the area of parachute required to sustain his weight it is right to conclude that all his predecessors in the flying art were no better off for scientific equipment. By the time of this adventurer the only persons who were supposed to ride through the air were the witches, who were popularly thought to use broom sticks. But this scarcely belongs to the subject of airships.

Leonardo da Vinci, painter, poet philosopher and man of science, was conspicuous among his contemporaries for the zeal with which he devoted himself to the art of flying. Drawings are extant of a contrivance which kept him employed for many years, a contrivance by which a man exerting the muscles of his legs might keep a pair of great wings in motion. It was the dream of this great man's life that one day his invention would enable men to fly like the birds through space at his will. But neither he nor the large number of persons who thought and hoped with him were learned enough in comparative anatomy to know that the superior muscular power of birds in proportion to their weight makes easy to them the problem of flight, which to man is impossible with his inferior muscular apportionment. Some of the inventors of that time, moreover, and indeed of other periods of history, were not always remarkable for proper study of means to ends. Like the artists who illustrated their ideas, they were more concerned with the magnificence of results than with the methods of producing them. There is, for instance, the project of Lara the Portuguese, (in 1670), whose proposal to build a flying-machine made him a conspicuous figure in the annals of his time. He designed a boat to be supported by four copper balls. Some gas lighter than air was to be put into these, which, thus charged, would infallibly raise the whole fabric aloft to any altitude. The diameter of these cups was to be 25 feet. But the metal employed in their construction was to be only one two-hundredth part of an inch thick. Had this genius proceeded from theoretical proposal to actual practice, his project would have had short shift, for the balls, long before the exhaustion of air in them, would have collapsed with unsatisfactory completeness. So it was with most of the inventors who were ready with the lightest hearts to undertake aerial voyages on the provocation of their ill-furnished brains. They have their place in history, however, which consists of a name merely, but little more. About Lara there is the additional distinction that he was the first to conceive the notion of getting some gas lighter than air to do the raising and sustaining required for flight through the air. His machine was wrong but his idea was right. Though the first balloon did not rise for a century after his death he was the first to evoke the idea of the balloon.

The attempts of man to master the air as birds do in their flight, is divided into two parts: the part which relates to machines that are lighter than air, and that which relates to those that are heavier. At the head of the former the name of Francis Lara is entitled to an honoured place.

LIGHTER THAN AIR.—THE BALLOON PERIOD.

In the year 1783, the brothers Montgolfier gave the thoughts of inventors a new turn by their success in elevating a balloon in the air. Paper-makers at Annoncay were in a position to experiment with the idea propounded by Guzman and others that if an envelope could be found for enclosing a given quantity of a gas lighter than air the envelope would rise up in the air, and the problem of flying would be solved. They turned their attention to the subject, and after various experiments managed to make a bag of paper and linen of considerable strength, and impervious to air. This they contrived to get filled with air heated over a straw fire, and the heated air, being lighter, carried the envelope high up into the atmosphere, to the great wonder of a large crowd of spectators. As the air cooled, the envelope descended gradually, finding its way back to earth without shock or trouble. The brothers soon constructed a balloon of 105 feet in diameter, and the name of Montgolfier became for ever famous in connection with the art of sailing ships through the air. Their balloon is number 1 of our next plate. It carried no passenger or crew, loomed large, rose mysteriously, floated about majestically, and returned to earth comfortably. Speculation and experiment followed in its track with eager enterprise. The first balloon was accepted as evidence of the fact that the work of ascension and suspension had at last become possible. One half of the problem of flying was therefore solved. The solution of the other half, the propelling and direction, would be only a matter of time. Let it be understood however that though the Montgolfiers had solved the problem of the application, the idea was not theirs. It was Guzman, of Lisbon who had suggested that heated air might be of use



1 MONTGOLFIER 2 TISSANDIER 3 RENARD 4 THAYER 5 CHARLES 6 POWELL, M P 7 WISE
8 CAPTAIN LORRAINE (LOST AT SEA NEAR LYTTELTON, N Z) 9 GREEN 10 GIFFARD

to the seekers of the secret of aerial navigation In 1766 Cavendish discovered the properties of hydrogen, *inter alia* the superior lightness of that gas, and soon after him Black of Edinburgh suggested the plan of making an envelope to enclose any gas lighter than the atmospheric air This suggestion reminds one of the idea put forward by Lana in 1670 Whether it was taken from him or originally hit upon is a question which probably will never be settled Its settlement however at this period of the navigation of the air is immaterial It is enough for all purposes that the brothers Montgolfier flew the first balloon That balloon carried a sheep, a duck, and a cock These were the first aeronauts, and they came safely back to Mother Earth

Two months after the first ascent, the chemist Charles conceived the notion of substituting hydrogen gas for the heated air of the Montgolfier process The obvious advantage was that hydrogen did not like hot air, depend upon a fire to keep it up to the mark as a lifter Charles had some trouble in getting the gas into his balloon but after a little difficulty he succeeded and the first balloon supported by hydrogen went up near Paris remaining in the air for three quarters of an hour On reaching the earth the fabric was torn to pieces by the affrighted peasantry This if it does not confirm the story (now considerably doubted) of Andree's fate in 1898, namely that he was murdered with his companions on alighting by some superstitious natives—Esquimaux, Laplanders, Yakoots inhabitants of some part of the rim of the frozen world—at all events gives it an air of probability The balloon of the chemist Charles was made by the brothers Robert

In November, a month later, Zambeccari discovered the advantages of oiled silk as an envelope for the lighter gas, and since then all balloons have been constructed of that material Soon after the new departure Zambeccari sent up a balloon which crossed the English Channel from Sandwich to the neighbourhood of Ostend, but there was nobody on board Hydrogen eventually took the place of heated air The latter was of course relied on for some little time The first human aeronaut, J Tytler ascended in a balloon inflated by heated air carrying the means of keeping the same hot The unfortunate Pilatre des Rosiers did the same thing, flying over Paris on December 1st, 1784, after ascending from Versailles Lunardi followed quickly with a hydrogen balloon The rival aeronaut compromised in the struggle of the elements, and ascended with two balloons, one above the other one filled with hydrogen the other with heated air Unfortunately something going wrong with the upper balloon the gas escaped, and the fire not being alight for expanding the air of the lower balloon the whole fabric came to the ground with a sickening thud from a height of 700 feet Hydrogen after this disaster displaced its rival Before his untimely death Rosiers had flown thirty leagues in his balloon establishing a record which the aeronauts of the day made it the object of their lives to beat In 1787 Blanchard crossed the Channel in a balloon, and the art of managing balloons had begun to be fairly well understood A valve at the top of the balloon worked from the car sundry bags of ballast, and an open throat were the indispensables—the first for lowering by letting out gas, the second for raising by throwing weight overboard, the third for preventing the expansion of the gas at the higher altitudes from bursting the balloon The last precaution was suggested by the fate of several aeronauts whose balloons had collapsed over them after bursting from this cause In 1821 the celebrated English aeronaut, Mr Green, substituted coal gas for hydrogen, and many used it after his example. But the other gas has never gone out of use in consequence In 1836 Green travelled from London to Weilburg in Nassau in his balloon, a distance of 500 miles, and was considered very lucky to have got safely to that place. For it was well understood that the big round balloon was unwieldy, unsteerable, entirely at the mercy of the wind and not too safe in rough weather The type of that balloon is seen in figure 9 in the illustration

The balloon was however, used for many purposes and no car was ever considered complete without a set of observing-instruments The atmosphere was tested and studied at every possible altitude, and under every manageable condition Humboldt was an indefatigable observer, and the names of the most famous aeronauts were Glaisher, Coxwell Croce-Spinelli, Nadar, Godwin and the American Wise, Tissandier, Giffard, and Dupuy de Lome Of these the American Wise flew from St Louis to Jefferson, a distance of 1159 miles He conceived a project for crossing the Atlantic but fortunately for himself it came to nothing It was early in the history that the aeronauts discovered the difficulties of the upper air. Mention has been made of the expansion of the gas at those heights The knowledge of the effect of the atmosphere on the human constitution followed speedily. Balloons ascended to heights up to 31,500 feet Breathing proved difficult, the faces of the aeronauts grew purple, insensibility often occurred, and on one occasion of three men who went up to a height of over 25,000 feet, all became unconscious and two died This type of balloon is in use to the present day Every war office has numbers of them for purposes of observation, many aeronauts keep them for show purposes, descending from them in parachutes,* giving displays on various public occasions, putting them to a variety of uses The only conspicuously serious purpose to which one of the type was put in later years was the purpose of making Andree's attempt on the North Pole This famous aeronaut had invented a system of steering the balloon by a system of drag ropes which he had experimented with in several journeys over the Baltic, all with much success He believed implicitly in the system But his fate contributed greatly to the encouragement of the reaction that had set in so far back as the early fifties against the round type of balloon, whose demerits the aeronauts had found such abundant reason for being displeased with, reasons chiefly of unwieldiness and unsafety.

One of the earliest proposals for getting over the steering difficulty was that of the Greek Stagapoulos who suggested harnessing birds to the sides of balloons to drag them through the air He did not go into any details to show how these novel teams could be driven as well as those which drew the renowned chariots of Venus and Queen Mab, but in the drawing which he made they seem to be doing their work fairly well Giffard—of Injector fame—was the first to devote serious attention to the much desired improvement In 1852 he elongated the shape of the balloon, making it elliptical instead of spherical constructed an example 144 feet long by 39 feet in diameter, fitted it with a rudder, installed a propeller and a motor, (steam) of three horse power, the weight of the motor apparatus being 462 lbs In this he ascended from Paris and, the weather being calm managed to work up to a speed of between six and seven miles an hour having his balloon under some sort of command

He was followed in 1872 by Dupuy de Lome Chief Constructor of the French Navy—a service which has always been in the van of enterprise—with a machine worked by man power taking up on the occasion of his ascent from Paris twelve men for operating the motor. The machine was 118 feet long by 49 feet in diameter, and he had a *success d'estime* He preferred man power, having a wholesome dread of a fiery motor working in close proximity to the hydrogen in the balloon The man power not proving economical others turned to steam, amongst them Wolfert and De Bradski who thought they could take sufficient precautions against the danger feared by their predecessor But they failed, and they lost their lives in full view of Paris

Tissandier came next, in 1883 with a "Dirigible" (see figure 2) which accomplished the best

* Baldwin in 1887 descended a mile in $3\frac{1}{4}$ minutes with a parachute

results hitherto attained. The machine (cigar shaped) was 90 feet long with a diameter of 29, it carried a rudder of unvarnished silk, a propeller 9 feet long, and an electric motor—the whole fabric, with stores, motor, and aeronauts, weighing 2650 lbs It managed to make seven miles against a head wind and did not manage to make any further appearance, as (so it was thought at the time) the flight had revealed some structural defects of radical character.

Proceeding on the lines followed by his predecessors Giffard, Dupuy de Lome, and Tissandier, Captain Renard, of the French army, chief of the balloon department of the service, reached high water mark of that day with his celebrated "dirigible" balloon *La France*. In his ascent he was accompanied by his assistant Captain Krebs of the same service. His machine was more like a cigar than any of its forerunners (see figure 3), it carried its propeller in front and its motor was electric, of greater power than Tissandier's The ascent was made in June 1885 Here is the account published of the same by the *Times*. "The balloon was of elliptical form and carried an electric motor, a screw and a rudder, the motive power being derived from electrical accumulators which could supply during four hours a power of ten horses. These worked the screw which served as a propeller to the apparatus. The balloon was made of light strong silk, and was covered as usual with a netting to which the car was suspended All the propelling mechanism was contained within the car, the rudder alone projecting outside like that of a boat. The car was mounted by Captain Renard, Director of the Balloon Works, and by his assistant. Captain Krebs, both engineer officers. On being released from the earth the balloon at once rose to a height of about 180 feet and, urged by the swift rotary movement of the screw, made a straight course for the Hermitage of Villebon, about seven miles distant as the crow flies A wind was moving against it at a speed of 18 feet per second. Captain Renard worked the propeller, Captain Krebs steered Villebon had been fixed upon as the goal of the journey, and when this place was reached Captain Krebs waved a flag as a signal that he was going to turn. The spectators were then amazed and delighted to see the balloon gracefully describe a curve of 300 metres radius and sail back to Meudon. On approaching the lawn from which the ascent had been made, the balloon descended in an oblique direction and with a steady motion, showing the engine was completely under control Within twenty feet of the ground the machine was eased and a rope being thrown out from the car, the balloon was hauled down and touched the earth without the slightest shock. The whole journey had occupied about forty minutes.

From this account it is clear that the balloon *La France* had attained a speed of 21 miles an hour half of the course against a wind of 12¼ miles The feat caused great enthusiasm throughout the world The United States government at once commissioned Thayer, the well known aeronaut, to build a "dirigible" double the size, carrying double the power. The theory was simple enough It was in fact thought to be a mere question of proportion a question of lifting power. Double the lifting power, and you doubled the power carriable. The orders to Thayer therefore were to build a balloon of a diameter of 60 feet with an ascending force of 70 tons, driven by compressed air A speed of 40 miles an hour was confidently expected as the result. The machine was designed according to instructions, but never built. The trouble was that Captain Renard ascertained by further experiments with *La France* that the machine was absolutely unmanageable in a heavy wind and nearly so in a moderately brisk breeze The French War Office built another and larger machine nearly double the size It had a motor of gasoline of 50 h.p., was said to be exceptionally manageable and altogether great things were mysteriously predicted of it on its first appearance, which would not be till the outbreak of war Then the Germans, all the critics declared, would understand the meaning of *La Revanche* But this redoubtable machine was never taken out into the light of day and has not been heard of for years.

Since the last appearance of Captain Renard's navigable airship there have been many, and in the hands of enthusiastic devotees But they have never, in spite of the encouragement of prize offerings enough to stimulate the dreams of avarice, advanced beyond the efficiency achieved by *La France* Her best factor of control and stability was the front propeller, and that has been followed in all the copies Renard himself, now a colonel disgusted by the demonstrations of weakness in the balloon principle of construction, has long been one of the most stringest supporters of the system of aviation His contemporaries remained, however, staunch to the principle of aerial navigation on behalf of which he had led the way with such high hopes

ZEPPELIN'S BALLOON

By the end of the last century a host of aeronauts was competing for the lead Invention succeeded invention and trial succeeded trial The scientific journals gave great space to the chronicle of their doings, prizes were offered to stimulate their enterprise, every war office was busy and the number of aero-clubs multiplied

In the first year of the present century Count Zeppelin, of the German army, made his great effort He had headed the famous cavalry raid which opened the campaign of 1870/71 he was determined to wrest from the same enemy the empire of the air won by the efforts of Renard and the mysterious invention that was alleged to have followed them The Kaiser looked on with approval, saying in his magnificent way that the Count had revolutionised the art of ballooning The Count's airship was built in a floating house on Lake Constance It was 420 feet long with a diameter of 28 feet , it was covered with a network of aluminium, its material was water-tight pergamoid above, and light silk below Fashioned in cigar shape, it was divided into seventeen compartments, each carrying its own separate gas supply Suspended was a gangway nearly the length of the fabric, carrying two aluminium cars, each furnished with benzine motor of 10 h p with oil tanks and water ballast There were two aero propellers at the sides of the machine about the centre a rudder and a running weight for keeping the balance On the day the ship was brought out of its house it had cost the inventor £7000, and the ascent that followed cost him £600 more. On that day, in the presence of a large crowd of spectators, the majestic fabric rose into the air and was very soon in difficulties The steering apparatus fouled one of the propellers the breakdown of a winch paralysed the running weight, and the power was found to be not nearly enough Nevertheless, after sailing some four miles, on a fairly straight course, the ship came safely to land, and as she was taken back to the floating house there were many congratulations and as many prophecies of her future greatness But she never left that house again The trip had revealed structural defects of radical character. Attempts were made to raise funds, as the inventor's means were exhausted, but without avail, the business of investing in airships having come to be regarded as risky. The Zeppelin airship was never heard of more, and the only subsequent news that concerned her in any way was the announcement of her patriotic proprietor's bankruptcy.

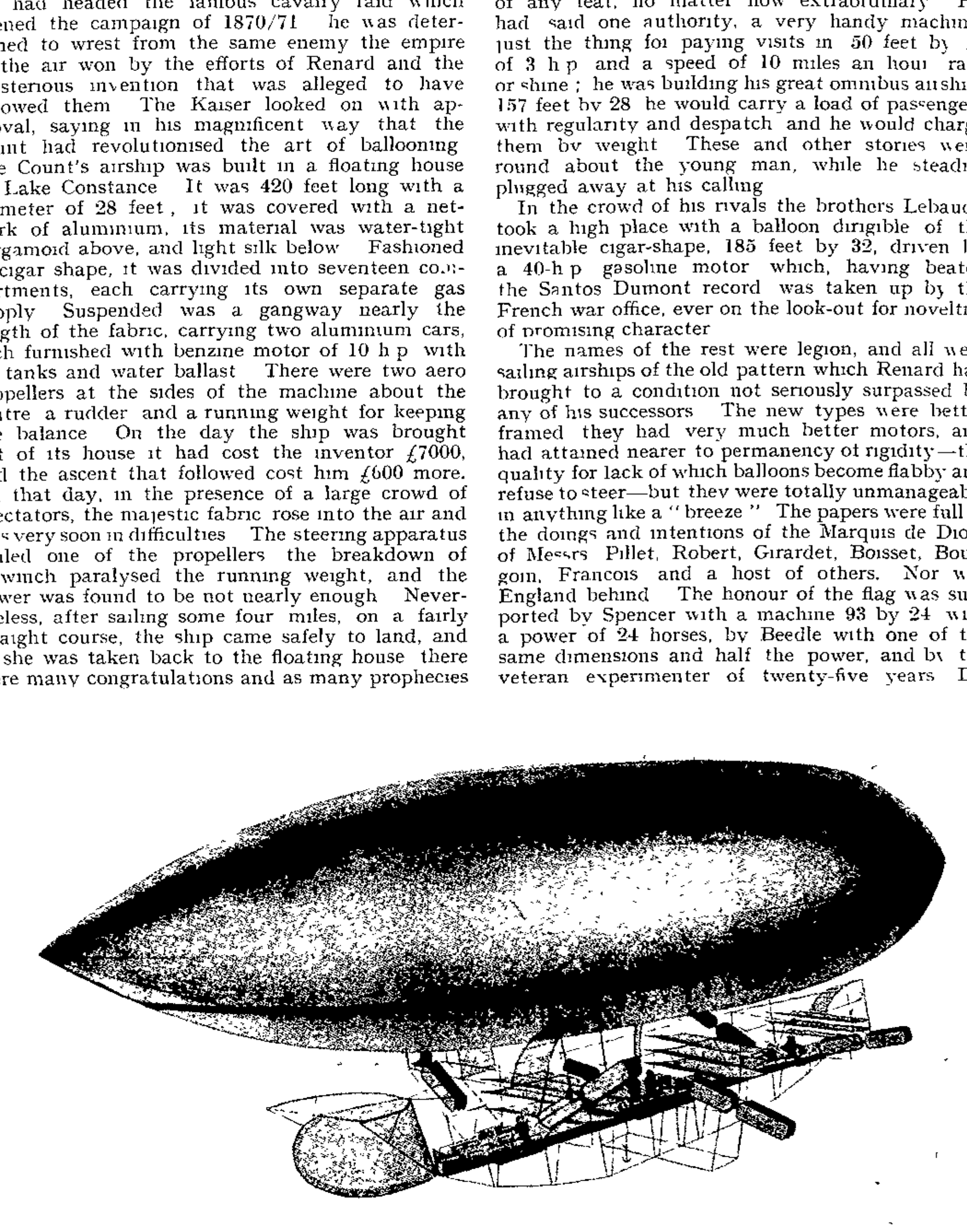
A host of rivals was in the field, the patent offices of Europe and America were busy, and men began to seriously consider whether after all they were not destined to fly, in machines of cunning construction.

Conspicuous among the crowd of aeronauts was Santos Dumont, the young and enterprising Brazilian He appeared first in the front in the same year that witnessed the failure of Zeppelin with a cigar-shaped balloon supporting a spar on which he rode after the manner of a cyclist Machine after machine did he construct until he astonished the world by flying round the Eiffel Tower and winning the Deutsch prize of £4000 He had a gasoline motor developing great power with very light weight a thing which seemed to realise the mechanical aspiration of "a horse-power in a watch case" and he did the distance—3½ miles and back—in half an hour The world applauded him wildly, but he fell short of the record of Renard by two miles an hour, and he only flew half the French soldier's distance, and in subsequent efforts he had many dangerous accidents. Encouraged by the plaudits of the public of many countries he went on building on the same lines, until he was announced as a competitor for the prize offered by the authorities of the St Louis Exhibition for the best airship. He was to compete in a vessel 165 feet long by 27 feet of diameter, with a motive power of 60 horses

This inventor was the theme of much comment at this time People seemed to think him capable of any feat, no matter how extraordinary He had said one authority, a very handy machine, just the thing for paying visits in 50 feet by 18 of 3 h p and a speed of 10 miles an hour rain or shine ; he was building his great omnibus airship 157 feet by 28 he would carry a load of passengers with regularity and despatch and he would charge them by weight These and other stories went round about the young man, while he steadily plugged away at his calling

In the crowd of his rivals the brothers Lebaudy took a high place with a balloon dirigible of the inevitable cigar-shape, 185 feet by 32, driven by a 40-h p gasoline motor which, having beaten the Santos Dumont record was taken up by the French war office, ever on the look-out for novelties of promising character

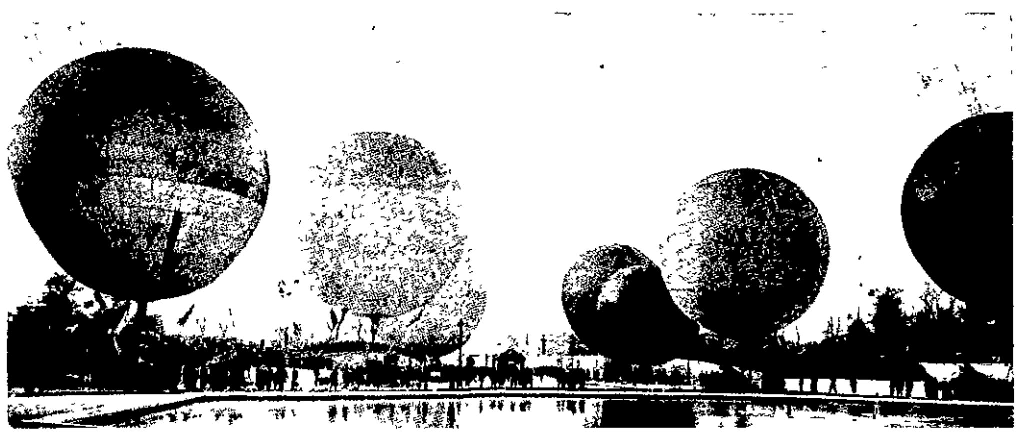
The names of the rest were legion, and all were sailing airships of the old pattern which Renard had brought to a condition not seriously surpassed by any of his successors The new types were better framed they had very much better motors, and had attained nearer to permanency of rigidity—the quality for lack of which balloons become flabby and refuse to steer—but they were totally unmanageable in anything like a "breeze" The papers were full of the doings and intentions of the Marquis de Dion, of Messrs Pillet, Robert, Girardet, Boisset, Bourgoin, Francois and a host of others. Nor was England behind The honour of the flag was supported by Spencer with a machine 93 by 24 with a power of 24 horses, by Beedle with one of the same dimensions and half the power, and by the veteran experimenter of twenty-five years Dr.



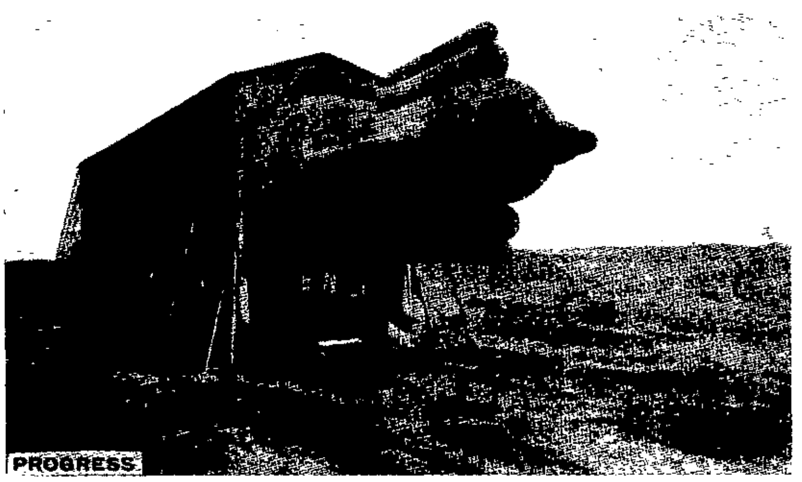
DR. BARTON'S AIR-SHIP.

Barton, with a monster 170 by 40, carrying three motors of 50 h.p apiece In America the names of Baldwin, Langley, Bell and the brothers Wright towered above the crowd The four last were, however, aviators

A description of the Barton air-ship is necessary, for it differed from the rest in the remarkable respect that it was designed on both the principles of aeronautics, combining the two, which had been kept separate by the inventors up to this time Barton's machine was fitted with aeroplanes as well as the gas bag of large size common to all the rest He had experimented with two models in 1899, one on the accepted principle of Renard, the other with the aeroplane exclusively, and had found them both deficient Profiting by the experience thus gained, he devised a third machine combining the two Constructing a fourth still of the model size—the respectable size of 35 feet in length—he made some experiments in the open Those he had previously made under the cover of the Public Hall at Beckenham answered extremely well, the machine rising and falling without any expenditure of gas, and obeying its rudder and keeping direction with good line But experiments under such conditions being inconclusive, as every inventor knows by this time, he arranged a trial in the open Unfortunately the clock-work motor was not powerful enough. Still, the results obtained were encouraging Although there was but little lifting-power in the balloon, the action of the aeroplanes caused it to ascend as it gathered way, and in ten minutes it had reached an altitude estimated by onlookers at 800 to 1000 feet it kept perfectly level, and steered well according to the set given to the rudder, nearly at right angles to the wind After going thus for about three miles the clock-work power ceased to act and the machine sailed on for another half-mile



THE BALLOONS IN THE AERO GORDON-BENNETT RACE.



A UNIQUE VIEW OF THE VILLE DE PARIS. M. DEUTSCH DE LA MEURTHE'S AIRSHIP LEAVING THE SHED FOR A TRIAL TRIP.

turning round and round after the manner of the ordinary round balloon, and came safely and quietly to earth Acting on the experience thus gained, Dr Barton called in the best ballooning experts, and with their aid designed a full-sized complete airship. (See figure)

The balloon or sustaining part is designed in the form of a cigar, the largest diameter being about two-fifths from the front end, and was 180 feet long by 41 feet maximum diameter This gives a total lifting capacity of 144,000 cubic feet or 10,080 lbs. The total capacity was 156,000 But a special chamber was reserved for air as will be seen presently, at a capacity of 12 000 Ordinary balloons filled with very carefully made hydrogen gas will lift 1200 grammes per cubic metre but it is not safe to calculate upon more than 1000, as the quality of gas varies so much With coal gas the lift is 730 grammes for a good quality, and 700 for medium It is found in practice that there exists a great necessity for preserving the external shape, especially of a cigar-shaped balloon as has been practically demonstrated lately In the balloon now described this difficulty will be greatly reduced, as no gas is expended for descending purposes, and it may, therefore, reasonably be expected to remain in the air for a very long period The subsidiary balloon is filled with air, so that when the reduction of the pressure from ascension of the airship, or from the heat of the sun's rays causes the gas to expand, the air is driven out ; and on the gas again contracting air is pumped in This plan has been, of course, used by many experimenters, the latest of whom is M Santos Dumont, who once got a bad fall because his air-pump broke down, the material buckled and the balloon collapsed. The entire upper surface of the balloon proper is enveloped in an extra casing or chemise provided with cane stiffeners

From this chemise the car and its superstructure are suspended—the suspending cords are not shown The superstructure is made of steel, mostly of tubular section, and is constructed to carry the propellers, aeroplanes, and rudder. The ship is to be propelled by six two-bladed triple fans three on each side of the superstructure It will be observed each pair of fans is centred on a different plane to the others, in order that each shall revolve and pass through different air The balloon is protected from the fans by network screens. Each pair of fans will be driven by an oil motor, with electric ignition each motor exercising 45 b h p Experiments recently carried out at Mr. Alexander's experimental works at Bath show

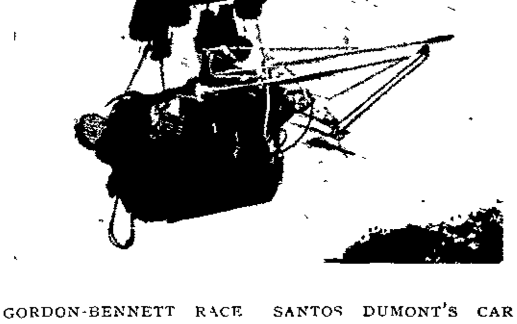
that a thrust of 25 lbs per brake h p can be obtained without excessive weight However, in this instance, the thrust is taken as 20, giving a total of 2700 lbs for the six fans There are three sets of aeroplanes, each set consisting of three, one over the other, each aeroplane having a rod in front for the pivot and a rod in the rear for raising and lowering the end by means of the links—as shown in the diagram Fig 2 By means of these aeroplanes the ship will be raised to any desired altitude above the point to which it would naturally rise by means of the lifting power of the balloon, and failure of the mechanism can result in nothing more than its returning to its original point, which will be 1000 feet above the ground The deck, on which the crew can freely walk about, is floored with a light matting and is provided with a hand-rail and netting, the fan motors are fixed to this deck, and in order that the deck shall remain always in a horizontal position a water tank is placed at each end, each tank containing about 50 gallons of water which is kept, by means of a pump and connecting pipes, in a constant state of circulation There is also a pendulum-operated valve arranged so that, should one end of the deck drop, the pendulum shuts off the water from the lower end and pumps it to the upper tank till the level of the deck is restored

The weight of the whole including a crew of five men, was 9600 lbs with a maximum area of balloon of 1320 square feet As to the efficiency of the power, the inventor was very emphatic He said that according to Dr Smeaton's experiments the air resistance of a flat surface at 13 miles an hour is just under one pound per square foot, while the more recent experiments of Professor Langley the famous aeronautical authority, (since verified by others of competent character) show

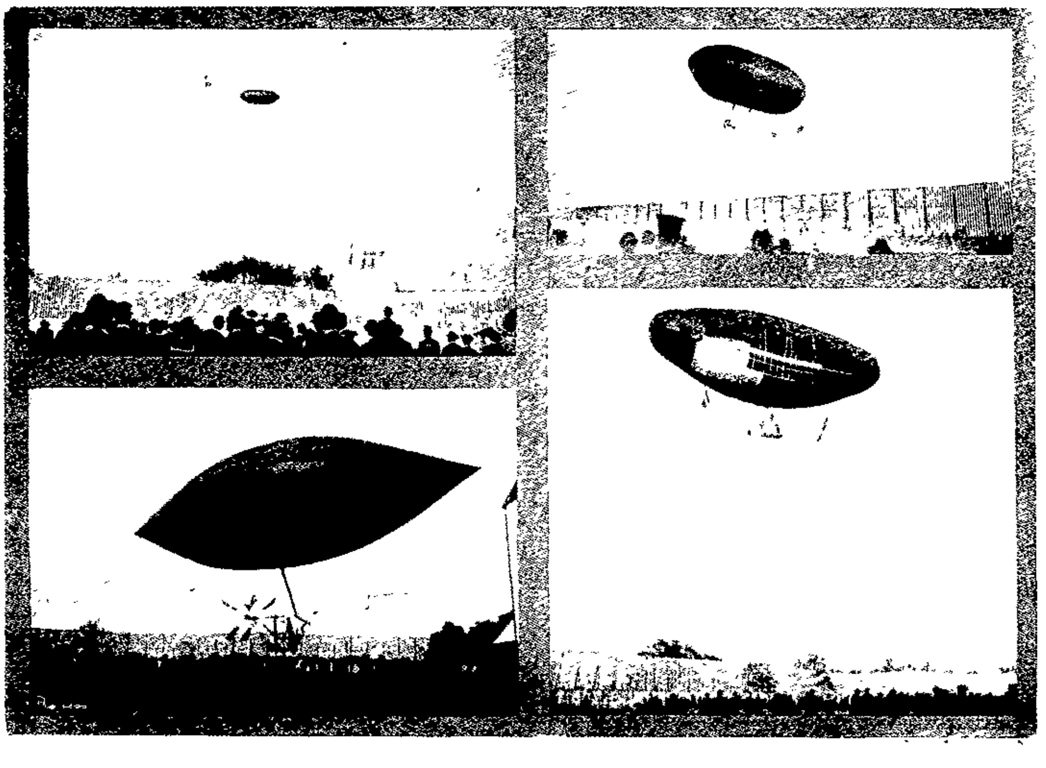
that amount to be excessive. This pressure is of course largely reduced if the object piercing the wind is in the form of a cone, in which case the resistance is variously given as from one-third to one-fifth of that of a flat surface. Now allowing only a third for reduction for the change of shape to the conical, the resistance offered by the balloon will be under 450 lbs to a wind of 13 miles an hour. To this add the resistance of the aeroplanes, superstructures, car and contents, and the surface friction of the sides of the balloon, say 250 lbs., and we have a total resistance of under 700 lbs. But the thrust available was estimated at 2700 lbs., therefore it was not unreasonable to expect a speed exceeding 20 miles an hour.

This apparently fair conclusion was supported by the experience of those present at the trial of Dr. Schwartz s aluminium balloon, which (before the first driving belt came off—a side-light, this, on the insecurity of the balloon race) had advanced steadily against a breeze of 19 miles an hour. That machine, however, had only a 12-h.p. motor, and was of about the same weight and dimensions with a capacity of 130,500 cubic feet, 13,500 less only than the Barton balloon It was understood at the time that, should the Barton achieve in practice the estimated results, it would be purchased by the British government for war purposes. The talk about this venture considerably increased the interest taken by the ballooning world in the great trial arranged by the authorities of the Louisianian Exhibition

Much was expected in the way of result. One hundred thousand dollars were offered as the first prize for the best airship flying a certain distance over an indicated course at a rate of not less than 20 miles an hour over the ground, which meant a rate of not less than 25 through the air. Fifty thousand dollars were to be divided in prizes for the victors, in certain contests between rival machines, and the balance of the offer of 200,000 dollars was devoted to the expenses of the exhibition and trials. The newspapers prepared the public to expect a great competition by publishing accounts of successful attempts of various inventors, and to enjoy the view of marvellous craft sailing at will under perfect control in sight in every part of the firmament of heaven. At one time it was announced on what appeared to be good authority that 92 competitors had entered for the big event But as the day approached the public began to see that its expectations would not be realised The fact is that as soon as the aeronautic world realised that the trials were to be less experimental than practical the conditions comprising a prescribed course the execution of



GORDON-BENNETT RACE SANTOS DUMONT'S CAR WITH MOTOR ETC.



DISPLAYS AT ST. LOUIS.

certain named evolutions, the attainment of a certain rate of speed and the return to the starting point within a specified time, the entries fell off. A panic set in among the inventors, the panic grew, and when the day came for the big event not one inventor qualified. Not even the ship of the famous Barton described above, or the bombastically heralded craft of Santos Dumont. The former did not go to St. Louis at all. The latter arrived and was found quarters duly, in accordance with the desire of its spirited inventor, who had been the very first to signify his intention of competing. But at the last moment some vandal succeeded in getting into the aerodome where the Dumont material was lying, unpacked, and slashed the gas bag so badly that it could not be repaired in time for the trial. Detectives were called in and a thorough investigation was made with no other result than a general suspicion that the general panic had included Santos himself, who had therefore either slashed the gas bag himself or instructed some one else to do so, in order that he might avoid the embarrassment of a failure. It was a suspicion natural enough as suspicions go. It may have been absolutely without foundation, as suspicions often are. But when the baffled aeronaut made no attempt to repair damages, and took himself and his machine back to Paris by first opportunity there were not wanting those who saw abundant confirmation of suspicion.

Only four exhibitors made an appearance, and it was only a factitious one, not for the prize for the best airship, which prize they felt they could not win, but arranged merely for pleasing the disappointed public. These were Baldwin, Berry, Benbow, and Francois. The last had a monster balloon with a motor of 24 h.p. and a great pair of propellers, and from this machine's performances the spectators expected much instruction. It was filled with gas only after very great difficulty, but when the hour came for cutting clear, the inventor's confidence evaporated and he declined to give the order. The balloon was described as behaving thenceforth like a hamstrung elephant.

On the other hand the airship of Baldwin was fairly successful, inasmuch as it made several ascensions under the direction of its "chauffeur" (if we may use the term), Knabeshuh, who accomplished the feat several times of making a wide circle and returning to the balloon enclosure. These flights were very interesting. "This bold mariner of the celestial seas," says the official account, "made no provision for his security, but stood upon lateral pieces of gas-pipe composing the framework of the ship, and skilfully directed her movements, exhibiting the most perfect control. By shifting the steering-blade and propeller he was able to ascend or descend at will, and similarly his ship was brought to change its course and to describe a circle, though the vessel was not thus controllable in a wind of more than seven miles an hour." The description added that the grace and beauty of these movements inspired the spectators with prophetic visions of the marvellous future awaiting the flying people of an enterprising world. But the only solid result of the great prize offering was the demonstration of the futility of the balloon called Dirigible for practical purposes.

Despite these poetical effusions the reaction made itself more pronounced than ever. By almost universal consent of aeronauts it was determined to return to the school of nature for direction in the art of flying through the air, and take lessons from the birds. It was said that the balloon had shown only that a few inventors had succeeded in calm weather in working on an angle with the wind and even in travelling to windward, but that they had not demonstrated the practicability of steering apparatus lighter than air under the majority of working conditions presented by the atmosphere.

The balloon, it must be said for it, had done good work in its day. Miniature specimens had penetrated the secrets of the atmosphere to heights above 40,000 feet, bringing back the figures of self-registering instruments which had become scientific records. Those of full size had given such extended opportunities of observations to soldiers that every war office in the world had employed them and spent large sums in the effort to improve their efficiency. The Republic of France never can forget the invaluable services of the balloon during the siege of Paris. The airships of that memorable time carried the government of the Republic out of the hand of the enemy to organise the defence of the country, and maintained, in spite of vigilant hostile fire, a postal service which kept the beleagured capital in touch with the world. Finally the balloon had participated in the eternal assault on the North Pole. It had failed, as the sailing craft, the steam boat, the sledge and the Esquimaux dog had failed, but it had at any rate proved itself by its attempt worthy of the honourable estimation accorded to it by the world.

HEAVIER THAN AIR.—THE PERIOD OF AVIATION.

Man has got back to the original plan of seeking the secret of the air in the flight of the birds thereof. The first question is of the bird to be chosen for the master. Shall it be the wide-ranging albatross, whose majestic flight is but seldom disturbed by the beat of a wing, or the flapping heron or the homer pigeon whose pinions never cease from struggling or the swallow, whose dexterity is like the lightning, or the "eagle aloft" soaring in circles "to the blazing sun"? The difficulty of choice is accentuated by the uncertainties of science as to the exact nature of the functions of the wing in flight. In a general way it is well understood that the forest bird has short broad wings, which enable him to swing round among the timber and the undergrowth, and to rise almost straight upwards to the shelter of the tree tops, whereas the bird of long wing when on level earth or water finds it hard to rise and can only do so at long angles.

Another difficulty in the way of the discovery of the secret of artificial flight is the difficulty of maintaining equilibrium in practice. Of this it has been well said that the air is not like the smooth level floor on which the child learns easily to walk, but is full of various inequalities ever changing by action of unexpected and unforeseeable currents. Man has as much difficulty in getting accustomed to this condition as the child would have in learning to walk on a tumbled and perpetually changing surface. Much practice is done in many things—skating, riding, walking—in all of which there are falls. But in the air there is only one fall and it gives no experience that can be used.

A third difficulty is the difficulty of the start. How to rise automatically from the ground in the face of gravity in a machine heavier than air or how to dive as the birds do off a tree bough or the edge of a cliff, finding stability and velocity with immediate success.

A fourth difficulty concerns the wing. Birds use their wings for the double purpose of sustaining and driving their flight. The wing evidently requires to be of considerable area. But where is the mechanism that will convert so broad a sail into a flapping propeller? Take the wing of the albatross with its long bones and lock joint at the elbow, and its fine feather work at the end opening and shutting at will, and the minute detail of muscles ever efficient for their operation. Man wants such an instrument for his airship if he chooses wings, but the idea of setting about those details on the scale he requires and with the materials at his command is almost unthinkable from the practical point of view.

Some difficulties which acted as deterrents in former times were difficulties of ignorance now dispelled. It was, for example long held that the bones of birds are, like balloons, hollow and filled with hot air and it was concluded that no other sort of structure could be got to fly. It is true that the bones of birds are hollow, it is also true that the air in them is heated by the muscular exertion of the bird in flight. Michelet, the most charming and, in some respects, most correct of all the writers on ornithology, takes the view that a bird is a species of hot-air balloon, rising from the ground and supported in flight by means of hot-air cells in its feathers and bones. To examine this theory, take an albatross weighing 24 lbs., and treat him as of the bulk of a cubic foot—as a matter of fact his bulk is less—and let the whole of this bulk be one huge hot-air cell. What is the sustaining power of the enclosed hot air? At 60° F. it is 40 grains and at 100° it is *nil*! But the weight to be sustained is 24 pounds! The hot-air cell theory does not require any further mention.

The exaggerated notion of the power required for flight which long prevailed was another stumbling block for the aviator. It was taken for granted that the power to be provided for sustaining bodies must be very great, and thus the difficulty of the problem was increased by the consideration that power must be provided for sustaining as well as for propulsion. With this fancy Mr. W. P. Thompson, C.E., dealt very neatly in the year 1881 in a lecture delivered before the Liverpool Polytechnic Society. He said: "It is a common remark that a body falls at the rate of 16 feet per second, therefore we can easily calculate the power required to keep it in suspension. But suppose our smallest measure of time were three seconds. In three seconds a body falls 145 feet, or nine times what it does in one. A similar calculation on this datum would make the power, necessary to keep a given body suspended, three times as great as when calculated by the other datum. Therefore if the popular form of calculating this matter be correct, it depends entirely on the quantity of our smallest measure of time what power is exerted in keeping a given weight in the air, which is absurd. If, indeed, our smallest measure of time had been a period equal to a hundredth part of a second, half the false theories in regard to the enormous power required for flight would never have arisen. If a heavy body were allowed to fall for the hundredth part of a second, and then arrested; then let fall for another hundredth part of a second and then arrested as before, and so on for a hundred times, so that the body should have been free to fall during a series of periods unitedly equal to one second, it would have only fallen two inches, instead of sixteen feet, the distance it would have fallen in a single continuous interval of one second. If the period of continuity had been the thousandth part of a second, and there had been ten thousand of these periods, the total fall would have been the fiftieth of an inch and the power required to bring it back to its primary position, in other words, the power required to keep the weight in suspension would only have been the weight multiplied by the fiftieth of an inch per second instead of by 16 feet per second as is the usual calculation. Going a step further and arranging, as in the inclined plane moving at sufficient velocity, that there should be no fall at all in other words, continuous instead of intermitted arrestation, and no power is exerted in keeping the weight in suspension."

These demonstrations that bodies which are not balloons inflated with heated air can fly, and that it is not necessary to expend any power in keeping them suspended in the air at high velocities, bring the study of the problem of aviation within more reasonable limits.

Then there is the saying of Jules Verne of twenty years ago, that it is not necessary for imitation of bird methods to be servile, as for example locomotives are not copied from hares, nor ships from fish. To the first we have put wheels which are not legs, and to the second screws which are not wings.

This idea of the propeller suggested the avoidance of the difficulties of wing construction, and the sailing of the albatross suggested the aeroplane The combination of the two would, it struck many inventors, answer the two-fold purpose of the bird's wing. Moreover, the fact was well understood that the air is highly resistent—a parachute of a yard in diameter in practice not only impeded descent but made it isochronous On the other hand there was the kite, the plaything of generations · men had even crossed rivers, towed over by kites of which they held the strings. Science studied the kite. The result is given by the authority we have already quoted thus —

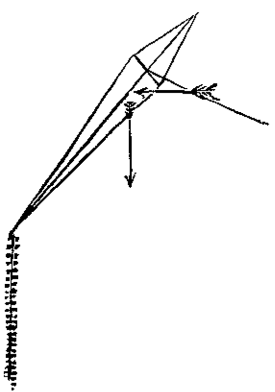


FIG 1.

" In figure I a kite is shown. The wind blowing against it in the direction of the horizontal arrow is deflected at the same angle. If then the kite be declined at an angle of 45°, the wind is deflected vertically downwards and the kite forced upwards with equal force. Referring to the diagram (Fig 2) let E F equal the weight of the kite in pounds, B D the force of the wind on the kite in pounds, A B or B F upward force caused by the rebound of the air; B C direction of string Completing the parallelogram we find an unbalanced power tending to raise the kite; the kite will therefore rise till the angle D B C, becoming more acute, the quantity B G increases until it and E F

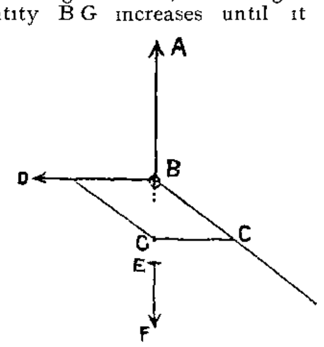


FIG 2

(dead weight of kite) become unitedly equal to B F (or A B), when the kite becomes stationary If, however, the wind lessens, the quantity B A diminishes, and the kite falls till the lessening quantity B G and weight of the kite E F again balance the upward force of the wind A B or B F. We see then as at an angle of 45 the wind is deflected vertically, and therefore gives the most lifting power, the tail ought to be weighted to such a degree as to cause the kite to stand at 45—that is, heavily in a high, and lightly in a gentle breeze Also that the nearer the thing approaches the horizontal the greater is the lifting power of the kite.

" Every one has doubtless played 'ducks and drakes' (*alias* throwing flat stones nearly horizontally over the surface of water) and has counted the number of leaps the stones have made before sinking into the water. All skaters, too, are familiar with the fact that a man can skate with impunity over ice that a boy could not stand on without immediately breaking through In each case velocity is a very important item; the skaters and the stones alike have not time to sink. A kite or plane traversing a *stratum* of air rapidly is supported in a similar way, not having time to displace each portion of the area traversed before entering a fresh portion

" Suppose a plane (A) slightly inclined moving rapidly in the direction of arrow B (Fig 3), the

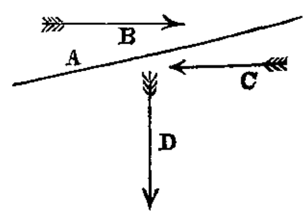


FIG. 3.

wind (arrow C), meeting the under surface of the inclined plane, is diverted downwards (arrow D), displacing the air below But air cannot be suddenly displaced without causing a great resistance, therefore if the plane goes fast enough the air forms an approach to a solid surface, like the water in the case of 'ducks and drakes'

" Now a solid projected through the air should present an edge or point to the air it cleaves, but if the planes of which it is composed have an uniform angle with the perpendicular, it makes little matter how these planes are placed. Thus A, B, C and D (Fig. 4) would have approximately the

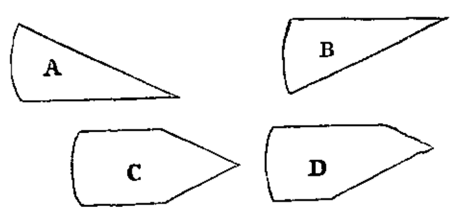


FIG. 4.

same resistance in cleaving the air point first. But A has a tendency to descend, B to ascend. If therefore we make a combination of these (C) it will be neutral, but it has, independently of its shape, a tendency to descend by force of gravity Let us therefore give a sufficiently great preponderancy to the lower slanting plane to neutralise the gravity, the result being D Now D thus weighed would require almost exactly the force to counteract the resistence of the given speed that A would destitute of weight We thus see that provided that we can alter the shape of the object at pleasure, at a high velocity, the amount of weight within certain limits causes little or no difference to the power required. How strikingly in this point the plane or kite differs as a means of keeping a weight suspended from the voluminous balloon."

There remains to consider the difficulty of making a machine rise as the bird rises for his flight. Take the albatross, which has to go some distance along the surface of the water before it gets up in the air How is a machine to be made to follow this example? The question was answered for the thinking by the analogy of the hydroplane They remembered that long years ago the Canadians constructed boats which did wonderful things on their big lakes; very strange craft of their invention beating everything that floated without being propelled by other than wind power That craft was called a "skate" It was a boat whose bottom was an inclined plane reduced to about one-third of normal width When sailing the skate showed a tendency to rise near to the surface of the water, and in strong winds with all sail set she actually did so skimming the water with a minimum of friction which enabled her to leave everything floating miles astern But the skate was, as may well be imagined a very dangerous craft, peculiarly liable to go over The advent of steam did not help matters, because while it made the craft safer by reason of the absence of sails, it dragged its propeller and therefore lost the superior speed For these reasons the "skate" went out of favour But its principle remains to give hints to the aviators Several of the competitors for pride of place in the invention they are seeking with such ardour have solved the problem of making their machines rise up from earth by provoking the resistance of the air.

The wing difficulty brings another in its train The question of that is raised by the question of the necessary length of the wing An albatross weighing only 24 lbs. has wings about 12 feet from tip to tip Therefore a man weighing 144 lbs ought by analogy to have wings each 36 feet long or 72 feet in all as shown in the diagram; and a flying-machine weighing 12 tons to take an extreme case by way of extreme illustration would require an extent of wings of $2\frac{1}{4}$ miles from tip to tip The difficulty has been faced and in one case met by a proposal to supply machines with a row of wings on each side horizontally placed one behind the other, copying nature in fact after the example of many insects. In support there is also the analogy of the long flights of the migratory birds which arrange their flights so that the birds fly in single file In this case the air compressed by the first wing rebounding upwards forms a firmer cushion for the succeeding one to act upon, until there is set up an advancing wave and an induced current The proposers of this expedient, however, admit that some sort of parachute arrangement would be required, capable of expansion, at need "to break the fall" The difficulty is lessened by the further consideration mentioned above that but little power is required after sustaining the body in the air in comparison with the power wanted for propelling at speed. Still as some provision must be made for the sustaining power, after the fashion of the kite, and that provision must bear some relation to the weight to be sustained, the difficulty raised by the length of the wing which acts both as sustainer and parachute is considerable The power required for sustaining is estimated at something like the ninth part of a horse-power for 10 tons. Still the kite or parachute effect must be attended to. In practice nearly all the recent experimenters in aviation who have got their machines to rise off the ground have found that when they return to earth after their brief flights there is a great and sometimes disastrous tendency to bump.

Science has proposed to get over this difficulty by the use of horizontal screws This was the theory on which Jules Verne relied for the support of his renowned "Clipper of the Clouds." Pettigrew, the well-known authority, describes a model which developed later into a favourite toy. It was a plane provided with two vertical axes, each carrying a horizontal screw These screws being set revolving in opposite directions displace quantities of air above the plane, which cause a resistance of the rest of the air in the neighbourhood, forcing the plane upwards. The toy made on this principle was operated by clockwork, which at once set the screws revolving and set up the machine The gradual expenditure of power caused the upward movement to become slower until it ceased, after which the power sufficed to retard the descent till the machine returned without harm to the earth One or two inventors have experimented in this direction. Others have preferred the use of a tail arrangement for the vertical steering

In theory such a use of power (the double horizontal screws) would maintain equilibrium without fail and automatically. In practice the pressures from without would have to be taken into account. There are two centres in practice · the centre of gravity and the centre of pressure. The problem that so baffles aeronauts is the problem of reconciling these pressures, so to speak, and keeping them friendly In some thousands of gliding experiments some experimenters have managed to adjust the balance by shifting their own weight in one direction or another as need arose. There were many disasters, and besides, when working on a large practical scale, such adjustment is obviously impossible some mechanical expedient is needed, and it is imperative that it should have automatic action Some inventors of to-day make express admission to that effect

These were the devices for overcoming the supposed natural law of the proportionate wing surface, which discouraged invention so greatly by its reduction to the absurd. The true answer, however, was soon found It is that there is no such law. The natural fact, demonstrated by many measurements, is that the greater the creature supported in the air, the smaller the relative supporting force.

Mr. Langley, the American experimenter who built a flying-machine in 1896 which actually flew over half a mile, collected figures from which he obtained the following approximate results

Machine with 54 sq. ft. wing sustained 30 lbs. using $1\frac{1}{2}$ h p

Pterodactyl, extinct flyer, with 25 sq. ft. wing sustained 30 lbs weight, using 0.05 h.p.

Condor with 10 sq ft wing sustained 17 lbs. weight, using 0 05 h p

Turkey Buzzard with 5 sq ft. wing sustained 5 lbs. weight using 0 15 h p.

Pigeon with 0 7 sq ft wing sustained 1 lb. weight, using 0 012 h p

Humming Bird with 0.03 sq. ft wing sustained, 0 02 lb weight, using 0 001 h p

On these figures he remarked "particular attention is to be paid to the fact that, regarding the ratios of supporting surface to weight supported, these ratios are not only not the same in all the birds, but themselves differ greatly, but systematically, with the absolute weight" If we enquire how much one horse-power would support for instance supposing the ratios of sustaining surface (i e wing area) to weight to be constant, we find that one horse-power will support in

The Machine 20 lbs. with 36 ft. of area or $1\frac{3}{4}$ sq. ft. to the pound.

Wild Goose 340 lbs. with 101 ft of area or 0.29 sq ft. to the pound.
Pigeon 83 lbs. with 58 ft of area or 0.7 sq ft to the pound.
Humming Bird 15 lbs. with 26 ft. or area of 1.73 sq. ft. to the pound.
assuming the three latter to preserve the same relations on an enlarged scale.

So that, broadly speaking, so far as these few examples go, the larger the creature the less relative surface and power needed for its support

From the obvious mathematical law that the area of bodies in general increases as the square of the dimensions, while their weight increases as the cube, it is an appreciably plain inference that the larger the creature or machine the less the relative area of support may be (that is if we consider the mathematical relationship without reference to the question whether this diminished support is actually sufficient or not), so that we soon reach a condition where we can not imagine flight possible

But this apparently mathematical consequence is not the law of Nature, for while it is found that in the larger bird a smaller area for each pound of the weight is given under the law than in the smaller bird, it is also found (what is another thing) that this smaller area is nevertheless sufficient, and that from the mathematical law just cited there does not follow the apparently obvious consequence (notable in the larger creatures like the condor, perhaps less notably in such a creature as the pterodactyl) that the bird cannot be supported While the fact is certain, the cause does not s em too clearly known.

This anomaly was first noticed by M Lucy a French observer in 1868, whose tables may well be quoted in support of the above conclusion

Square feet of wing surface per pound of weight

Insects.	
Gnat	49
Dragon Fly	30.00
Ladybird	26.60
Dragon Fly (common)	21.60
Tipula (Daddy Longlegs)	14.50
Bee	5.25
Meat Fly	5.60
Drone	5.08
Cockchafer	5.15
Stag Beetle (female)	4.66
Stag Beetle (Male)	3.75
Rhinoceros Beetle	3.14
Birds.	
Swallow	4.82
Sparrow	2.72
Turtle Dove	2.13
Pigeon	1.25

Mouillard's table (in *L'Empire de l'air*) may also be quoted —

	Weight lbs.	Sq ft of Wing surface sq ft	Wing surface per lb.
Screech owl	0.33	0.776	2.35
Sparrow hawk	0.336	0.69	2.05
Black owl	0.619	0.92	1.49
Goshawk	0.641	0.84	1.31
S. owl	0.67	1.50	2.24
Glossy Ibis	0.806	1.24	1.54
Raven	1.34	2.50	1.87
Kite	1.41	3.02	2.14
Fish hawk	2.80	3.01	1.08
Scavenger vulture	3.83	3.65	0.95
Turkey buzzard	5.6	5.33	0.95
White pelican	6.66	6.32	0.95
Flamingo	6.34	3.50	0.55
Griffon vulture	16.52	11.38	0.68
Condor	16.52	9.80	0.59
Eared vulture	17.76	11.90	0.68

Dr. Lendenfeld in 1904, writing in the periodical *Naturwissenschaftliche*, adds his testimony with a table in which the albatross figures at 67 square millimetres of wing surface to the gramme of weight, the Laughing Gull at 336, and the gnat at 10,000.

It is interesting to note that the same authority worked out a table on that occasion from which it appears that a man of ordinary weight (90 kilogrammes) can be supported in the air by two wings "furnishing together 2.7 square metres of surface" Compare this with the indispensable 72 feet spread of the judgment by analogy.

The above table exhibits the same paradoxical law that the greater the creature the smaller the relative supporting force This is now known as Langley's law and accepted Before definitely coming to the conclusion himself Mr Langley made long and patient investigation For the test he installed an apparatus consisting of "a whirling table of unprecedented size mounted in the open air and driven round by a steam engine so that the end of the revolving arms swept through a circumference of 200 feet at all speeds up to 70 miles an hour. At the end of this arm was placed the apparatus to be tested and, among other things, this included surfaces disposed like wings which were hung from the end of the arm and dragged through the air till its resistance supported them as a kite is supported by the wind One of the first things observed was that if it took a certain strain to sustain a properly disposed weight while it was stationary in the air, then not only to suspend it but to advance it rapidly at the same time took less strain than in the first case A plate of brass weighing one pound, for instance was hung from the end of the arm by a spring which was drawn out till it registered one pound weight when the arm was still. When the arm was in motion with the spring pulling the plate after it, it might naturally be thought that as it was drawn faster the pull would be greater, but the contrary was observed, for under these circumstances the spring contracted till it registered less than one ounce When the speed increased to that of a bird the brass plate seemed to float on the air, and not only this, but taking into consideration both the strain and the velocity, it was found that absolutely less power was spent to make the plate move fast than slow, a result which seemed very extraordinary, since in all methods of land and water transport a high speed costs much more power than a slow one for the same distance"

These experiments were continued for three years with the general conclusion that by simply moving any given weight of this form fast enough in a horizontal path it was possible to sustain it with less than one-twentieth of the power that Newton's rule called for

Langley's final remark was "The first stage of the investigation had shown how much or rather how little power was needed in theory for the horizontal flight of a given weight" Obviously the next stage to be entered upon would be to show how to procure this power with as little weight as possible, and having it how by its means to acquire this horizontal flight in practice In other words, how to acquire the art of flying He indicated the line. A kite in a calm, when sinking for want of sufficient wind to keep it flying, may be restored by a strong pull on the cord of control Place the pull on board the kite and you will see the kite fly The stronger the pull and the quicker the motion, the heavier the kite may be made.

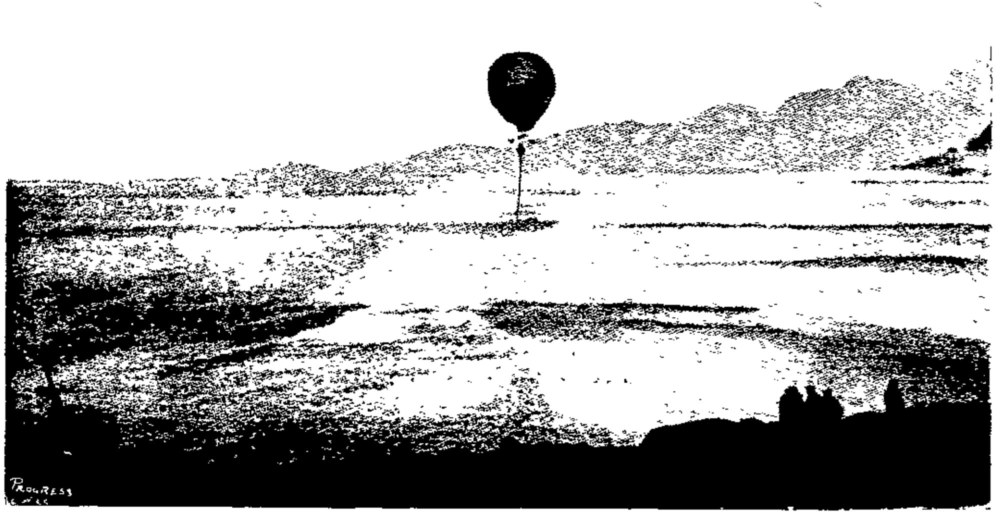
Such are the conditions of flying It is established as beyond doubt that this is the easiest form of locomotion The flight of an eagle has been measured by two theodolites set on an accurately measured base line at 100 miles an hour, pigeons have been known to fly at a rate of 80 miles an hour from Cologne to Paris. Sea gulls and albatrosses keep up a flight of from 12 to 20 miles an hour for days as they circle round a ship, butterflies and insects scarcely eat anything in the perfect state, yet are they ever on the wing No land animal could journey from Cologne to Paris without stopping, at any pace at all, let alone the tremendous speed of these carrier pigeons, whose flight is marvellous, however much may be allowed in the way of assistance from gales of wind. As for the other feats of the birds above mentioned, which are their ordinary habits, such achievements are unthinkable in the case of any land animal. Add the story as authentic as astounding, of the albatross caught one day in the Southern Ocean and liberated with a record label, and recaptured twelve days later at a point 3150 miles distant from the point of liberation. If that bird flew straight he averaged nearly 11 miles an hour for every hour of the time But he had to range for his food and to sleep, and probably flew double the distance. What does it mean except that far less power is exerted in flying than in running? The air is the more penetrable element in comparison with water, as is proved by the bullet which is stopped by water but flies freely through the air. But what shall be said of the difference between the results of earth and air travel? That brings us back to the starting-point of this article namely the saying of a distinguished aeronaut, one of those perhaps destined to solve the problem of flight, in our time, that the air is waiting to be harnessed to the behests of man. The birds of the air, by making use of the resistance and the other properties of their element, have done the harnessing for themselves

Having thus indicated the difficulties of the problem and reviewed some of the main principles involved, we pass on to the history of the struggle of man for its solution, by the use of machines which, like the birds that fly, are heavier than air The Duke of Argyll said "We all know that a bird is never buoyant. A bird is immensely heavier than the air. We all know that the moment a bird is shot it falls to the earth, and it must necessarily do it, because one of the essential mechanical principles of flight is weight, without which there can be no momentum, and no mature force capable of moving through atmospheric currents"

THE STORY OF ANDREE AND HIS BALLOON.

The fruitless expedition of the Andree balloon ended the career of the round balloon begun a century before by Montgolfier. Therefore the right place for the story of the former is between the chapters devoted respectively to the balloonists and the aviators.

Andree, who conceived the idea of reaching the North Pole in a balloon, was a Swedish civil engineer of considerable ability and determination, who had paid great attention to aeronautics and become very proficient in the art During his experience of three years of flying over Sweden, Norway, and the Baltic, he had brought to some perfection—as far as it went—his idea of steering balloons by means of guide ropes trailing on ground or water, astern. When he determined to apply the new system to the navigation of the Arctic ocean, no difficulty was found in raising the funds, M Nobel and three others subscribing between them the necessary £7000. The project was simplicity itself A balloon was to be constructed of extra strength with a buoyancy of some two months; it was to be provisioned for several months, provided with collapsible boat in case of accidents, inflated with gas (hydrogen) at some point near the Arctic circle, wait for a south wind, and sail off. What next, was left vague Before the balloon there would be (after the Pole) Greenland, Alaska, and Siberia. If fate took them to the tremendous ice-cap of the first it would be certain death to all But Andree reasoned that the numerous glaciers of this region, quickly cooling the air about them at sea level as they do, always produce air currents in the lower planes radiating outwards in all directions, and as it was proposed to keep the balloon within 300 feet of sea level, there was no danger of a compulsory journey to the inhospitable shores of Greenland The choice would be, therefore, between Alaska and Siberia. With good luck the balloon might one day find itself sailing through the Golden Gate with the whole population of 'Frisco staring agape, with bad it might be landing in the midst of the swamps of the uninhabitated part of eastern Siberia The balloon was prepared to float in the air for fifty-five days. A good deal might happen in fifty-five days. And a good deal did. It is only part of it that we know. The rest—shall we

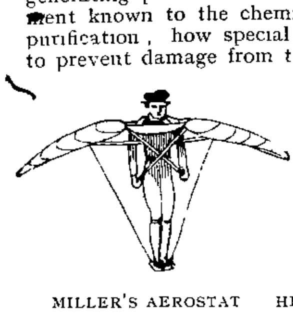


ANDREE'S DEPARTURE FOR THE NORTH POLE

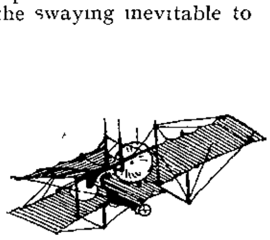
ANDREE

know it before Ice pack and Tundra give up their dead?

The balloon was made of Pongee silk, of a capacity of 176,582 cubic feet Most of this material was used in fourfold thickness and all was of more than double the strength—as tested by the Nordenfelt company's engineers—stipulated for by the careful aeronaut Provided with an envelope for protection against the snow, with all seams made stronger, by a special cement, than the material itself of the balloon; with valves of improved design, and a great tearing rent for emptying the balloon rapidly in case of accidental dragging, with guide ropes trailing astern and giving control within fair limits before the wind, and a car and platform below carrying four months provisions and arms and ammunition, which Andree used to refer to in his optimistic way—no one but an optimist of the most inveterate would have undertaken such a venture—as "an unlimited supply of concentrated meat,"* this balloon was the strongest and the best equipped the world has ever seen There is only one thing more amazing than the truly amazing prudential genius shown in every detail of its design and execution. It is that the possessor of such an abnormal gift of wariness should have trusted himself to a south wind in a region where a south wind is the rarest thing. It was not for want of warning of the fact, for the whole summer of 1896 was wasted at Danes' Island near Spitzbergen, waiting for the southerly which never came. It was not till the next season that the aeronauts got away, and then not till July, when most of the season had gone by—so capricious are the winds from the south in that quarter of the world How in that second season the balloon was got once again to the starting place, how with its weight and bulk it was safely navigated by the intrepid sailors of the Swedish navy through the rough waters and the ice floes between the ship and the landing-place, how the shed built for it the previous season was renewed, how the gas generating plant was set up with every improvement known to the chemistry of the time for its purification, how special precautions were taken to prevent damage from the swaying inevitable to



MILLER'S AEROSTAT 1843.



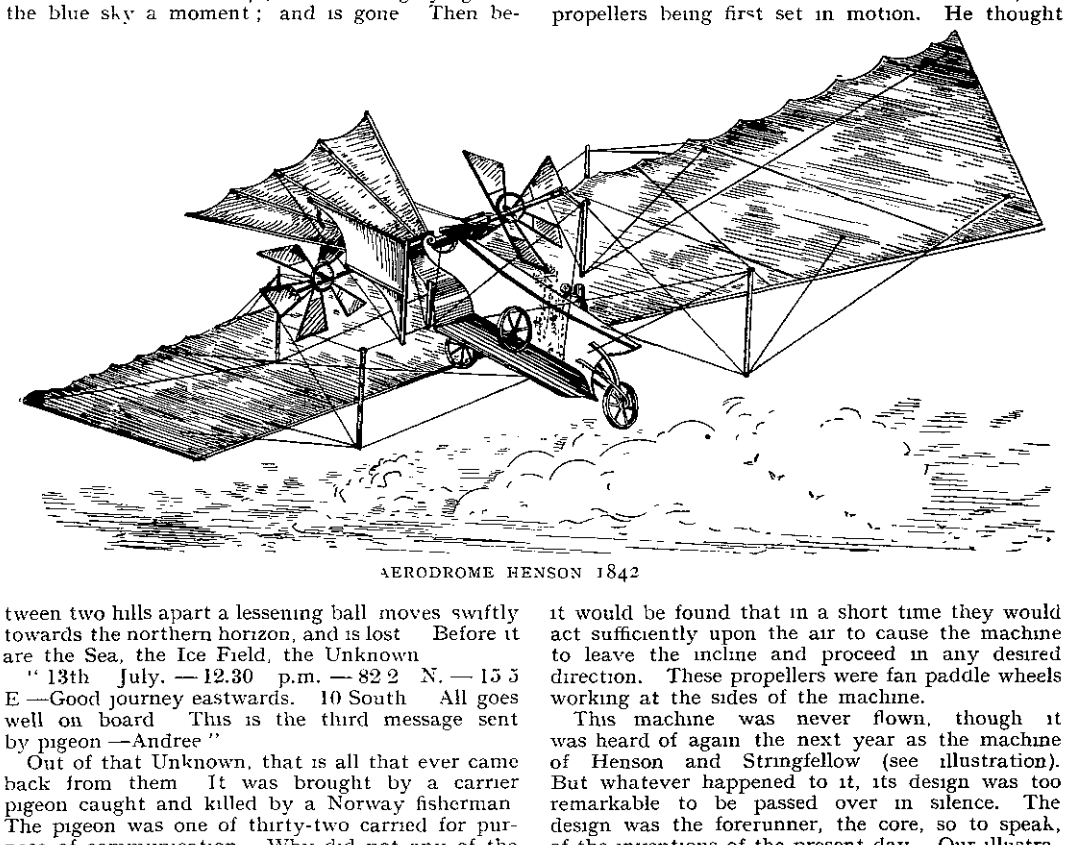
HENSON AND STRINGFELLOW (AERODROME) 1843.

so great a mass while being let out of its cover, and how at last it was launched, all this would take too long to tell. The representative of Lachambre, who built the balloon, was there and has told the story in warm and earnest words.

It was the 11th of July 1897 Andree had been all the morning considering the weather with the wind blowing fresh from the south Would it last? He decided in his own mind that it would. He left it to his two companions to say what they thought of it, the case being too serious for any interference with their unfettered discretion They thought it would last There was a scene at parting Friends shaking hands, the travellers leaving last words for loved ones far away, tears were falling, voices trembled In the midst of it the voice of the commander was heard "Strindberg! Volkmar! Let us go" The three aeronauts took their places, on the platform under the straining balloon tugging at its ropes The decisive moment had come

"One! Two! Cut!" cries the commander in Swedish The seamen cut the ropes and the balloon rose majestically, sailing out of the shed. The first peril was in the very gateway A gust of wind descended upon them from the mountain and the balloon, being encumbered with ropes, did not rise any further, and presently was seen to be rushing down towards sea level The sailors hurry to the boats for a rescue which they think is imperative Fortunately the balloon slows down, just touches the water, and, rising up once more, sails off "The balloon at an altitude of 164 feet," it is the narrative of the builder, who is watching the behaviour of his craft, "speeds rapidly away The guide ropes glide over the water, making a very perceptible wake which is visible from the starting-point like the track made by a ship We exchange last signals with our friends Soon we can no longer distinguish them, but we see that they are setting their sails on the bamboo mast There is a change of direction the balloon is travelling straight to the north at between 18 and 22 miles an hour. If the wind hold they will be at the pole in two days."

There was a line of hills in the distance between the explorers and the Pole The balloon travelling steadily on clears the top, stands out grey against the blue sky a moment; and is gone Then between two hills apart a lessening ball moves swiftly towards the northern horizon, and is lost Before it are the Sea, the Ice Field, the Unknown



AERODROME HENSON 1842

"13th July. —12.30 p.m. —82 2 N. —15 5 E —Good journey eastwards. 10 South All goes well on board This is the third message sent by pigeon —Andree"

Out of that Unknown, that is all that ever came back from them It was brought by a carrier pigeon caught and killed by a Norway fisherman The pigeon was one of thirty-two carried for purpose of communication Why did not any of the others bring a message? They would have had to fly 1600 to 2000 miles Pigeons do not fly so far as a rule but a pigeon in 1905 started from a point in Alaska for San Francisco, and was picked up in an exhausted condition at Havre, in Montana, 3100 miles distant These no doubt perished in the northern wastes All we know of the expedition is that on the third day out the treacherous south wind had left it travelling east in the desperate hope of a change to better conditions How desperate, we may judge from the fact that the travellers who had nothing else to rely on knew that they had waited in vain a whole season the year before for a south wind R I P

HENSON'S FLYING MACHINE

The thing most noteworthy about this invention is its date It was patented in the year 1842 The fact will considerably astonish those who have followed the preceding description of the laws governing the flight of bodies heavier than air Henson anticipated nearly everything in the way of principle though in detail he was as far behind as one might expect from one who, besides living half a century ago, did not bring his invention into practice Here is his own description, taken from the records of the Patent Office "If any light and flat or nearly flat stone be thrown edgewise in a slightly inclined position, the same will rise in the air till the force exerted is expended, when the article thrown will descend; and it will be readily conceived that if the article possessed in itself a continuous power or force equal to that used in throwing it, the article would continue to ascend so long as the forward part of the surface was upwards in respect to the hinder part, and that such an article, when the power was stopped, or when the inclination was reversed, would descend by gravity only, or by gravity aided by the force of the power contained in the article, if power be contained, thus imitating the flight of a bird."

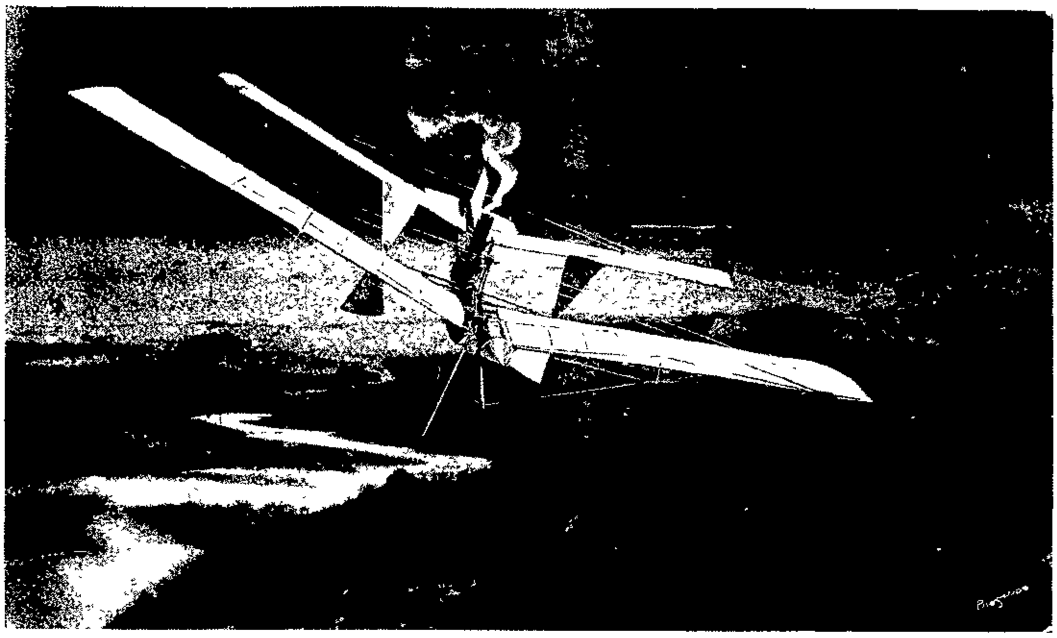
The machine (see illustration) was designed to represent a bird with wings and tail. The bird's body was a car carrying a steam engine of 40 h.p. the wings were outstretched above the body, each made of a light strong framework of bamboo or other wood hollowed, covered with oiled silk, and the tail was arranged for raising or lowering the plane of flight The wings were carried on two masts rising out of the car and braced to them, "making the whole one trussed beam of light construction." To supplement the steering of the tail, which was to act vertically only, there was a vertical rudder to do the lateral steering. The function of the wings was confined to that which is performed by the wings of the bird, when it is skimming through the air at speed, and they were to exercise a retarding power in descent after the manner of the parachute The inventor, however, relied entirely on the tail action for bringing the machine down at such a flat incline that impact with the earth would be entirely without shock. For starting the machine he preferred an inclined plane like the side of a hill, and he proposed to allow the machine to run forward down the incline, the propellers being first set in motion. He thought it would be found that in a short time they would act sufficiently upon the air to cause the machine to leave the incline and proceed in any desired direction. These propellers were fan paddle wheels working at the sides of the machine.

This machine was never flown, though it was heard of again the next year as the machine of Henson and Stringfellow (see illustration). But whatever happened to it, its design was too remarkable to be passed over in silence. The design was the forerunner, the core, so to speak, of the inventions of the present day. Our illustration is from the copy supplied by the inventor to the Patent Office.

LANGLEY'S AERODROME, 1896.

This machine, the name of which signifies the runner of the air, as seen in the illustration, bears a resemblance to the flying-machine of Henson, which was patented fifty-four years earlier. It was the outcome of the experiments of Langley which have been detailed above, and it was several years in the hands of the inventor before it could be trusted to the air. Langley began with kites and proceeded gradually to the complete model. Very many attempts to fly the latter failed on account of the difficulties of launching Fortunately the launching was done overwater, for which reason the machine never sustained any damage in its numerous falls Finally it was launched from a house-boat in a secluded part of the Potomac River 20 miles from Washington, from a height of 20 feet Dr. Graham Bell was present and took an instantaneous photograph of the flight that followed He described it as rising steadily in half circles of about 100 yards in diameter and flying at the rate of 25 miles an hour, under direction

* Nansen left the *Fram* with three months' provision and lived on the ice for sixteen months on the above "concentration."



LANGLEY'S AERODROME

of the rudder which was set to follow the course of the stream below This was done and only a short supply of steam given, for fear the model might fly off and lose itself, or get disastrously damaged, in the Virginian forests After half a mile the steam gave out and the machine settled gently down to the water level, was picked up uninjured and repeated the flight, this time not circling so much.

This was in 1896, in which year Dr Bell's description and photograph became famous throughout the world. So well satisfied was that authority that he declared that the model had solved the problem of flying so completely that it only required the efforts of practical men with the command of money to carry it to practical working conclusion. The model, as seen in the picture flying, weighed 30 lbs., one quarter of which weight was contained in the engines and machinery—which was of unexampled lightness Within the small body suspended, as seen in the photograph, under the rod, was contained everything for generating 1¼ brake h.p. the total weight of boiler, grate, and all accessories (including funnel) coming to less than seven pounds The engine weighed 26 ounces This moved the propellers, which, turning at 800 to 1000 revolutions, drove the ship at a speed varying according to the inclination given to the motionless wings It was found in practice that the power required diminished indefinitely with the increase of speed The wings were fixed aeroplanes, two on each side, and there was a rudder of special design which did both the lateral and the vertical steering The machine could have flown much farther in fact, from its performances there was no reason to doubt (the inventor said) that it could not have flown for an indefinite period Its short flight was only due to the necessity for preventing its straying away over the land and into the forests

SANTOS DUMONT

In the next illustration the famous Brazilian aeronaut is seen in the flight which drew from the *Figaro* the enthusiastic words quoted at the opening of this article We publish the illustration to-day to complete the series of recent flyers. In our next we propose to describe the performance of the machine, while completing the story of ballooning to date

(To be continued.)

Trackless Trolley-Car.

The trackless trolley is a French and German novelty which is offering serious competition to the regular lines. The advantage of such a motor-car lies in the saving of the cost of track laying and maintenance. In Germany the construction of a two-mile trackless trolley line costs but £7,000, as against £17,500 for the regular system between the same points. Moreover, in country districts having good roads, the trackless trolleys perform a service in the marketing of farm products that the track lines cannot do. The cost of operation is low In winter the energy required for a distance of some 28 miles is said to be about 40 cents per car, considerably less than with the usual track lines The rate of speed is about 5½ miles per hour. The trackless trolley is almost impracticable, however, where the road surface is much broken by ruts or other irregularities.

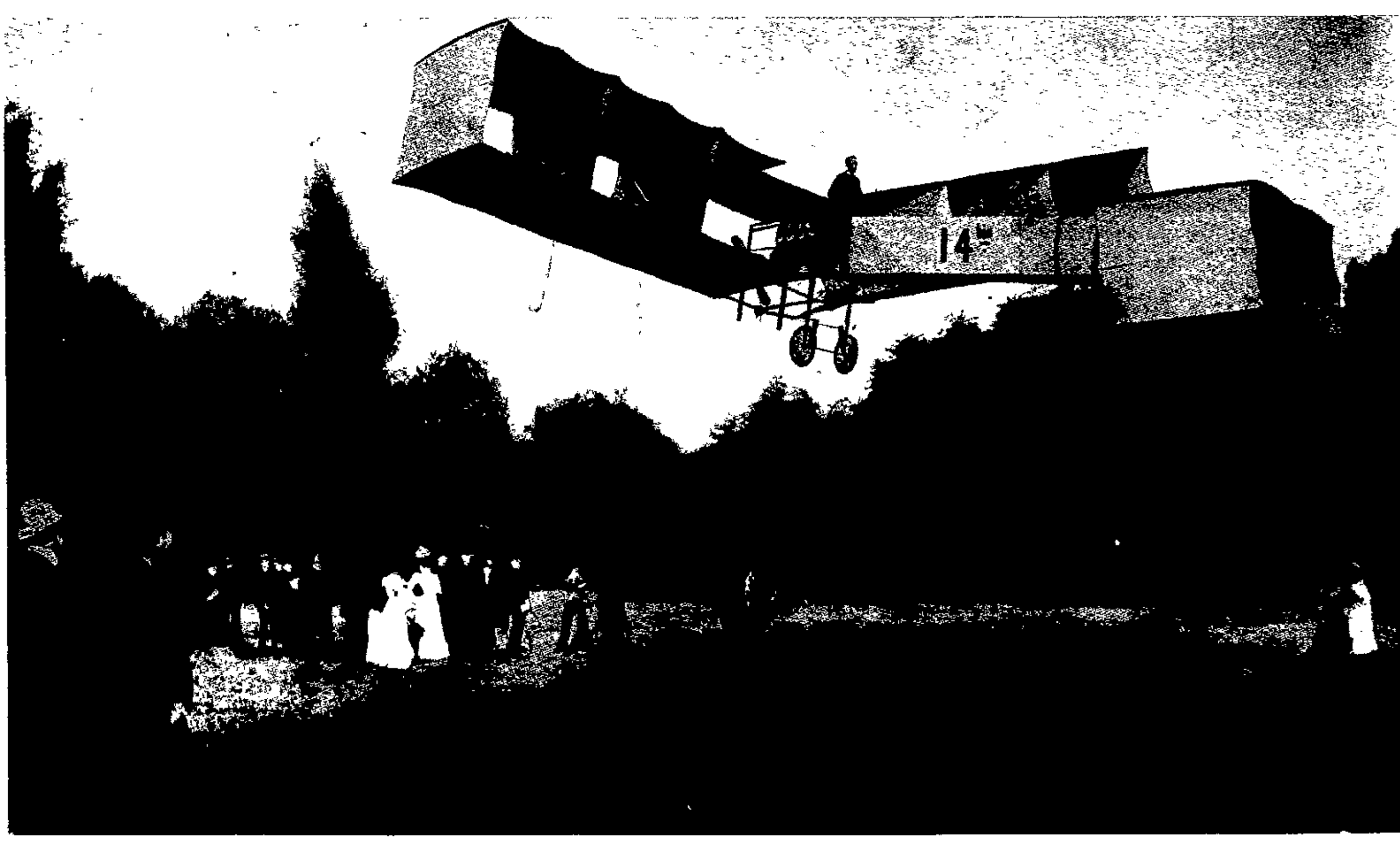
New Way to Waves.

For electricity still another use has been found—namely, in the launching of vessels. The British battleship *Agamemnon*, recently launched, slid to the water by this new method. A series of interlocking levers were connected with the electrical arrangement. The Countess of Aberdeen, who performed the ceremony, turned a wheel which controlled the apparatus, thus closing the circuit and releasing the triggers that held the man-of-war on either hand The time occupied by the ceremony was very brief. From the instant the Countess put her hand to the wheel, to the ship's clearing the ways, was a matter of but one minute and fifty seconds.

To safeguard against the contingency of the vessel's not starting of herself, powerful hydraulic rams were placed one on each side of the vessel. No use was found, however, for either of these

Wood Conquers Stone.

Not even rocks can withstand the gentle but persistent and resistless force put forth by Nature in her processes of plant growth A remarkable instance in evidence of this may be seen near the city of Waterbury, Conn., where a large, sturdy oak tree has performed the unusual feat of bursting its way through a thick stratum of rock. The tree appears to be growing directly on top of the stone, in fact, the pressure exerted by it when growing was sufficient to rent the rock apart



SANTOS DUMONT FLYING, IN THE "BIRD OF PREY.

Our Industries.

No. XII.—THE WELLINGTON WOOLLEN MANUFACTURING CO., Ltd.

THERE are changes in contemplation in the working of the woollen mills of the colony, changes for the better which the public feels much concern in The public is therefore very much interested in the business of the institution which flourishes so well at Petone. A few words about that institution will, then, not be out of place at the present moment

The foundation stone of the mill was laid by Sir Robert Stout during his premiership of the colony, on the 28th of November, 1885. The institution has therefore reached its majority. On that occasion many things were said of the future prosperity of the institution which the managers can honestly declare, after twenty-one years, have been fulfilled.

For example, in 1903 the demand for worsted goods was so great that the directors were compelled to erect a worsted mill, which, with new engines, boilers, etc., cost £36 084. The plant, buildings, etc., stated in the last balance sheet at £68,263 8s. 9d., have been written down by £42,000, while their maintenance in an efficient state has been charged to working expenses. When it is remembered that £36,084, or just 53 per cent. of the total plant, etc., is new, being added since late in 1903 (and not worked for many months afterwards), the satisfactory position of the company's property asset is more clearly perceptible

Also included in the above £68,263 8s. 9d. is the land at Petone, some 18 acres, standing in the books at original cost of £2409, although as a matter of almost common knowledge its value has increased enormously Shareholders have received in dividends since 1889, £68,511, or only £11,489 short of the capital called, while £6765, the amount previously written off the then allotted shares, has been restored

Although so large a sum has been written off the property, and no account taken of the increased land value at Petone, the reserves and undivided profit amount to £24,018. The assets at July 31st last totalled £168,982 7s. 7d. after being written down as stated, as against a debt of £60,000.

A notable event in the history of the company was the visit of the Duke and Duchess of York to the company's premises in 1901. On that occasion their Royal Highnesses were much surprised to see so flourishing and up-to-date an establishment so far away from the centres of the wool industry at home It is a feeling shared by all who pay the works a visit.

Before visitors reach the place the well proportioned graceful chimney, the best of its kind in the colony, strikes their attention, preparing them for one of the best equipped and largest woollen and worsted mills in New Zealand Two gigantic Lancashire boilers, 30 feet by 8, tested to a pressure of 340 lbs, fitted with every appliance up to date for economy and efficiency, give steam to the new engine, 500 h p, which has replaced the old one of 240 h.p This is of the horizontal tandem Corliss condensing type. It is fitted with all the latest improvements, including an electric stop motion which can be operated by the youngest employee from any part of the mill, in case of accident, bringing the engine to a standstill instantly. The fly wheel is 16 feet in diameter, weighs 16 tons, and makes 75 revolutions a minute. The power is transmitted by 14 driving ropes. The main fact about this engine, as the men say, and they are the people to appreciate (or they work her every day, is that "she is built like a watch." In this connection there is a new fire pump of a capacity of 80,000 gallons per hour which represents a fire system comprising everything necessary in the shape of pumps, hoses standards, etc., for the safe keeping of so large and valuable a concern

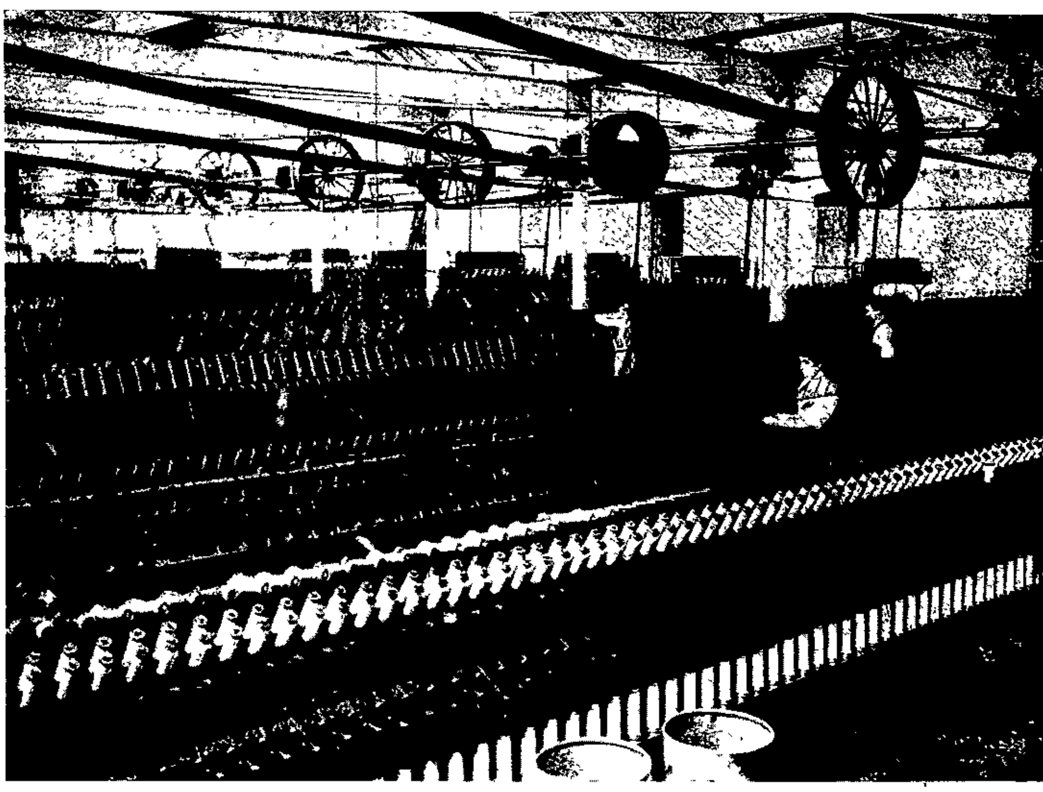
The wool arriving is stored in the wool shed There the sorters divide it up into the sorts required by the manufacture, and send it on to the scouring shed. The scouring process is automatic, the wool being placed on a tray at the entrance and sent going through numbers of troughs, from the last of which it emerges snow-white. Washed to the perfection of cleanliness and brightness a most necessary thing in wool, it is passed on, automatically also, to the drier. This is a patent continuous drying machine, heated to a heat of 180 degrees, which impels the travelling wool through many stories one after the other with a regularity most conspicuous, finally driving it through a hot-air blast, driving it through three compartments before delivering it at the far end dry and in the best condition.

After scouring, dyeing, unless wanted in white state. First the wool is worked through baths of bichrome, in preparation for the dye, which it duly gets in the proportions decided upon by the operator. When dyed it falls into the embrace of a hydro-extractor, which whirls it around until every drop of moisture is extracted, it then goes to the "Willey," known to the trade as "the Devil." This opens up the wool and removes any stray particles of dirt which may have been overlooked by the cleansers, blending and oiling is done at this stage, and the wool is then put through the teaser and made ready for the carder

The worsted mill is a room 244 by 88 feet beautifully lighted with Helliwell's patent sky-lights Business begins in an automatic feeding and weighing attachment it goes on upon a table on which the wool is placed ready for rollers which draw it through at a regulated weight, and pass it on after various delicate operations to the carding machine Finally it is reduced to "sliver," passes in that state through various machines more or less intricate, and at last, after back-washing gilling combing, drawing, spinning, roving, and a host of other processes too numerous to mention is changed into yarn ready to be woven

One of the processes is combing It is interesting enough to have a special description to itself The comb is a circular machine of wonderful construction, and its duty is to separate the long staple wool from the short staple, which it does in a most bewildering manner and is a wonderful illustration of what ingenuity can do After the wool is treated in this room by the foregoing machines this ends the process of worsted yarn making, and the subsequent treatment is the same as for woollen goods

On the woollen side the processes are somewhat similar except that the wool is scribbled and carded and condensed into threads, instead of combed.



WORSTED SPINNING.

And the most interesting of all the processes is the spinning done by self-acting "mules." After spinning, the wool is twisted, in special "twisting frames." Spun and twisted, the yarn is ready for the warper and weaver. To see the girls and women starting the looms, stopping them, working amongst them with the utmost cheeriness and unconcern, is an experience of things marvellous. The woven product is passed to the "burlers." These are girls, armed with tweezers and other instruments, whose duty it is to look over the fabric and pick out foreign matter, or remedy any faults there may be. In this department one sees heaps of tweed, flannel, blankets and rugs (there is no finer rug than the Petone) waiting for the attention of the "burlers." The blanket whipping machine is a simple but ingenious invention, which puts the coloured binding on the blanket edges at a rapid rate.

After the "burlers" comes the "milling"; this washes and shrinks the fabric, sending it on to be "finished," a work consisting of a marvellous medley of processes, raising. cutting, brushing, pressing, and rolling. There is incidental to the finishing processes a hydraulic hot press capable of a pressure of 3 tons per sq. inch. It puts what is called the "high gloss" on tweeds, ending the manufacture. All this turmoil ended, the finished fabric enjoys the rest of the warehouse where it is packed and ticketed and made ready for beginning life as a manufactured article. The rest of its history does not belong to this department.

Hard by, in the same building, is the Knitting Department, where all sorts and conditions of knitted goods are made. You will see lying around the best samples of stockings, socks, jerseys, sweaters, bloomers, and a host of other things, well known in the hosiery trade. The machines are the very best procurable for the manufacture of these garments, and the foremen here, as throughout the mill, are all experts, most of them specially imported from the old country.

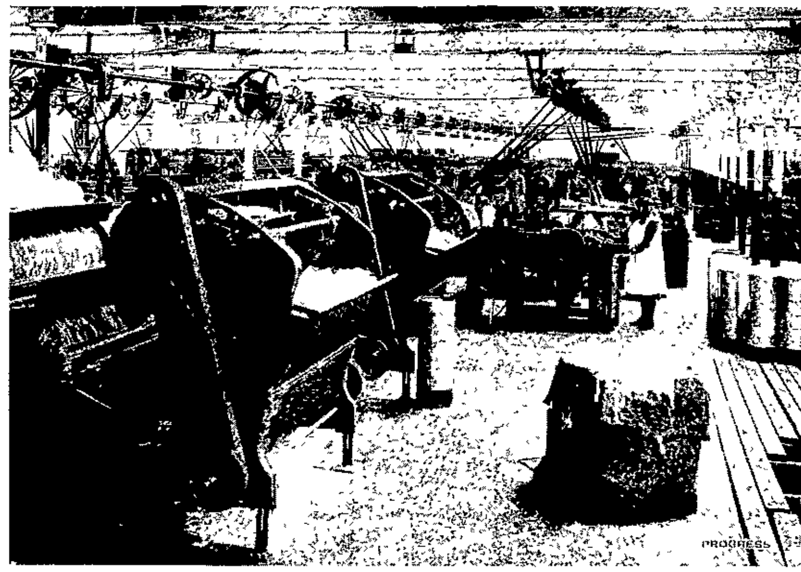
In addition to the 240 hands employed, more girls and boys could be put on, but this class of assistance is hard to get. Much of the work is only suitable for girls, the male fist being considered too large and clumsy. The mill outbuildings and residences stand in 12½ acres, which the mill manager says he hopes to see entirely covered by buildings before many years.

The company's head office and warehouse are in Wellington, where there is also a clothing factory for the making up of the company's tweeds, etc. into garments. In Wellington there are some 200 hands engaged, so that the Wellington Woollen Co is no small factor in the lives of our work people. It is surprising to see the variety of goods displayed by the firm The flannels, blankets, rugs, tweeds, hosiery and clothing are fit to compete in any part of the world The tweeds now made at Petone are second to none.

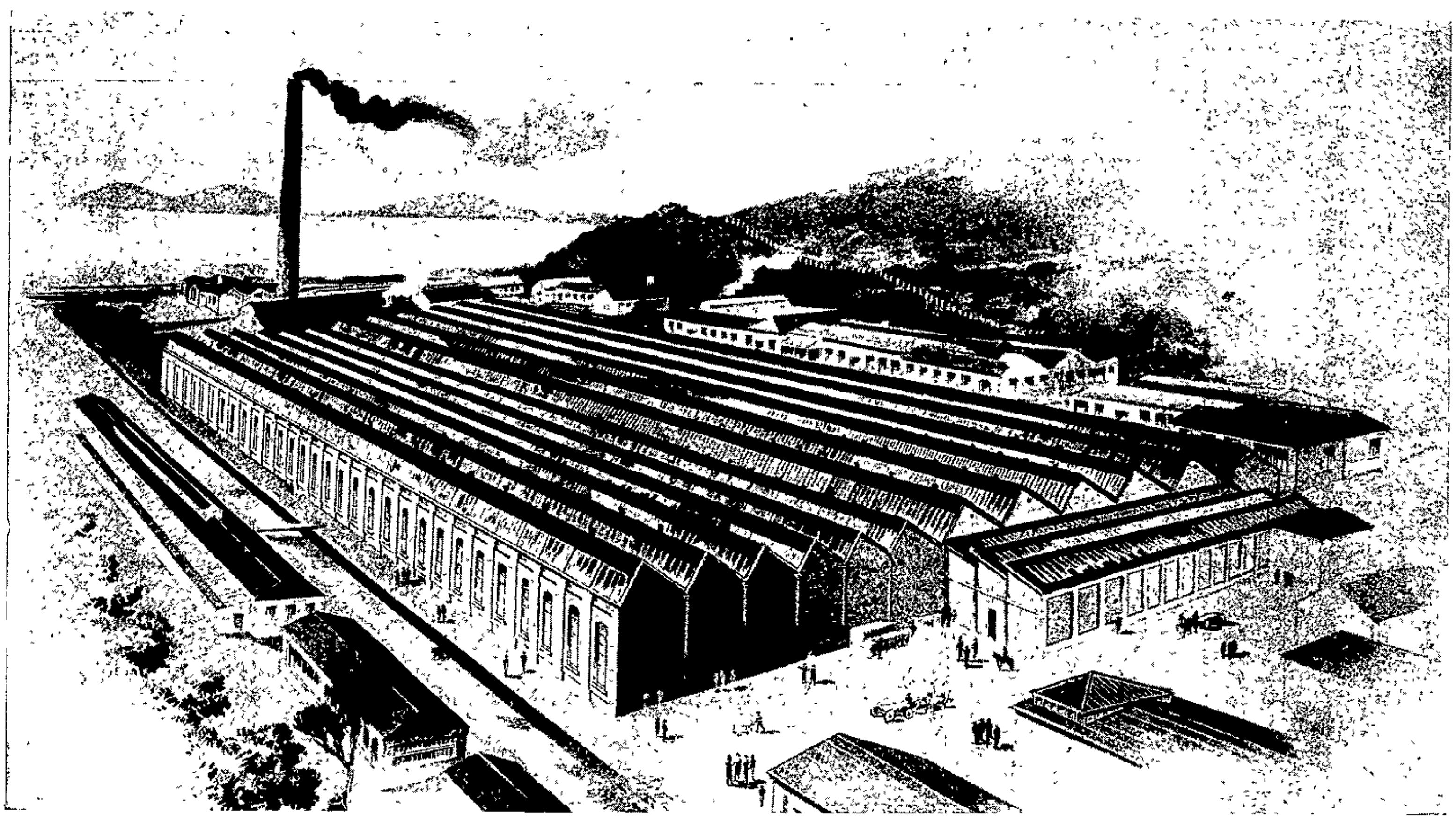
Wellington should on the whole be proud of its woollen mills, of the extent and value of which few of its citizens have any conception.

The Wellington Woollen Manufacturing Co., Ltd.

WORSTED DRAWING

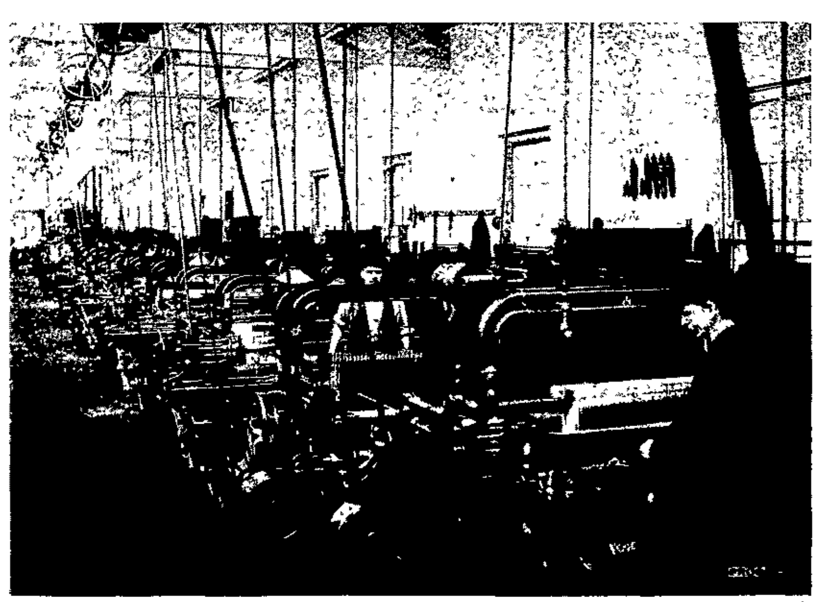


WORSTED CARDING AND GILLING.



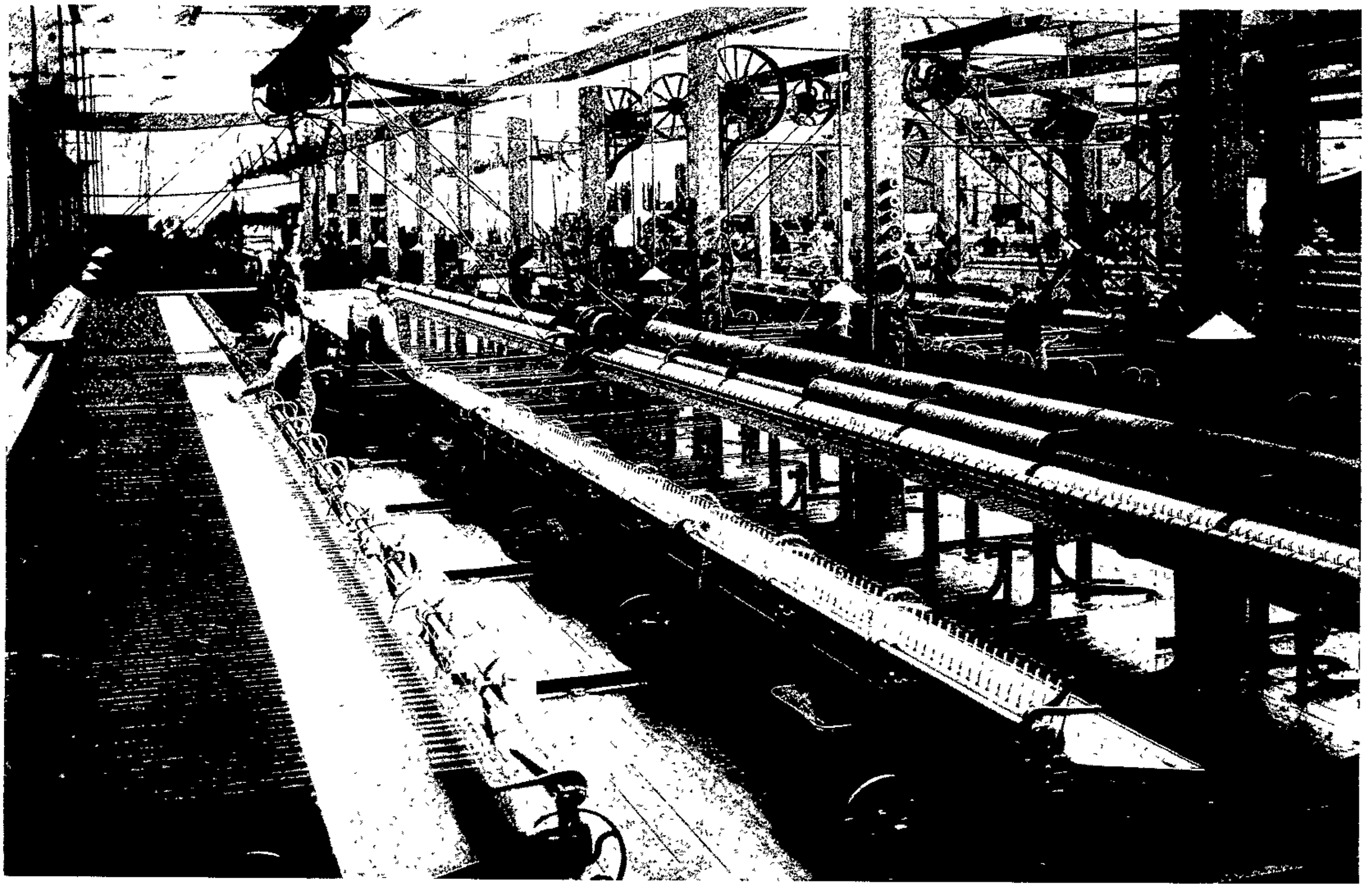
THE MILL AT KORO-KORO, PETONE

WORSTED GILLING AND COMBING.

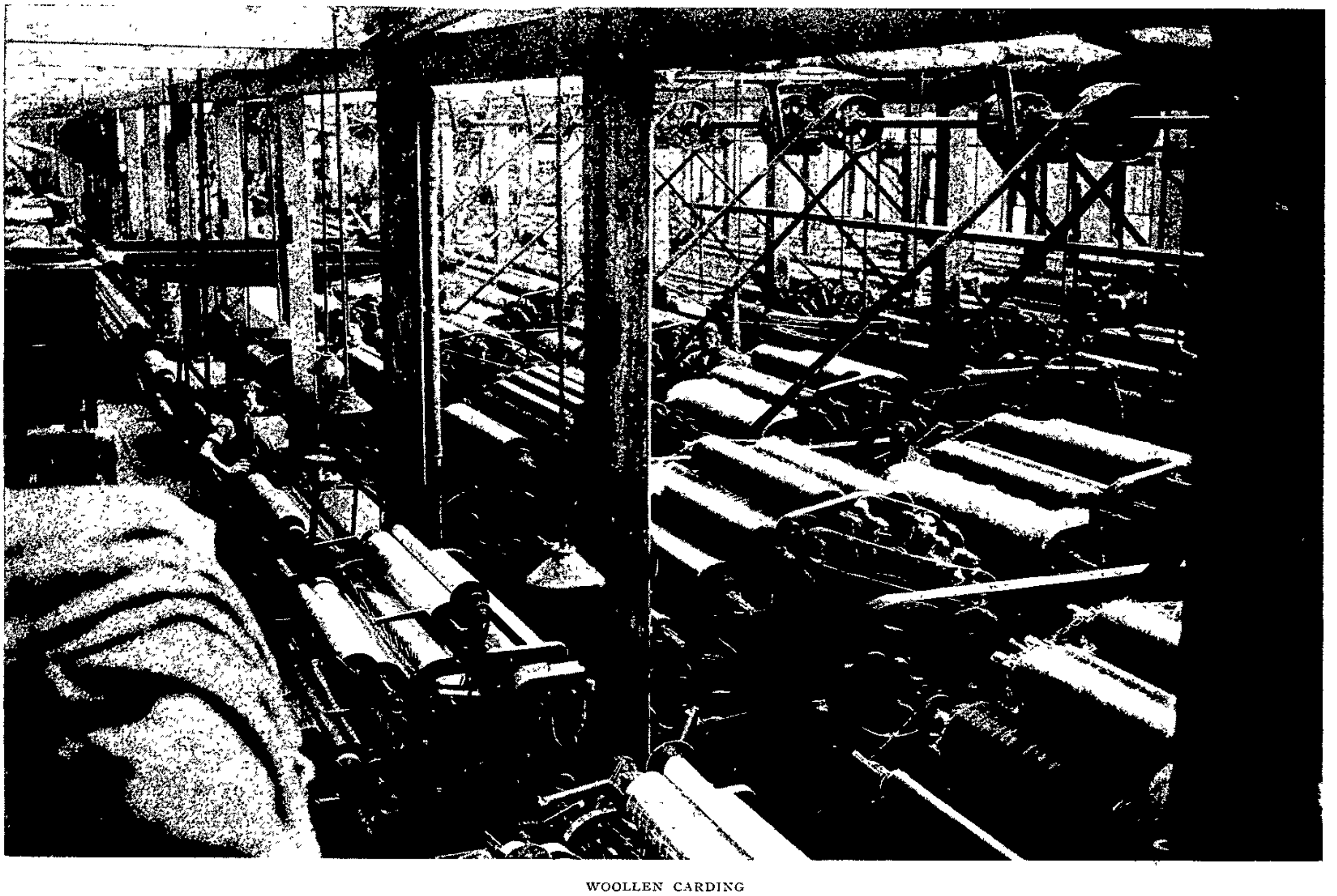


SECTION OF WEAVING DEPARTMENT.

The Wellington Woollen Manufacturing Co., Ltd.



WOOLLEN SPINNING



WOOLLEN CARDING

Inventive Progress in the United States.

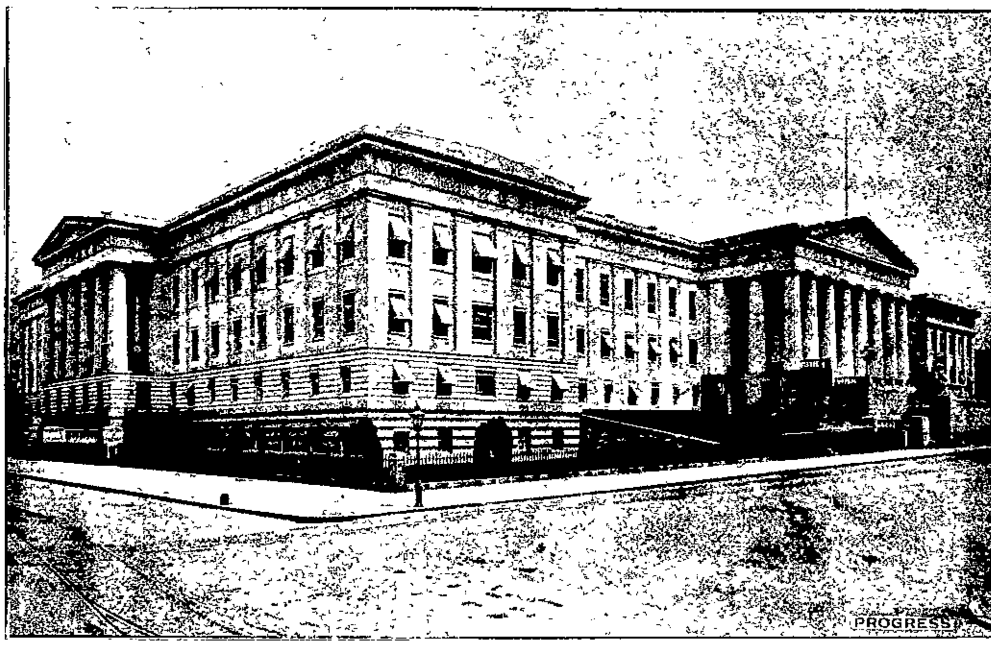
The remarkable progressive industrial development of the United States, within barely a generation, may be ascribed to the inventive genius of the American people, coupled with the stimulus of great financial rewards guaranteed by favourable legislation. The American patent system, which had its birth one hundred and sixteen years ago, has witnessed a wizard-like transformation in mechanical appliances, in the utilisation of nature's forces, and in all the conveniences and accessories of life. If we consider the stride from the primitive plough, with which the ancients tickled the soil, to the marvellous farm implements of to-day, from the burnt-brick libraries of Babylon and Nineveh to the superb treasures in movable types and sumptuous bindings that stand, piled tier on tier, in the British Museum and the Library of Congress we may truly realise how the world has progressed. Yet the most wonderful part of this advancement has been made within the period just mentioned. During that time we have had the discovery of the telegraph, the electric light, and all the various uses of electricity. Within the same period we have seen the evolution of the printing-press from the clumsy hand-lever contrivance of Franklin's time, to the marvellous Hoe machine which prints and folds one hundred thousand copies of a complete eight-page newspaper in an hour In that time the locomotive engine, the steamboat and the luxurious sleeping-car have supplanted the primitive modes of travel which preceded them, and we have advanced from the old hand-spinning wheel to the wonderful weaving-looms and knitting-machines of the present day Besides all these we have had the discovery of the telephone, which conveys the human voice, in conversation, hundreds of miles, the phonograph, which records the sound of the voice and repeats its tones at the will of the operator; the kinetoscope, which reproduces moving pictures; the sewing-machine and the typewriter, which have revolutionised methods in important branches of business, and even the convenient little lucifer match which has replaced flint and friction. Let any man try to imagine the comparative condition of life and society if these discoveries had never been made, and he will measurably appreciate the benefits of the system that inspired them.

The first patent law of the United States was enacted April 10, 1790, and under it the Secretary of State, the Secretary of War and the Attorney-General were the tribunal to determine the question of granting a patent It was not until July 10 of that year that the first patent was issued, which was to Samuel Hopkins for a new method of making pot and pearl ashes. Since that date more than 475,000 patents have been granted Under the law of 1790, which remained in force until February 19, 1793, only 57 patents were issued, and on the latter date a new act effecting some modifications was passed, which stood until 1836, when the great law that really created the American system and " marked an epoch " was enacted Up to this time only 9957 patents had been issued, while in the fifty-six years following, down to the first day of January, 1892, a total of 466,000 were granted. Under the new act of that year the Patent Office was vested with quasi-judicial, as well as executive, functions, the patent being adjudicated upon in advance, and possessing as soon as granted the attributes of a patent, which, under the old system, had been tested by expensive litigation Thus under the stimulating effect of fostering laws and large profits inventive genius has developed and great results have been achieved. From three patents in 1790 there was a growth to 26,292 in 1890, and where, 114 years ago, Franklin, a man of science, was content to leave the printing-press as he found it and as Gutenberg had left it three hundred years before, the last hundred years have seen it advanced to one of the most wonderful mechanisms in the age of wonders And where a century ago the workman and the artisan were satisfied to jog along with such crude implements and methods as were at hand, to-day he is alert and thoughtful, looking to the attainment of better instrumentalities and a higher plane of action.

COMMISSIONERS OF PATENTS, UNITED STATES PATENT OFFICE.

THE PATENT OFFICE.

The United States Patent Office is one of the most important Governmental institutions. It occupies the massive Doric structure, an illustration of which appears upon this page, and which is, within, a vast human beehive. It is the only bureau or department of the Government that pays its own way. The office organisation embraces a trained force of examiners, clerks, and officials, a majority of whom have been in service many years and nearly all of whom are skilled experts possessing the highest qualifications for the work to be performed At the present time the entire force consists of the Commissioner, who is supreme, the Assistant Commissioner, three Examiners-in-Chief thirty-two Principal Examiners, and seven Chiefs of Division with about 650 Clerks and other assistants, making in all 705 persons on the roll. The archives of the Office are valuable and interesting The model-room in the third story of the building, is a veritable curiosity shop. Here, in



UNITED STATES PATENT OFFICE.

immense glass cases, arranged in balconies three tiers high, are stored nearly three hundred thousand models of all sorts and sizes, pertaining to all kinds of inventions The fire of September 24, 1877, destroyed a large number of models which have never been replaced, but the collection that remains furnishes material for more than one day of interesting study. There are models of almost every implement of human use, from the Hotchkiss machine gun to the toy pistol, from a steam engine to a common wood screw, from the great wind-mill to a bottle stopper, from a steamship to a rat-trap, from a threshing-machine to an ice-cream freezer, from a cradle to a tombstone, and from a brick-machine or a folding-bed to a fish hook and a toy hoop There are jumping-jacks, dosing-bottles, and life-saving boats, cooking-stoves printing-presses and gate-openers, horse shoes, railroad frogs and sausage machines corn-planters corn-shellers and corn-extractors fans, corset-stays, and glove fasteners world without end

In recent years models are not generally called for and science and art have outgrown many of the contrivances which the model-room displays; but in their day they were regarded as perfection in the various lines for which they were designed, and made fortunes for those who invented them. There is a strikingly humorous side to Patent Office research, growing out of the many peculiar and funny things for which patents have been obtained or sought. Among these oddities is a tape-worm trap, to be inserted through the mouth and catch the unwary tape-worm when he ventures too far off his reservation; an illuminated cat, metal cat showing eyes of fire, etc designed to be a holy terror to rats and mice; the frontiersman's cannon-plough'—beam of plough loaded with grape and canister shot, in case of sudden attack by Indians; a " cyclone-house "—house anchored at the four corners as protection against cyclones · an artificial tail for horses—to improve their appearance; a device for making hens lay—when the hen deposits her egg in the patent nest it immediately disappears into an incubator and she feels compelled to repeat herself; a steering apparatus—fan attachment to hunting-dogs' tails to enable them to turn sharp corners. These are only a few of the many similarly unique devices that might be mentioned. In the line of toys there is an endless display, some of which have been amongst the most profitable patents issued. The little return-ball, with a rubber-string attached to the hand, drawing it back when thrown, is one of these. It made an immense fortune for the inventor, simple as it is. There are over one hundred different toy banks, some exceedingly ingenious and unique, and dolls without number.

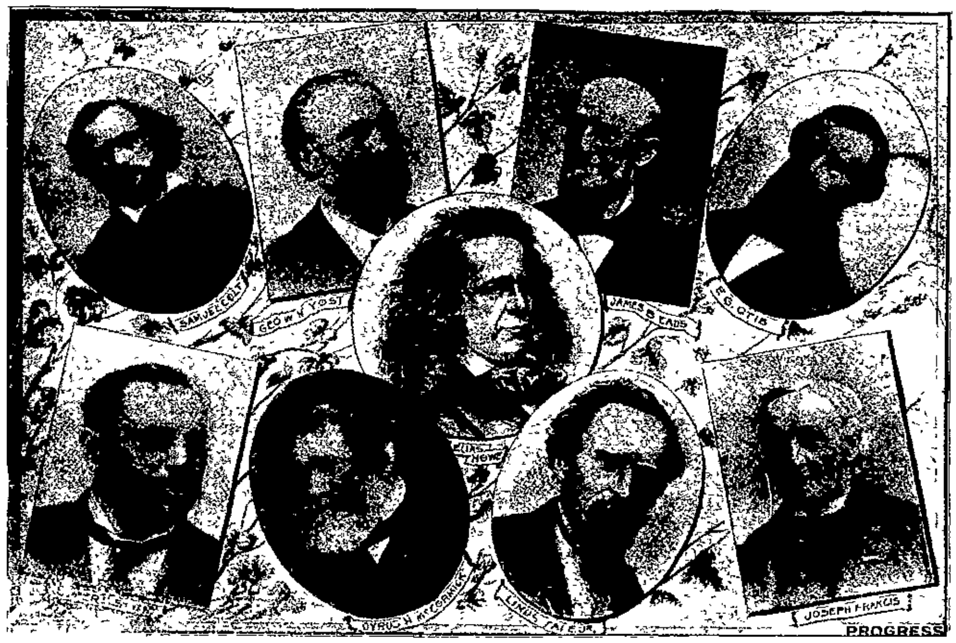
To a novice, or one who has never given the subject thought, the great number of patents in some of the classes is surprising. There have been 4200 patents issued for sewing-machines and their various attachments; for fire-arms, not including heavy ordnance, torpedo or machine guns, 4519 patents; for car-couplings, 5217, and for knitting and weaving machines, 6906. For agricultural implements, including planters, harvesters, threshers, and the whole range of machines and appliances, the total number of patents is 45,776, of which 9721 relate to ploughs alone. These are fair illustrations, and it is not necessary to extend the list. It would seem that with this great number of patents, every possible improvement or device in these classes must be covered. But so it seemed to many a few years ago, when a majority of the present inventions were undiscovered; yet inventive brains have gone on developing new ideas, and more than half of all the patents issued have been granted in the last eleven years. There is actually no limit to the possibilities, but the one thing suggested by the increased complications growing out of a continued multiplication of patents is the importance to every inventor of employing the most expert, skilled, and experienced attorneys to prosecute cases in all their stages.

PROFITS OF PATENTS.

Of the nearly half a million patents issued to date, many hundreds have made millionaires of their owners, while many thousands more have produced fortunes large and small. It is estimated that more than three-fourths of all the capital invested in the United States, a total of over nine hundred and fifty millions of dollars, is directly or indirectly based upon patents. Of the well-known inventions that have produced enormous returns, a few examples may be cited. The sewing-machine patents not only made numerous individual fortunes, but created several large and wealthy corporations. The telegraph patents realised an immense fortune to the original inventor and to a number of others. The Goodyear rubber patents, the original of which was a simple mixture of rubber and sulphur, formed the basis of vast manufacturing industries and gave immense wealth to hundreds of people. The McCormick harvesters and many other agricultural machines have reaped the earth's products and great wealth at the same time. The sleeping-car patents have made millions for their owners, and the electric and telephone patents have enormously enriched the inventors and all who are associated with them. These are only a few conspicuous instances, and while the list of millionaire patents, so to speak, might be increased to great length, it is not these which have realised the greatest total of wealth. It is the thousands and tens of thousands of lesser inventions which have each brought their discoverers a few hundreds, a few thousands, or a modest fortune, that amount to the most in the aggregate and have really resulted in the greatest benefits. It should also be understood that the great aggregate of patents granted is vastly swollen by the enormous number of improvements and attachments upon the larger inventions, and these may be made by any one who can. For instance, the Crane and Otis elevators employ in their construction and operating mechanism over two hundred separate patents. The modern printing-press manufacturers own hundreds of patents which cover the various parts that go to make the complete machine, while the great electric companies have procured or purchased scores upon scores of patents necessary to the perfection of their various systems. And so it is all through the list. The field of invention is practically limitless, and great as are the rewards that have been realised by the wonderful and useful discoveries already made, still greater ones remain to be enjoyed by those who solve the numerous problems and hoped-for achievements remaining in the realm of the unattained.

FAMOUS INVENTORS.

The names and achievements of great American inventors, whose discoveries have made them public benefactors and brought them fame and fortune, are quite familiar to all readers. It is scarcely necessary to speak of Benjamin Franklin, who first unravelled some of the mysteries of electricity; of Robert Fulton, who designed the first steam-boat; of Elias Howe, who invented the sewing-machine; of Charles Goodyear, discoverer of the rubber combination; of Samuel F. B. Morse, who invented the telegraph: or of Cyrus H. McCormick, inventor of



PROMINENT INVENTORS

the great harvesting machine. These and many others, including Eli Whitney, inventor of the cotton-gin; Thomas Blanchard, who patented the tack machine, and John Ericsson who designed the screw-propeller for vessels, and invented the iron-clad monitor, all occupy a place of honour in our school text-books and encyclopædias. Among the illustrious inventors of more recent years Thomas A. Edison stands first. Mr. Edison was born in Ohio, in 1847 and is, therefore, now nearly sixty years of age. In boyhood he was a printer's "devil," in youth a telegraph operator, and in early manhood the inventor of the quadruplex telegraph, the incandescent light, and many other electric and scientific appliances. Nearly one thousand and fifty patents have been granted to him, and he is still at work upon important problems. Among his most wonderful productions is the phonograph. Alexander Graham Bell, who patented the telephone, was born in Scotland, is a noted writer on scientific subjects, but never ranked as an inventor, the telephone comprising his only patent, from which great wealth to himself and associates resulted. Richard M. Hoe, the printing-press inventor, was born in New York in 1812. His father, who was the first American machinist to use steam, was partner of Matthew Smith inventor of a hand printing-press which Hoe improved. Afterwards young Hoe made many inventions and improvements until he finally produced the wonderful rotary presses into which were fed ribbons of paper five miles long at the rate of 800 ft. a minute, which other mechanisms cut, pasted, and folded. Robert Bruce, inventor of the type-casting machine, was also born in New York. Previous to his inventions the casting of types was a hand process by which fifteen pieces per minute could be produced. After several trials he devised an improved machine which produced 140 pieces per minute; the sale of patents brought the inventor a handsome fortune. Christopher Latham Sholes, one of the early inventors of the typewriter, was born in Pennsylvania, in 1819, and died at Milwaukee, Wis., in 1890. In early life he was a printer's apprentice, and later held several important public positions. Thaddeus Fairbanks, inventor of the scales which bear his name and are in use the world over, was born in Massachusetts, in 1797, and died in 1886. He was early of a mechanical turn, and while employed in the business of dressing hemp observed the defects in the scales then in use and began in 1822 to work upon the invention which he finally perfected by various stages. George M. Pullman, patentee of the Pullman palace sleeping and vestibule cars, was born in New York, in 1831. At fourteen years of age he was clerk in a country store, and ten years later was a contractor for warehouses in widening the Erie canal. Afterwards he went to Chicago, and was the first to apply machinery to raising whole blocks of stone or brick. In 1859 he began experimenting with his improvements in railway coaches and has since obtained a number of patents.

Elias Howe, the original inventor of the sewing-machine, is perhaps more generally known to fame than any other inventor except Edison. Like many other men of genius his early struggles were full of discouragements and trials, but success finally crowned his efforts and vast fortunes were realised from his patents, which laid the foundation for a large number of kindred inventions also useful and profitable. He died in affluence. Samuel Colt, inventor of the revolver pistol, made the first model of his invention on board a ship in 1829. His first patent was taken out in 1835, and was the forerunner of all the great inventions in revolving fire-arms connected with his name. His factories at Hartford afterwards became great institutions from

PROMINENT INVENTORS.

which were supplied a large portion of the machinery for the armory of the British government at Sarfield, England, and the whole of that for the Russian government armory at Tula The inventor of the time-lock for banks, and the original tumbler or Yale lock, now so generally used, was Linus Yale Jr., who passed the early years of life in his father's shop. The elder Yale was also an inventor and locksmith. Both are now passed from the scene but the world enjoys the advantages of their inventions James B Eads' genius created the St. Louis bridge and the New Orleans jetties Joseph Francis was inventor of the life-saving boat used in the government coast service, Congress voted him a medal of pure gold, which was the largest and finest ever given by the United States government to an individual It is now on exhibition in the National Museum It is worth $6000 being two-thirds of an inch thick and as large as a tea plate Together with it is shown his original life-car which saved 201 lives from the wreck of the Ayrshire, on the coast of New Jersey, in 1847. G W N Yost is identified with and responsible for the great progress made in typewriter inventions since the first crude writing-machine came into being He was a pioneer in this field Dr Francis, who first conceived the typewriter, never perfected or made practicable his invention, but shortly after it was first exhibited Mr. Yost joined in the work He first worked out the older machines like the Remington Nos 2 and 4 and afterwards the Caligraph which were great achievements thirty years ago Elisha G Otis the pioneer inventor of elevator machinery for buildings produced the original Otis Safety Elevator in 1852/53, while superintendent in charge of the construction of a new factory in Yonkers N Y Mr. Otis commenced life as a farmer but at the age of nineteen showed a marked preference and aptitude in building operations which soon engaged his attention. His genius and versatility are evident in the great number of inventions which he brought out. His two sons C R and N P Otis succeeded to the business which he established in the manufacture of elevators and have brought it to its present perfection and immense proportions

Saving Ships by "Wireless."

Not long ago a large freighter became disabled in the Gulf of Mexico. She was equipped with wireless telegraphy apparatus, so instead of hoisting distress signals to flap idly in the old way the captain began to send out wireless messages in all directions. "We are disabled and need help" he said, giving the location of the ship Soon there was a sputtering among the receiving instruments of the disabled vessel Word was received from a distant vessel that the appeal had been heard and help was coming.

Wireless has come to the aid of the mariner to a remarkable degree. Take the case of the whale-back steamer *City of Everett* towing a barge of oil from Sabine Bar, Texas, to New York The steel door of a forward turret was torn off by the sea a compartment was flooded, and the ship became unmanageable She was then about 150 miles from Port Arthur, Texas From the wireless chart showing the routes of the Gulf vessels the captain saw that the ships *Col. E L Drake* and *Maverick* were about due at Port Arthur He sought to locate them by wireless The message, however was answered by the *Captain H F Lucas* which was fifty miles distant The *Everett* communicated her position, the *Lucas* did likewise and they kept in communication until sighted The disabled ship was then towed to the shelter of Ship Shoal where she was repaired and enabled to proceed with her tow

One day the Atlantic De Forest wireless operator at Manhattan Beach was advised that the steamer *Winifred* was ashore somewhere off Marcus Rock on the Central Atlantic Coast The operator learned from his charts that the steamer *Larimer* was near that point, so he sent the captain this message "Steamer *Winifred* ashore somewhere off Marcus Rock. See if you can give her a pull Tugboat and lighter will be there at high water Answer." In four hours he had a reply from the captain, saying that he was trying to pull off the stranded ship

Maurice Chaulin, a French inventor, has perfected a clever apparatus for killing mosquitoes It consists of a small lamp—electric or oil—hung between two rings, the rings being connected with tiny vertical and parallel chains These chains are charged with a current of electricity, sufficiently strong to kill instantly a mosquito which touches any two of them at the same time. The light in the lamp, which is entirely surrounded by these chains, attracts these insects to their death.

Building & Architecture.

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

A contract has been let at Farndon, near Napier, for a substantial up-to-date residence for Mr R L Paterson Architect C Tilleard Natusch

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The new Post Office at New Plymouth has just been completed and is to be opened early this month

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A seven-roomed residence is in course of erection on the Cashmere hills for Mr R Forbes Architects S & A Luttrell contractor, M Wharton

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Additions are in course of erection to the Pier hotel Kaiapoi and will cost £1000 Architects, S & A Luttrell, contractor F Pearce jun

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Additions to the tea rooms on Riccarton racecourse also to stewards stand are in course of erection Architects S & A Luttrell

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In the past fortnight the New Plymouth borough engineer has issued permits for buildings to the value of £3333

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A bungalow residence of five rooms is being erected at Sumner for Mr L Forbes Architects S & A Luttrell

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A quaint house of ten rooms is in course of erection for Mr Wood in Colombo street Christchurch Architects S & A Luttrell, contractor M McCleave

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The new buildings for Messrs E Griffiths & Co and Messrs Macky Logan & Co New Plymouth have the foundations nearly finished and the new Technical School is approaching completion

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Thirteen tenders were received for the erection of a residence in Millward street Wellington and the contract has been signed by H E Caird Contract price about £500 Architect John S Swan.

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A fine new residence is being erected in Wicksteed street Wanganui for Mr Wm Rankin The building is nicely designed and when completed will present a very striking appearance

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The new Crown hotel Geraldine is now approaching completion It is a two-story brick building and is lighted with acetylene gas Architects, Clarkson & Ballantyne, contractor Wm Waters.

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A contract has been let for brick additions to a house in Kent terrace Wellington consisting of a shop and eight rooms replete with modern conveniences Architect C Tilleard Natusch

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The conversion of a house into a shop with a brick concrete and iron dairy at back has just been completed in Kent terrace Wellington Architect C Tilleard Natusch, contractors W H Edwards & Son

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Messrs Sargood Son & Ewen's new brick warehouse at Wanganui is approaching completion, and will be out of the builders' hands this month Architect, John S Swan contractors, Davis and Browman

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A two-story residence of ten rooms and all conveniences is in course of erection at Little Akaloa for Mr A Waghorn The total cost of house is £1400 Architects S & A Luttrell contractor, Wm Maher

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A picturesque residence is being erected for Mr A. Hutchins at Purakai Bay This building which contains ten rooms is built in the bungalow style Architects, S & A Luttrell contractor, Mr Roxburgh

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Messrs Wood Brothers' three-story premises, Cashel street Christchurch are nearing completion The buildings are of brick with front elevation in bold Renaissance style Architect F J Barlow, F R.I B.A.

The Rangiora Town Council are building new Council Chambers in brick and cement The building is divided into public offices, town clerk's office, mayor's room and large council chamber with domed ceiling Architect, F J Barlow, F R I.B A.

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Designs are in hand for a new Convent of Mercy in Colombo street Christchurch. This building will be of three stories and built in brick and stone. The frontage will be 80 feet and the depth 100 feet. Architects S & A Luttrell

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A large new building has been added to the Wanganui Meat Freezing Co's works at Castlecliff The new addition is a substantial building, and is being used by the company as meat preserving works Architect G L Maclachlan contractor N Meuli

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The printing-works warehouse and factory for Messrs H J Weeks, Ltd at the corner of Tuam and Madras streets, Christchurch, are almost completed The buildings are two stories in height and cover half an acre of ground These buildings are costing some £10 000 Architects Clarkson and Ballantyne, contractors, D Scott & Son.

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One of the late building improvements in Gisborne is a block of shops with warehouse over them, and having a frontage of 165 ft to Peel street, and 66 ft to Gladstone road The warehouse is occupied by Messrs Archibald Clark & Co The block is erected in concrete steel and brick Another sample of Georgian work is Mr J C Field's house at Whataupoko Architect C Tilleard Natusch

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A three-story building at corner of High and Tuam streets, Christchurch, is in course of erection for Messrs A J White & Co The materials used in this structure are brick and Oamaru stone while the roof is of Marseilles tiles There are two oriel bays on each street on first floor and over the first-floor windows a band of dispersed flintwork has been introduced with good effect The corner (an acute angle) is surmounted by a battlemented turret in rock-faced Oamaru stone Architects Clarkson & Ballantyne, contractors, Rennie & Pearce

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Tenders for the erection of a five-floor shop and office building to be erected in High street Christchurch, closed at noon on Tuesday the 15th ult Architect John S Swan

The rebuilding of "Longwood" Featherston has been completed and the house is a good addition to the domestic architecture of the Wairarapa. The building contains seventeen living-rooms, together with bath-rooms and all conveniences. The outside walls and the bulk of the partitions are of brick while the style is late Gothic modified to suit modern requirements Contract price about £7000 Architect John S Swan

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Mr Frank Messenger of New Plymouth, is the successful designer of the plan selected by the New Plymouth Borough Council for the new Carnegie Library under the soubriquet of "Egmont" The other architects in the competition were "Prism" Mr. Tong, "T Square," Mr J Sanderson, "L'Inconnu," Messrs. Rigby and Warren The successful architect has submitted a plan of a modest, neat and solid-looking building, without over-ornamentation yet not severe in its outline The front is of red brick, relieved by facing stones There is a pillared portico with steps leading up to it and the exterior of the building is further enhanced by the fine balustraded pediment which runs along the whole of the top front, the semi-elliptical windows of the first floor and the circular windows on the ground floor. The front of the building does not conform to the street front but will be about parallel with the front of the present Town Hall, and an ornamental iron railing will front the building On the ground floor on the Egmont-street side, is the public reading-room 35 feet x 22 feet, running the full depth (35 feet) of the building, and on the other side of the 8 feet vestibule is the magazine room 22 feet x 10 feet 6 inches; caretaker's room, 16 ft x 10 ft. 6 in.; and a storeroom A broad staircase leads to the first floor, and upstairs are found a spacious landing, a lending-library, 35 ft. 6 in. x 22 ft. 6 in.; ladies' room, 25 ft. x 11 ft., and a reference library, 31 ft. x 14 ft 6 in The lighting arrangements are on the whole good but in this matter the committee will confer with the architect. Lavatories and sanitary arrangements are provided on both floors

Expanded Steel.

The uses of expanded steel are both satisfactory and pleasant. That at all events is the verdict of every engineer who likes to combine strength with elegance in his design, and of every builder and warehouseman who places economy of construction in the first rank of all things.

Of these uses, one of the most remarkable, by reason of the rapidity of its development, is the combination of the expanded metal with concrete. This constitutes a partnership of materials recent in date, but incomparable in the magnificence of the future before it Re-inforced concrete, or armoured cement, is to be seen now in floors, roofs, walls, in sewers, bridges, wharves, warehouses, in constructions of every conceivable kind; and for buildings for which artistic adornment is required, no material can be more suitable for the retention of sharpness of outline and clearness of design.

Concrete construction is, of course, not new, The Roman builders were partial to it for they knew its properties. Of all the work they did with it the finest example which has come down to our days is the Pantheon of Rome, a building (the subject of a prominent illustration in our issue of last December), erected by Agrippa in the year 27 B.C. The walls of the circular part of this great structure are nearly 20 feet thick, while there is a hemispherical dome of 142 feet 6 inches span with a circular opening in the centre of about 30 feet in diameter To-day it does not show a single crack after the heats and frosts of time the storms of nature, and the tempests of war have beaten upon its bulk and tested its endurance in every conceivable way for 1933 years

Useful and widely used as it was the art of building with "pozzuolana" the concrete of our day, was lost in the desert of the centuries that followed the collapse of the Roman Empire—it is a sidelight showing forcibly the tremendous completeness of the sweep made by the disasters under which that Empire perished. Smeaton rediscovered it in 1726, and in the next sixty years the manufacture and use of hydraulic cement made great progress. There were many makers on both sides of the Atlantic, most prominent among whom were Parker the Englishman and White the American At the end of the period or about 1820 Joseph Aspden, of Leeds, eclipsed all other makers, for he produced the famous Portland cement, so called from its colour resemblance to Portland stone. The new material was recognised as superior, and its superiority to the ancient cement of the Roman days has been admitted The uses of this material in the engineering of the world are now historical

To Jean Monier, of Paris, a gardener of great ability and enterprise, is due the credit of the combination of the material with metal. Wanting one day some large pots for the planting of orange-trees, he built some of concrete with wire netting embedded in the material, and found the combination so strong that he determined to follow his invention further afield He sought the protection of the patent office received the gold medal of the Paris Exposition, in 1878, and secured the friendship of engineers and the co-operation of capitalists Presently his reinforced concrete was spread over many tanks, bridges and sewers in France, Germany and Austria, and was finding its way into the "fire-proof" floors of nearly every country of the European continent

It is well known that concrete, though an excellent material in compression, has very little strength in tension while on the other hand steel is of little value in compression as being in this combination light, it would have a tendency to "buckle"; but when used in tension can be relied on with perfect safety. Mr Walmesley, M I C E addressing the Institute at Bradford on the 7th of September of last year, said on the subject of the respective strains to be borne by the two members of the combination: "If the beam be supported at both ends of its length, and loaded between the supports, the upper portion will be in compression and the lower in tension" Following these principles Monier placed his metal in the bottom of the building and his concrete upon it with the resulting development of construction above noticed.

EXPANDED STEEL CONSTRUCTION SHOWING STEELWORK READY TO RECEIVE COVER OF EXPANDED STEEL AND CONCRETE

The combination, however, was found to carry with it two objections. There was an element of uncertainty about the position of the steel in the combination, and the manipulation was tedious, and therefore expensive It was necessary to use a large number of rods which had to be woven together, or latticed, and secured with wire at the joints. The process was not only slow, but it demanded great accuracy from the workmen, failing which the metal was exceedingly likely to get into the wrong place, i e. into the wrong line of strain, thus receiving the compression, not the tension strain—doing, in fact the work for which its partner had its place in the combination

Quite recently John Golding swept these two objections away by the simple expedient of expanding the steel before use After many trials he constructed a machine which does this part of the work with ease and certainty Seizing each thin plate, it drags it lengthwise and sideways until it becomes like a square of wire netting being really a sheet of steel expanded into meshes The sheet when lying on a flat surface touches at only one point in each mesh Thus, when concrete is applied, it embeds the steel entirely, getting under and over at every part, while the steel remains in the bottom layer, the region of its special tensile strain There is no difficulty about the jointing for the necessary continuance of the sheet of steel. All the workmen have to do as they lay down the sheets for the combination is to overlap them to whatever extent the architect may order. In general the overlap of a single mesh is considered ample. With this improvement there does not seem much to be desired in the manufacture of armoured concrete At all events the process is now at the highest point it has ever attained. The metal is sure of its right place in the combination, and, being fully embedded, is preserved indefinitely, suffering absolutely no deterioration whatever.

The engineering verdict applied after long and careful trial as all such verdicts are in England, is that the tension efficiency of a given beam is increased from ten to twelve times, by the use of the expanded metal, the rule being vouched for by such men as Sir B Baker and Sir J. Fowler. The rule has been subsequently tested by the committee of the Architects' Association at Newcastle, and it was found that the strength was appreciably greater than the rule allotted It was after that

EXPANDED STEEL CONSTRUCTION SHOWING THE EXPANDED STEEL AND CONCRETE COVER.

test that the architect of the Armstrong-Whitworth Company, unhesitatingly approved of the proposal to construct the floors of the company's new establishmentafter the destruction of the first one by fire, jo the combined material. These floors have to bear all the heavy weights incidental to the manufacture of the heaviest ordnance The fact that the cohesion of the combined materials is perfect and that their expansion and contraction, according to the conditions that prevail, are the same identically, weighed chiefly with the firm in making the selection

A large number of warehouses and workshops and gasworks are provided with floors of expanded steel, and it is the custom to cover the reservoirs of water supply installations with it. Our illustration shows the cover of the Ipswich (Eng.) Corporation's new service reservoir in course of construction The material is the combination of expanded steel and concrete The combination has been finished on either side; the centre carries only the steel, evidently just laid down and waiting for the workmen to spread the concrete over it for the combination.

The agents for the New Expanded Metal Co (Messrs. Edward Reece & Sons. of Christchurch) have an excellent display of expanded metal work at the Exhibition showing not only the heavy mesh for concrete but also the finer mesh for plaster work

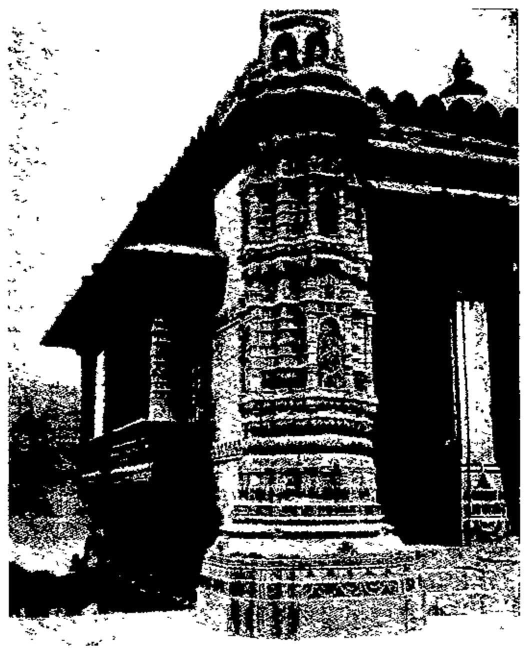
Already this method of construction is "taking root" in New Zealand. It was adopted in the construction of the new Roman Catholic cathedral at Christchurch, and in the new Stoke bridge over the river Cust in North Canterbury it was recently employed with marked success. It is now being adopted in the erection of a bridge for the Eyreton Road Board, near Kaiapoi, North Canterbury, and in every case it is found that enormous strength is obtained at a remarkably low cost.

Indian Architecture.

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

Indian Architecture, like that of other countries has, as far as its ancient examples are concerned, to be studied in the remains of its temples and tombs, as these are practically the only buildings that have stood through the ages required to form history. Indian civilisation is, of course, infinitely more ancient than that of our own race, and while our ancestors were painting themselves with woad and were satisfied to live in groves and caves, the people of Hindustan were erecting buildings which excite the wonder and admiration of the European traveller of the present day. To write anything like an exhaustive account of Indian buildings would be the work of years. Fergusson, who wrote many years ago, and whose knowledge of Indian architecture was comparatively circumscribed in consequence of many of the finest temples being in out-of-the-way and ruined districts, tells us that the introduction of Mohammedanism into India led to the formation of fifteen distinct styles of Saracenic architecture in that country alone, and when we consider that this was not till the end of the 12th century, and that there are still existing Buddhist buildings that go back to 250 years B C, we can to a certain extent realise what an immense field for study the different phases of Indian architecture present.

The earliest buildings extant are of Buddhist origin and are known as topes Some of these are towers, and others are enormous hemispheres of masonry, but what their use is seems to be rather obscure. They were, however, evidently considered sacred and were probably built to mark some holy spot or to hold some venerable Buddhist relic Though much smaller than the pyramids of Egypt they were no mean structures. The one at Sanchi, of which we give an illustration, is circular in plan and 120 feet in diameter at its base, and about 60 feet high. After the topes in antiquity come some of the earlier rock-cut temples, or monasteries, of which nine-tenths were Buddhist and the rest Brahminical or Jain The Jain were an important non-conforming sect of the Brahmins and were famous as builders, the wonderful shrines on Mount Abu, which are among the seven wonders of India, being their work The earliest of the Buddhist series of these cave-temples is that of the time of Asoka, 250 B.C, while the date of the latest is about 700 A.D, or 950 years afterwards Several of these cave-temples are in plan very similar to our ordinary Christian churches, the main part being a nave with an apsidal end and having aisles on each side, with a colonnade supporting the nave roof. They vary much in size, some being over a hundred feet in length, and others small chambers not larger than a cottage living-room. Most are rich in sculpture and carving, and in some cases their walls are covered with frescoes which, in the estimation of many, are thought closely to resemble the Italian work of the middle ages, although some eight hundred years earlier in date The most interesting group of cave temples is at Ellora, an out-of-the-way place 170 miles, as the crow flies, north-east of Bombay, but far away from any town or village Here there are 116 Brahminical caves, in addition to many that are Buddhist or Jain As will be seen from the illustration of the exterior of the Vishwakarma Cave at Ellora, the entrance is generally in a scarp on the



DETAIL RANI CIPRI MOSQUE, AHMEDABAD

hill side. When reading of rock cut temples the imagination naturally pictures the buildings as being caves, but there is one edifice that of Kailasa, one of the Ellora group which is quite unique inasmuch as though it is cut out of the solid rock, it stands fully exposed to the air on all sides The famous rock-cut temple of Elephanta is 130 feet long 110 feet wide and 14′ 6″ high, with a flat ceiling supported on four ranks of columns each 9 feet high There are also well-known cave-temples at Canarah in the Island of Salsette, in which there are 300 chambers, and of which the principal temple is 84 feet long, 40 feet broad, and the vaulted roof rises to a height of 40 feet The mere tabulation of these buildings gives some idea of the stupendous work done by the Indians in this class of edifice alone but the country is still rich in raised buildings of more than ordinary character and importance We say still rich, for it is a melancholy fact that many temples are being rapidly destroyed chiefly through the active agency of trees—the banyan perhaps, being the chief offender A seed is dropped between the stones, takes root, and soon the swelling of the growth forces the joint open, and within a com-

ENTRANCE TO VISHWAKARMA CAVE TEMPLE, ELLORA.

paratively short time the place is in ruins and hidden by vegetation. In Hindu work the outlines of roofs seem to be nearly always pyramidical; of pointed gables we have met with no examples, although semi-circular, or horse-shoe, gables are not uncommon The dome is distinctly Saracenic and an introduction into India of comparatively late date

In a climate like that of Hindustan courts form a considerable part of all temple buildings, and the entrances to these are often surmounted by splendid structures known as gopuras. We give an illustration of a very beautiful and characteristic one at Chidambaram, about 130 miles south of Madras. It will be noticed in another illustration how very much of the rich effect of the design is obtained by having sharply cut horizontal recesses running in continuous lines around the building. In a tropical country and with the sun generally at a high altitude, dark shadows are thus obtained which are most effective This emphasis of the horizontal lines is one of the chief features in successful architecture of most sunny climes, while in the indigenous architecture of the countries of Northern Europe (Gothic and its variations) the vertical lines of a building are most pronounced. In the detail of a part of the Somnathpur Temple, which lies 22 miles east of Mysore, we can see an exceedingly fine piece of the Oriental magnificence of carving which characterises so much of the Indian work. Here the whole surface of the building is covered with sculpture in bas-relief. The lowest is a procession of elephants, above them horsemen, then a scroll pattern, then a scene from one of the sacred stories, then a fifth course of strange beasts, and finally, as a finish to the base, a row of the sacred geese. Above the base is a series of shrines, and then the highly ornamental roof. To an Englishman there is something barbaric in this exuberance of carving, this unframed honeycombing of surface, and the eye longs to repose a moment on some unbroken masonry or plain straight or curved line. At the same time there is an air of coolness given by the deep recesses which seems to be perfectly in keeping with the surroundings of the temple. Some of the Indian buildings are more broken in outline than even those we have illustrated, and they suggest a series of mushrooms growing one out of another, each layer being less numerous than the one below it, till the apex is reached and one larger than the rest crowns the whole. In the great temple at Tanjore the Pagoda, which dates from the fourteenth century, is from its proportions and mass decidedly impressive. We regret that we cannot give more illustrations of these fascinating structures, for though at first sight there is the same likeness between many of them that we see in a group of Chinese work, yet upon closer examination and nearer acquaintance we find that there is an immense variety of expression and design which is not immediately apparent to the observer. Compare the outline, for instance, of the Mukteswara temple at Bhuvaneswara, some 250 miles southwest of Calcutta with that of Tanjore: both are fine examples and, though the horizontal lines are well defined in each there are in one strong vertical lines as well, and the outlines of the buildings are far from similar The Mukteswara temple dates from about 637 A D. There is another tower with very much the same outline at Khajuraha.

Hitherto all the temples mentioned in this paper have been Buddhist, Jain, Dravidian, or Indo-Aryan Arches in them seem to have been used most sparingly, if at all The roofs have been formed by a system of corbelling in with large stones till the whole is enclosed, and wall openings have been spanned by lintels, either in one piece or resting on corbels With the introduction of Mohammedan architecture at the end of the 12th century under the Pathan dynasties a considerable change was made Wherever the Saracenic influence was felt, there we find domes and arches, minarets and other features more or less like those of Persia and other neighbouring countries. That marvellous tomb, the Taj Mahal at Agra, might almost be a Persian building transplanted to India, and, like the German-designed cathedral on Italian soil at Milan, it fails to give that full satisfaction to many which its beautiful material and workmanship ought to ensure. At Mulwa the Jumma Musjid mosque, which was built between 1405 and 1432 is one of the most remarkable in India. It is 290 feet long by 275 in width, and though built in a district where Jain influences predominated, and where it would be expected to have square openings pointed arches and domes are used throughout There are some beautiful pierced stone windows in a mosque at Ahmedabad placed within an arcade which is almost Gothic in its proportions and shape In other respects this city is especially rich in its architecture—Fergusson telling us that its buildings are the most elegant and characteristic of the Indo-Saracenic style in the country One photograph we are able to give is that of part of the Rani Cipri mosque, and we venture to think from it that Mr. Fergusson's remarks are well deserved The Mohammedan towers and minarets in India have balconies like those of other Eastern countries, and many of them are of good design , some on the other hand are decidedly top-heavy and not happy in their outlines The modern buildings of India, like the modern buildings of all countries, are not specially interesting. Sir William Emerson and some other architects have done splendid work, and have contrived to give an Eastern character to their modern buildings, but many of the new palaces and public edifices are of very ordinary character Perhaps these new styles are best suited to the requirements of this age, and the present buildings in their turn will be considered interesting when age has surrounded them with associations , and, no doubt, the antiquarian of some far future period will find in them an expression of the genius of our time, and of our occupation of the great and wonderful country called India

The illustrations accompanying this article were taken from Dr. Workman's interesting book on India.

Hollow-Concrete Block Construction.

By Spencer B Newberry

THIRD PAPER.

The accompanying table of tests of various mixtures, made by the writer, shows the good results that can be obtained with low proportions of cement, had, almost without cost, in unlimited quantities, concrete blocks made from such a mixture would be far cheaper than lumber, and ought easily to replace all other building materials. All that is needed to bring this about is practical demonstration, and the requisite skill and ingenuity on the part of architects and builders It is conceivable that a type of construction for small dwellings, using a 4-inch or 5-inch hollow block, might easily be developed, and these could be turned out, two at a time on 8-inch or 10-inch machines, provided with suitable cores and partition The possibilities of development in this direction seem almost limitless

The terms " porosity " and " permeability " are often used and by many supposed to be of the same meaning. The porosity of concrete is however the proportion of voids, or empty spaces, which it contains, while the permeability is the rate of speed with which water, under a certain pressure, will pass through it All concretes and mortars are more or less porous, and all are somewhat permeable by water under heavy pressure. It is well known that, with the same proportion of cement mixtures of fine sand are more porous than those of coarse sand The latter are however much more permeable than the former Feret has shown that the porosity is the total amount of voids contained in the mass, while the permeability depends on the size of the individual openings The least porous concrete may, therefore, be the most permeable and vice versa If, however, both fine and coarse grains are present in proper proportion, the mass will show the least porosity and at the same time be the least permeable The concrete which best resists water will therefore be that which is most dense, provided a sufficient amount of fine grains are present

If a concrete block be immersed in water it will gradually absorb the liquid, and in time the amount of water taken up will be nearly equal to the total of voids present The rapidity with which this absorption takes place will greatly differ however with different mixtures of the same porosity , blocks containing fine material in the right proportion will be found to absorb water much more slowly than those made from coarse materials only It is the *speed* with which the water is absorbed that is of consequence in the case of concrete blocks rather than the total amount which will be taken up after a long time If the absorption is slow, the moisture during a long-continued rain will penetrate only partially through the block, and will dry out again before the surface is again wetted Perfectly water-proof walls are not necessary, and are even objectionable, owing to their tendency to " sweat " from the deposition of moisture on the inside surface. For health and dryness it is necessary that a gradual circulation of air through the walls should take place, and that any moisture condensing on the inside shall be absorbed and carried away.

Sufficient impermeability for practical purposes, to avoid all danger of dampness penetrating from the outside, may be secured by use of

Sufficiently large proportion of cement,
Addition of hydrate lime,
Suitable sand and gravel or screenings, containing both fine and coarse material.

With poorer mixtures, which would otherwise be too absorbent for use in the walls of dwellings, any desired water-proof qualities may be secured by the addition of a very small percentage of water-proof compound, as already explained

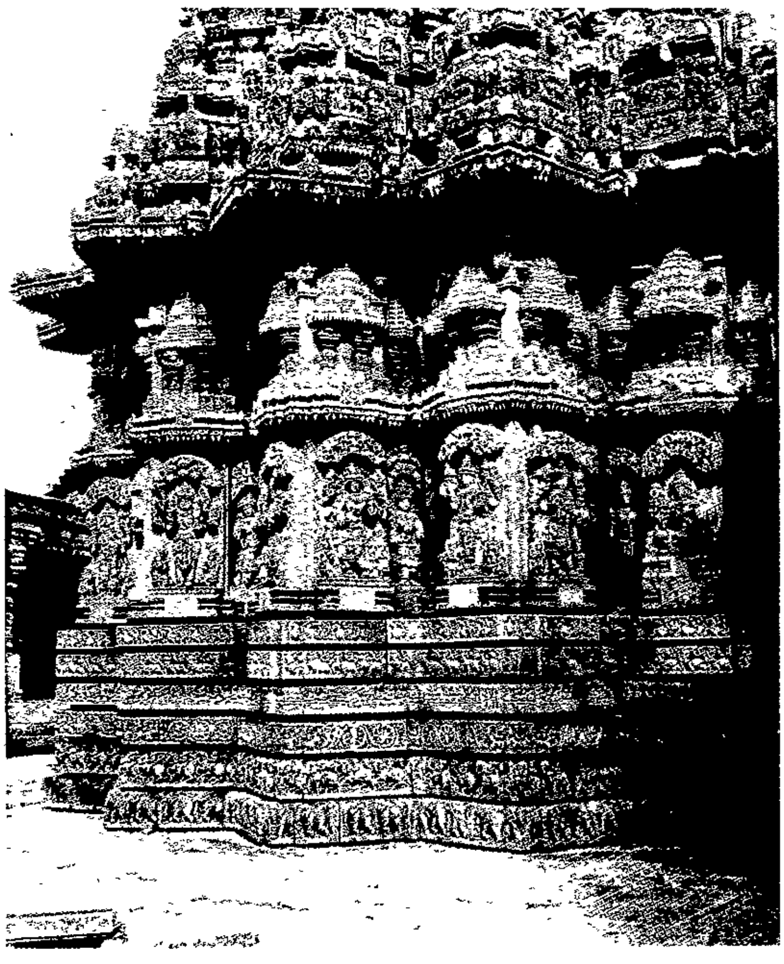
COLOUR, ETC.

The experience of the writer has been that the natural stone colour, obtained by the use of ordinary sand and gravel or screenings, is more popular with purchasers of blocks than any tint which may be given by addition of pigments to the mixture. Limestone screenings give a lighter colour than most kinds of sands, but the colour is chiefly determined by the cement used, and the tint obtained with white sand is very little lighter than that with sand of ordinary grey shade. The addition of hydrate lime makes the blocks decidedly lighter in colour and the same result is obtained, in still greater degree, by making the mixture as wet as possible The difference between blocks made fairly wet and those made too dry will be found to be very striking

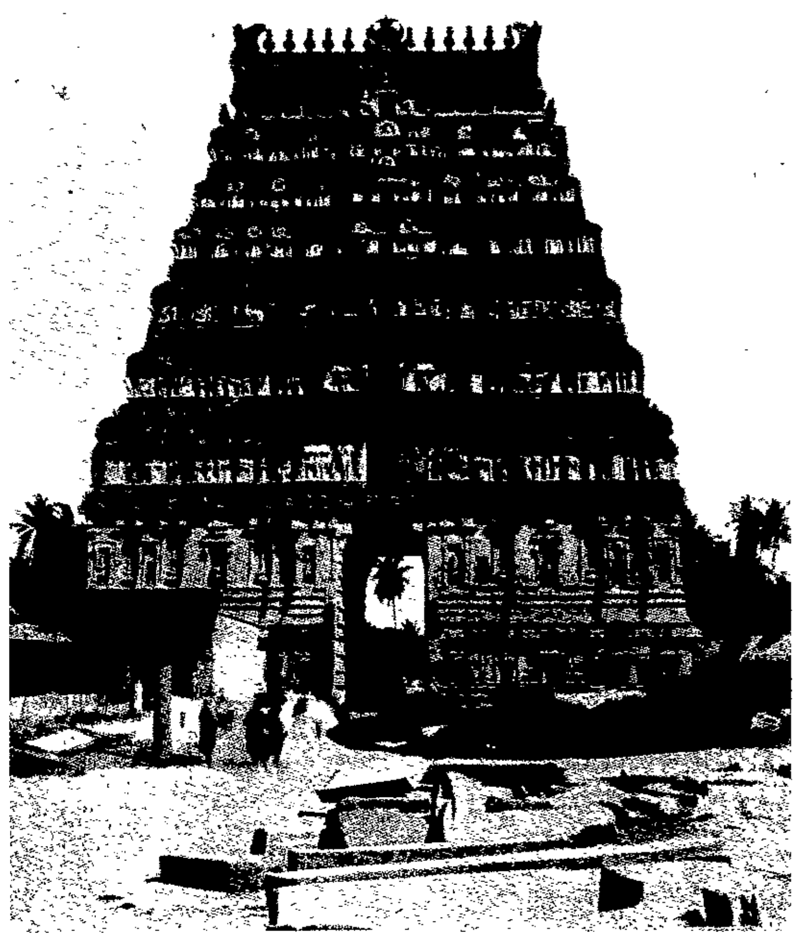
Coloured blocks, imitating various tints of natural stone may be obtained by a facing of richer mixture to which from one to three per cent of dry mineral colour has been added The colours most suitable are —

Red iron ore paint or Venetian red,
Yellow ochre,
Ultramarine blue
Ultramarine green

These colours are inexpensive, and may be mixed to any desired shade It must be remembered that all cement work bleaches and whitens decidedly on hardening and drying The colour of the freshly-made blocks must therefore be much deeper than it will appear after a few weeks' exposure to weather Deep and strong colours are in fact difficult to secure in cement work.



INDIAN ARCHITECTURE DETAIL OF ONE OF SIKRAS OF SOMNATHPUR TEMPLE.



INDIAN ARCHITECTURE GOPURA, CHIDAMBARAM

especially with the addition of hydrate lime It should be remembered that the compression strength of concrete is generally about ten times its tensile strength. The water absorption given is the per cent. of water, by weight, which the dry block absorbed after soaking 24 hours The tensile strengths are the average of 4 briquettes each The sand used was a coarse bank sand, containing very little gravel The cost of material is based on assumed price of 6s 3d per barrel for cement 20s 10d per ton for hydrate lime and 1s per ton for sand and is stated in cents per 8-inch block, 32 in long

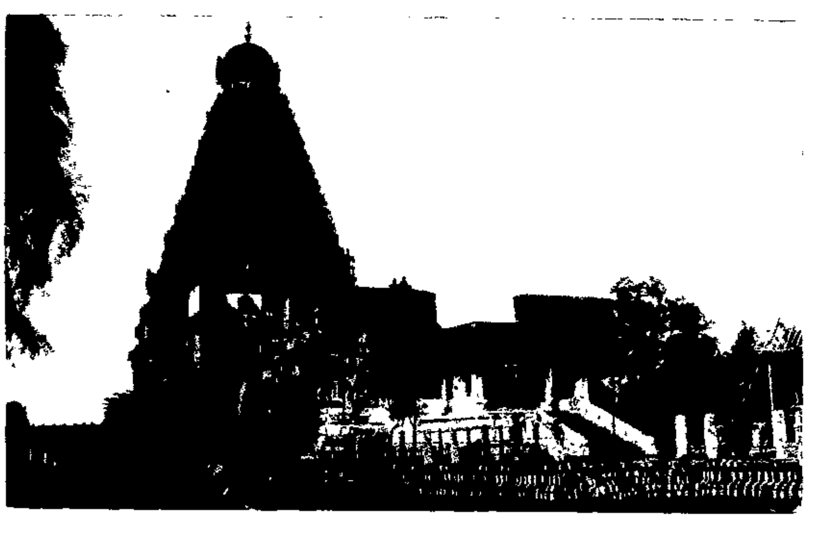
It will be noted that the hydrate lime considerably decreases the water absorption, and in small proportions increases the strength The last mixture 1 to 1 to 12, appears strong enough for all practical purposes, and is actually less permeable than the first, consisting of cement and sand, 1 to 4, without lime. It is evident that in the vast sections of our country in which sand and gravel are to be

TABLE OF MIXTURES—HOLLOW BLOCK CONSTRUCTION.

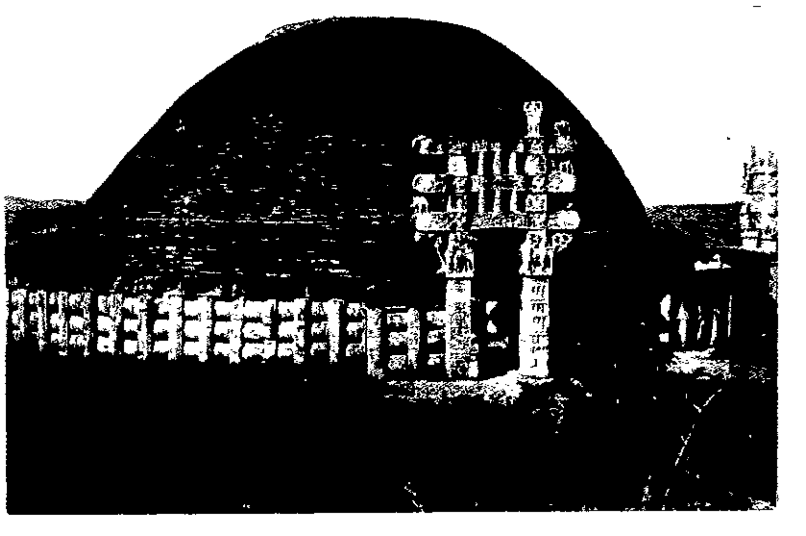
Proportions by Weight.	Tensile Strength 22 Days	Weight Per Cu. Ft. Pounds.	Water Absorption	Cost of Materials for 8-in Block.
Cement ..... 150 Hyd. Lime ..... 0 Sand 600	334	130 0	7.72	5½d
Cement ..... 125 Hyd. Lime ..... 25 Sand 600	360	136 4	5.75	5¼d
Cement ..... 100 Hyd. Lime ..... 50 Sand 600	278	139 5	5 23	5d
Cement ..... 100 Hyd. Lime ..... 25 Sand 600	197	136 0	5 75	4½d
Cement ..... 50 Hyd. Lime ..... 50 Sand 600	182	132 6	7 03	3¾d

USE OF BLOCKS IN BUILDING

From the foregoing it is evident that no other building material compares in cheapness and practical usefulness with hollow concrete blocks By their use, buildings having all the advantages of natural stone, substantial, comfortable, safe, and everlasting costing nothing for repairs, may be built at about the same cost as dangerous, uncomfortable and perishable frame structures. Why, then, is any other material used, and why do we not see thousands of concrete block dwellings springing up in our cities? The answer to this question is to be found in the ugly and unattractive character of most of the block buildings thus far erected. Something more than a good building material is needed to make an inviting dwelling, pleasing to the eye and a pride to the owner. The chief fault of block structures is monotony. A square house made of four block walls, with blocks all of the same size and made from the same mould, windows equally spaced, and the same everlasting blocks used for piazza posts and perhaps perched on the roof to form an open-work cornice, reminds one of the houses children build from the wood blocks of the nursery. What is needed is variety and artistic design. No other material is so capable of this as concrete, for blocks of any pattern and shape, also columns, capitals, cornices, friezes—all these can be turned out by the million at a trifling cost, if architects will only tell us what make There are multitudes of people about to build who would adopt concrete blocks without a moment's hesitation if they could see something tolerable in the way of design. Here the block industry is under a heavy handicap Architects are slow to take up a new material and study its capabilities and to change their habitual styles of design to suit its requirements. Domestic architecture *in stone* is a branch of art which has been but slightly developed in any country, and yet its possibilities seem to be unlimited It is, of course, only a question of time when many architects will see the opportunity which this material offers and the advantage to be gained by making a specialty of this new type of construction Without their assistance the block-maker is helpless, and the growth of his business must be slow Perhaps it may be in the artistic utilisation of concrete, both in block and monolithic form, that the source of a true American style of architecture may be found



INDIAN ARCHITECTURE THE GREAT TEMPLE, TANJORE.



INDIAN ARCHITECTURE GREAT TOPE AT SANCHI.

Vessel Construction Returns.

According to returns compiled by Lloyd's Register there were, excluding warships, 512 vessels of 1,264,767 tons gross under construction in the United Kingdom on September 30th of last year, as compared with 569 vessels of 1,409,456 tons gross on June 30th, 547 vessels of 1,401,882 tons gross on March 31st 515 vessels of 1,355 756 tons gross on December 31st, 1905, and 474 vessels of 1,325,328 tons gross on Sept. 30th, 1905 The returns, remarks *Syren and Shipping*, merely compare the totals of the two Septembers, and from these it appears as if there had been a gradual decline from 1,325,328 tons to 1,264,767 tons But as the figures which we have given show there was a slight revival, which is now apparently subsiding Of the vessels on hand 478 of 1,253,531 tons are steamers and 34 of 11,236 tons sailing vessels. One of the steamers, representing 500 tons is of iron and 14 of the sailing vessels, representing 1400 tons are of wood or of composite construction The rest of the tonnage is steel The June total, it may be pointed out, came to within about 4000 tons of the record of September, 1901. Compared with it the total is now 144 000 tons down "No such striking decrease within one quarter has," says *Lloyd's Register* "taken place in the shipbuilding industry of the country for the past 22 years, it being necessary to go back to June 1884, to find so rapid a diminution of the work on hand" Considering that wages questions are "local" problems and that their solution depends or ought to depend, on the amount of work on hand, we think *Lloyd's Register* would be well advised to amend Table II so as to show the fluctuations from quarter to quarter in each district We do not say this in any spirit of dissatisfaction with the return as it is We incline to the view that Lloyd's returns would make the basis of a first-rate sliding scale and we should like to see the compilation so clear that the meanest of the shipyard workers might grasp its full significance. For instance here are the district totals for five consecutive quarters —

	Sep 30, 1905 Tons	Dec 31, 1905 Tons	Mar. 31, 1906 Tons	June 30, 1906 Tons	Sep 30 1906 Tons
Belfast	213,530	194,510	171 130	166 790	132,540
Barrow, Maryport, Workington	2 560	3,240	3 000	4,010	4,040
Clyde	486,970	503,335	537,836	527,930	515,241
Hartlepool, Whitby	65 570	76 630	84 620	80,815	56,460
Tees	84,220	88 051	95,245	92,859	74,843
Tyne	253,915	253 894	265,547	285 216	232,613
Wear	169 835	174,109	187 766	179,864	190,389

The examination in bankruptcy of a Wolverhampton builder recently revealed a state of simplicity on the part of the debtor which one would hardly expect to find in a business man In the course of his evidence he stated that he replied to an advertisement of a Birmingham loan society In reply to his letter, a representative of the society came over to Wolverhampton to see him. In the course of the interview the loan society's representative advised him to give a bill of sale on his household furniture and trade effects. He said they could arrange the loan cheaper that way, and he could pay it back as he liked. He (debtor) then went over to the office of the loan society's solicitor in Birmingham, and there signed an agreement for a loan of £35 The agreement was not read over to him, neither did he read it himself. He understood that the loan of £35 was at five per cent. per annum interest, but he had since learned that it was five per cent per month. If there were many such simple souls in business there would appear to be need for an elementary text book of commercial practice, which should include such obvious maxims as "Do not sign documents you have not read" "Note carefully the difference between monthly and yearly rates of interest." The story might be useful also of the moneylender who was always content with a modest five per cent It was an attractive modesty until one discovered it to be quarterly Then the sweetness of its simplicity disappeared

Preserving Wood with Sugar.

The latest method of preserving wood is to treat it with a solution of sugar The material to be treated is put into a cage and the latter plunged into a boiler, which is then closed, and a solution of beet sugar introduced The liquid penetrates the pores of the wood, and as would appear from the results of microscopical examination, undergoes some sort of union with the fibrous substance, as no traces of sugar crystal are found after the process is completed The wood is then withdrawn from the boiler, and dried in an oven, which is regulated to different degrees of temperature, depending upon the nature of the material submitted to the treatment It is claimed that wood thus treated is no longer porous, can be worked without shrinking or cracking and is permanently protected against decay

Astronomy of To-Day.

Notes of a Lecture delivered by SIR ROBERT STOUT, K C M G *under the auspices of the Wanganui Astronomical Society, in September, 1906*

PART II

ONE class of beautiful objects is the double stars Many thousands of double stars have been catalogued Most of the catalogued are binary some are, however, multiple. Are they all physically connected? Some astronomers say so Few seen as double or triple are not connected.

To the great credit and honour of Wanganui from 80 to 130 double stars, not hitherto catalogued as such, have been observed by Messrs Ward and Jobsin, two of the Wanganui astronomers

The orbits and length of time that binary stars take to revolve round each other have in the case of a few of these double stars been calculated Some, it is said, take 11½ years to complete their revolution, others even 1000 years.

Some of the solar systems have two suns, some three suns, revolving the one round the other, and there are some stars that have companions that are not shining as they shine. One of the most notable of this class is Sirius Sirius has what is called a faint companion. Another one is Procyon It was noticed in reference to Sirius that the star did not move with a uniform and proper motion, and the astronomers determined that this irregular motion must be caused by some satellite near but they were not able to see any The discovery of his dark companion came by accident A very fine telescope was made in Massachusetts, and the son of the maker was looking through the new telescope when he observed a faint companion near Sirius It was in the position that astronomers had from their calculations predicted In Procyon the astronomers had also stated that the variation of its motion must be due to some satellite near it, and it was not until 1895 that Schaeberle found the missing satellite through observations made with the Lick telescope in California

Perhaps the most striking object in the sky (at present) is the planet Saturn It is unique There may be other planets that have a ring round them, but none save Saturn is visible to us The planets round the suns other than our own sun we cannot see, save the satellites of the planets of our solar system. Saturn is surrounded by a ring or belt, beautifully radiant. It looks as if the planet hung in the belt, and you will not grow tired in looking at it for its beauty and uniqueness This ring or belt consists of innumerable small moons each kept in its place by the law of gravitation Saturn is well supplied with moons for in addition to this belt, which, it is said, is about 40 miles in depth and 40 000 miles in breadth, it has ten moons—one of them pretty large, namely, Titan

After you have examined the clusters and Saturn, and perhaps looked at Venus, Mars, and Uranus you may have your attention directed to some of the Nebulæ They were once thought to be clouds of stars, but they are clouds of gas in process of being formed into stars.

One of the finest is the nebula in Orion Every one knows the constellation of Orion—it is perhaps the finest in the sky. In summer and early winter we see it every clear night; you can see it in October in all its beauty about midnight. Orion was known to the ancient Babylonians and Semites, and is referred to in that ancient drama the Book of Job In it are most beautiful stars Betelgeuse is a bright red star, and the star Theta is a multiple star. You can easily see four distinct stars, and it is said that some observers have seen seven.

The nebulæ in Orion in Andromeda and in Argo are the only nebulæ that can be even dimly discerned by the naked eye Each looks like a faint blur or small cloud round a star in each of the constellations named. When you examine them by the telescope you get some conception of their vastness and beauty

Prof Ball has thus spoken of the nebula in Orion "The earth sweeps round the sun in a mighty path, whose diameter is not less than 185 400 000 miles Let us imagine a sphere so mighty that this circle would just form a girdle round its equator and let this gigantic globe be the measure wherewith to compare the bulk of the vast nebula of Orion It can be demonstrated that a million of these mighty globes rolled into one would not equal the great nebula in bulk, though how much greater than this the nebula may really be we have no means of ascertaining"

Andromeda is not a constellation very often seen in our southern sky You will see it in the evenings in September October, November and December It is right north of us now, and linked to Pegasus, you see a large square, and two of the stars in the square—one side belongs to Andromeda The nebula in Andromeda is also a most remarkable one It is thought that in this nebula we see a stage in advance of the nebula in Orion, and that stars are nearer formation It is so distant from us that light from it will take 160 years to reach us The diameter of the nebula is 333,000 times the sun's distance from the earth Light would take five years to pass from one side to the other of the nebula, that is, the distance is 30 billions of miles, that is more than the distance of Alpha-Centauri from us

There is a fine nebula in Sagittarius. The forms of nebulæ vary. Many are spiral in form. The spiral form is the first step towards the formation of a sun or star About 500,000 nebulæ have been observed, and 75 per cent of them are spiral in form Then there are ring nebulæ—nebulæ in the form of rings One beautiful one is near Vega in the constellation of Lyra or the Lyre It is half-way between Beta and Gamma of this constellation. There is another in the constellation of the Swan—Cygnus

Then there is the great nebula in Argo, round the famous variable star of Argus you can see now low in the horizon in the south-east, about 10 p m The bright star Canopus is in this constellation In the brightest part of the nebula there is an opening known as the Keyhole Regarding this nebula Sir John Herschel, in his "Outlines of Astronomy," says "If placed at the distance I have assumed for the nebula in Andromeda, it must fill a vast extent of space, a space compared with which our solar system sinks into insignificance"

This nebula, as seen by Sir John Herschel at the Cape greatly impressed him. He says. "It is not easy for language to convey a full impression of the beauty and sublimity of the spectacle which this nebula offers as it enters the field of view of a telescope fixed in right ascension, by the diurnal motion, ushered in as it is by so glorious and innumerable a procession of stars, to which it forms a sort of climax, and in a part of the heavens otherwise full of interest."

One peculiar feature of this nebula is that it has changed in appearance since it was observed by Sir John Herschel in 1834–38. Mr Russell, the astronomer of Sydney noticed in 1871 that part of the cloud had disappeared.

There are two objects that you see in a cloudless night like two clouds. They are the Magellanic clouds, or Nebecula Major and Nebecula Minor. In the larger cloud is a famous nebula called 30 Doradus

It has been described by Sir John Herschel "as one of the most singular and extraordinary objects which the heavens present" It has a keyhole perforation like the nebula in Argo etc, and because of its convolutions has been termed the "looped nebula"

The larger cloud shows evidence of a spiral structure and the smaller cloud has, it is said the same structure. In both of the clouds numerous small stars are mixed up with nebulous light

(4) What is a nebula? Tennyson in his "Princess" has said:

> This world was once a fluid haze of light
> Till toward the centre set the starry tides
> And eddied into suns, that wheeling cast
> The planets

And this, in some respects represents the theory of the nebula to-day It is that a nebula is a fluid haze of vast extent of burning gas but as this gas cools suns are formed, and that the suns cast off pieces which form into planets This was explained by Prof. Darwin in his presidential address at Capetown and Johannesburg when he dealt with the theories of astronomical evolution For example he stated that the moon separated from the earth gradually and that at first it would be only a few thousand miles away This took place according to him, perhaps about 500 to 1000 millions of years ago

Closely connected with these double stars is the question of variable stars Some stars vary in magnitude What is the cause? It is said that some dark body comes between us and the star, so seen to vary in brightness Some five hundred stars have been observed as variable stars, and their number is being yearly increased. I mentioned the new star in Perseus, that is not a variable star A star that suddenly blazes out is called a new star, and, so far as our record extends, no star has blazed out twice. But some stars have regular periods of brightness and dulness. Is this variability caused by an eclipse? That is the theory Some dark body, perhaps a dark companion, intervenes between us and the star, and therefore we lose its light There are many types of variable stars, and I must refer you to Newcombs' work on the stars for a full discussion of the subject.

Are there then dead suns in the universe? Most astronomers say there are. I notice in a number of *Knowledge*—in the July number of last year—that Mr Gove, the author of several well-known astronomical works states that the existence of such dark bodies has not been proved. He does not say there are none, and it appears to me the existence of such bodies is the most reasonable explanation of variable stars Ball goes the length in his book on the heavens to state that there may be dark masses of matter not spherical in shape, and this may explain why we see dark patches or rifts in some of the nebulæ

We know of one dead world, the moon, which appears a luminous body to us because of its borrowed light from the sun If we admit, and we must admit, that the stars pass through various phases, why should we not accept the theory that there are dead worlds, dead suns?

There may be thousands or hundreds of thousands of such

The existence of such bodies has an interesting connection with what has been observed, namely, the sudden appearance of new stars. There is a record of sixteen new stars having been seen, that is, stars suddenly appearing where no stars, or stars of a small magnitude, had been seen before The earliest one recorded was discovered by the great Danish astronomer, Tycho Brake in 1572 in the constellation Cassiopeia. Its history is the history of them all It was first seen by Tycho Brake on the 11th November 1572, and was then a star of the first magnitude as bright as Canopus. It continued to increase in brilliancy till it was as bright as Venus—that object of beauty we now see in our western sky It was visible in day-light. It began to fade in December, and finally passed out of sight in May

In 1901 a new star was discovered, as I have stated by Dr. Anderson from observations made by him in Edinburgh and it was the brightest new star discovered since Kepler's star in 1604. When first seen it was a star of the second magnitude in the constellation of Perseus In two days it increased in brilliancy till it was the third brightest star on the northern sky Then it began to fade away In March it was of the third magnitude, in April of the fifth, and it faded till it was of the eleventh magnitude There was a star of the eleventh magnitude where it blazed out, so it rose from the eleventh to the first magnitude in three days

How is the advent of these new stars to be explained? The suggestion is that through a collision of the star with perhaps one of the dark ones that have been referred to there is a sudden outburst of flame Another suggestion is made by Newcomb He says that it is "probable that stars, like our sun, have somewhat the character of masses of gas confined under enormous pressure as if they were hollow globes of highly heated and compressed gas," and "if by the fall of a foreign body, an opening is suddenly made in the shell, the interior gases will burst forth" He does not venture to give this as a solution of the appearance of these new stars. It is only a suggestion,

One suggestion made as to the creation of stars is that two dead suns may collide and form one new hot gaseous body, or star, and thus, though there would be one sun the less, we would have a live one instead of two dead ones If this is happening we may see endless succession of life for so long a time that it may be called Eternity for our mind cannot fix a time when there will cease the new stars new suns and all that follows from such a creation, an evolution of star-life from the intense heat of the highest-known heated stars through myriads of ages, till we have fluids and then solids millions of years giving their organic life, vegetable and animal Then myriads of ages when life will be no more and again a dead sun, and then after myriads of ages the process of another evolution from death to life And so the universe is without beginning and without end

Some may say that it is a sad outlook that just as man, through myriads of ages of development and civilisation, becomes only a little lower than the angels that decay should set in or a cataclysm happen, and that all the fruits of the long evolution should pass into nothingness. Is it Nature's way? Who knows? Our duty lies before us. It is to work whilst it is to-day, and to do our work as best we can and be kind. The destiny of the universe is not in our hand. We are a very humble part of the immensities that surround us.

The vastness of the universe, the distances of the stars, their sizes are overwhelming to us. Is it any wonder that a German was led to exclaim "I will go no further, for the spirit of man acheth with this infinity. Insufferable is the glory of God, let me lie down in the grave and hide me from the persecution of the Infinite, for end I see there is none."

We can see systems being formed and systems dead, and with the aid of the spectroscope we may trace different stages of star development. A picture in Naismith's Astronomy may give us some idea of the time it takes to make a planet suitable for life. If organic life has existed for 500 millions of years on our earth, the evolution of the earth from a superheated gaseous body till it was fit for organic life may have taken trillions of years—a time so great that it is beyond our comprehension. Truly it may be said that in the universe a day is as a million of years, and a million of years as a watch in the night. A million years is to us infinity. We think the civilisation of Egypt old, and beyond our comprehension is the age of some of our fossils, but what are the ages of Egyptian civilisation and of the oldest specimens of organic life compared with the age of the world? There can be little comparison. What theory can we have of the end of the world any more than of the beginning? We may spin theories, but a solid basis of fact for any conclusion we have not. The recent scientific discoveries in physics and chemistry have altered our conceptions of matter and of life. And in view of these we should hesitate to say anything about either the beginning or end of the universe. Had it a beginning? Will it have an end? I doubt if we can conceive of a time when the universe was not, and I also doubt if we can conceive of a time when it will not exist.

Day by day, I may say, our knowledge of the universe, of its potentialities, of its hidden powers is extending. I see that in a recent number of the *Atlantic Monthly* there is a suggestion by Prof. See regarding the heat of the suns that was not the view of physicists even five years ago. He believes that the sun has not yet reached its maximum of heat and that the years of its decadence are far off. Perhaps 30,000,000 of years after this it may have got cold.

And we all know of the discovery of Radium and of Helium and how the discovery of these metals has altered our whole view of the age and future life of the suns and of the stars. And who knows what other hidden things in nature may not yet be laid bare. Let me give you one illustration that was given by Prof. Darwin in his address about radium; it will make us appreciate the potentialities and powers of the universe of which a few years ago we knew nothing. It is said that the energy expended in towing a ship of 12,000 tons a distance of 6000 sea miles at 15 knots an hour is contained in 22 oz. of radium. It would take about 5000 tons of coal to perform the same operation. And radium and its power were unknown twenty years ago.

Our attitude must be that of the patient observer, ever remembering that our knowledge is limited and ever will remain limited, and that it is a very poor conception of the universe that even the brightest of the intellects of men can ever attain. If there is one study more than another which should make us humble and point out to us the littleness of man and the insignificance of the earth, it is the study of astronomy.

We sometimes hear or read of people making confident and dogmatic statements as if our earth and its life were all; and that the rest of the universe was of no account. Do we realise that as compared with the seen universe—and who dares venture to say what is unseen?—our little earth is not as large as the smallest particle of matter that can be seen in the most powerful microscope? It would be a good thing I often think if the study of astronomy were popularised. It might rid us of much dogmatism and make us humble when we become observers of nature and her ways.

Some people say that astronomy leaves no place for Deity or for abodes for the Blessed. Others claim that it stimulates the religious emotions. A clergyman has thus replied to the former assertion:

> Go not, my soul, in search of him
> Thou wilt not find him there
> Or in the depth of shadow dim,
> Or heights of upper air
>
> For not in far-off realms of space
> The spirit has its throne;
> In every heart it findeth place,
> And waiteth to be known
>
> Thought answereth alone to thought,
> And soul with soul hath kin,
> The outward God he findeth not,
> Who finds not God within.
>
> And if the vision come to thee
> Revealed by inward sign,
> Earth will be full of Deity
> And with his glory shine
>
> Thou shalt not want for company,
> Nor pitch thy tent alone,
> The indwelling God will go with thee,
> And show thee of his own
>
> Oh gift of gifts! Oh, grace of grace
> That God should condescend
> To make thy heart his dwelling-place
> And be thy daily friend!
>
> Then go not thou in search of him
> But to thyself repair,
> Wait thou within the silence dim
> And thou shalt find him there
>
> F. L. Hosmer.

An old philosopher said the eye sees what the eye is prepared to see, and I doubt if a man's religion is changed by the study of astronomy. We will read into the stars our creed.

I know no study so glorious, so uplifting, or so impressive as astronomy. A man who communes with the stars will get ideals that must be of immense service to him in his pilgrimage through life. Emerson that great New-England prophet, said that "Every one should hitch his wagon to a star." High ideals in life were needed by men. May there not be a practical, as well as an idealistic, application of this aphorism? Let us keep our eyes on the stars. May they not guide us all and be a help to us amid the troubles and temptations of our existence?

But whether the stars will be an ethical help to us or not they will ever brighten our imagination and develop our æsthetic and artistic sense. Has not Shelly told us what we see?

> Palace-roof of cloudless nights!
> Paradise of golden lights
> Deep immeasurable, vast,
> Which art now and which wert then!
> Of the present and the past
> Of th' eternal where and when—
> Presence-chamber, temple, home,
> Ever canopying dome
> Of the ages yet to come!
>
> Glorious shapes have life in thee
> Earth and all Earth's company
> Living globes which ever throng
> Thy deep chasms and wilderness
> And green worlds that glide along
> And swift stars with flashing tress,
> Icy moons most cold and bright
> Mighty suns beyond the night,
> Atoms of intensest light

Wireless Telegraphy at the North Pole.

Wireless is entering largely into the plans of Arctic explorers and promises to be a very necessary part of their operations. Heretofore the explorers in their hazardous dashes north have been cut off from communication with the world.

Now, Mr. Walter Wellman who is to make the attempt in an airship will take along three wireless experts with a complete De Forest outfit and establish a chain of stations so as to enable him to keep constantly in touch with civilisation. Incidentally it will permit him to send at once the news of any achievement. The first station will be established on the Arctic steamship *Frithiof*, which will be anchored at Spitzbergen while the airship is northward bound. A second station will be at Hammerfest, Norway, the most northernmost point in Europe, which is already a cable station. Instead of sending the message *up*, as is normally the way the explorers will have to send their messages *down*. Wires trailing down from the hull of the ship will be the substitute for the steel mast usually employed to send wireless messages. Mr. Wellman will send as many messages as possible to the Spitzbergen station. Each message will give the exact longitude and latitude of the exploring party. If the messages suddenly stop coming it will be an indication that some disaster has befallen the party, and it will be easy for the relief expedition to locate it.

A policeman's club with a electric light in the handle is a late invention. If it proves a success the search-light lantern may be dispensed with.

Industrial Betterment.

By H. E. J. Porter.

No good business man can justify his taking up a line of work which, as the term "welfare work" implies, has no direct bearing upon his business, but, on the contrary, is directed towards improving his employees' condition, and which, he may deem, would be considered a mark of presumption on his part if he should attempt it. On the contrary, every business man now-a-days is compelled by the exigencies of competition to adhere closely to his direct line of business. He cannot digress, or his competitor will take advantage of the lapse, and he will soon find himself hopelessly in the rear, and will have to close up his plant or run it as a charitable institution. For these reasons many employers have not only considered the adoption of so called "welfare-work" unfavourably, but look upon the whole movement with derision, and this attitude of mind has been brought about largely through the fact that they have been misled in their understanding of the purpose of the movement by the unfortunate appellation of the work embodied in it. These various attitudes are all wrong, and their falsity is due to the misunderstanding of the rationale of the movement. Just now it is necessary to make the point very clear that there are no features covered by the term "welfare work" which have not been thoroughly proved to be a good investment, and, therefore, of betterment to the enterprise. There is nothing philanthropic or charitable whatever about them. They are simple improvements in the manner of conducting the business. As such it is not proper to call attention to them by advertising. A man should advertise his business, not his methods of conducting it. And yet there should be no hesitancy on the part of any manufacturer who has bettered his conditions by the adoption of these features to let that fact be known. It should be a benefit to him to advise the public judiciously that his product is turned out under the best conditions and by a high class of operatives. For it is now recognised as a fact that the best work is performed only by the best class of help, and that this class will work only under the best conditions. In view of the foregoing, employers need not be deterred from the adoption of these features by the feeling that they would be diverting either their attention or their money from legitimate business channels. Too often have enterprises on the point of failure been resuscitated and brought to a high state of success entirely through the adoption of industrial betterment features.—*Cassier's Magazine.*

Machinery to Roll Glass.

An invention for drawing molten glass out of the furnaces and rolling it mechanically, has been sold to a syndicate of plate glass manufacturers for £200,000. The inventor is a Belgian, Mr. Fourcault, and the purchasers of his patent rights are German, French, Belgian, and Bohemian manufacturers. Only high priced manual labour has been able to do this work heretofore. In making window glass the viscid glass was drawn out from the furnaces and blown into cylinders by men, and with plate glass the hot molten mass was cast from pots and rolled to the desired thickness. The new mechanical process is of course, much cheaper and quicker. The machine brings the liquid glass from the pots and draws it between rollers, seventeen pairs of which tower above the pot. The mass of hot glass gradually cools as it passes between the rollers, and emerges from them a great plate of perfect glass, polished on both sides and of any desired thickness. Great promises are held out for this wonderful invention.

The ....Motor.

MOTOR NOTES.

By "ACCUMULATOR"

The Wellington and Wairarapa Motor Co. Ltd have succeeded to the business formerly known as that of Jenkinson & Co Ltd

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I am informed that the car leading the motor-car procession through the tunnels of the *Mauretania* (which formed the subject of an illustration in last month's PROGRESS) is a six-cylinder Napier

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The Motorist is the name of a new fortnightly review published by Argyll Motors, Ltd The first number, issued on November 10th of last year, has reached this office and is of a highly attractive nature

* * * * * *

A new method of adjusting chains has just been introduced by the famous Peugeot house Instead of the old left and right-handed nut placed on the radius rod midway between the driving sprockets and the back wheel, there is a very neat adjustment provided on an extension of the radius rod which projects behind the axle. Not only is it more accessible but provision is more easily made for fitting a gear case

* * * * * *

A five-ton steam wagon was landed in Dunedin a few days ago to the order of Messrs Ross and Glendining, who were first in the southern city to recognise the great saving to be made by the use of steam traction

* * * * * *

The voracious parasitic insect, or spider, popularly known as a tick and familiar in most hot countries, has been scheduled in New South Wales as an undesirable alien, and strict watch is kept on the frontier to secure its exclusion A Brisbane motorist with a 16 h p car was recently stopped at the frontier by the local "tick inspector" and condemned to forty-eight hours quarantine while the car was undergoing the process of being smeared the regulation number of times with disinfectant

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The Czar of Russia is the possessor of a bullet-proof automobile, devised not for safety alone but for comfort as well It is fitted up with a chest of drawers, cabinet, easy chairs etc

* * * * * *

In an advertisement in a contemporary, I notice that one satisfied member of the medical profession in describing the merits of his particular car, gloats over the fact that his high-tension magneto is "gear-driven, and not, be it remembered, driven by chains or belts—another very striking feature in a small car" Certainly a belt-driven high-tension magneto is a striking feature!

* * * * * *

Although the success of the recent Olympia Show has reduced the interest taken by British motorists in the Paris Salon, there is no doubt the French exhibition will still attract automobilists from all parts of the world Among British exhibitors will be Argylls, who are fast gaining a footing on the Continent as well as in the Colonies

* * * * * *

Unavoidable circumstances prevented the inclusion of the new Straker and Squire cars in the Tourist Trophy Race recently held in the Isle of Man. Messrs Straker and Squire Ltd have therefore made arrangements for carrying out a 4000 miles reliability trial under the auspices of the Automobile Club so that, irrespective of the Scottish Trials, in which the cars of Messrs Straker and Squire performed so satisfactorily, this club trial will enable the cars further to demonstrate their merits in the public eye

* * * * * *

In a recent number of PROGRESS were described the advantages of substituting steam motor wagons for horse traction in the carriage of heavy goods It is gratifying to note that the satisfactory working of those in use in Auckland, Wellington and Christchurch has caused numerous enquiries to be made for this class of vehicle

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After exhaustive enquiries and trials of various wagons, by their engineer, the Rangitikei County Council have purchased a wagon from Messrs Norman Heath & Co, Wellington, who represent Messrs Sydney Straker & Squire, Ltd Three more of these wagons have been shipped to orders received from different parts of the Wellington Province

* * * * * *

British motor-car manufacturers are just discovering that it is necessary for them to build special cars for tropical climates It has now dawned on them that coach-work into which a good deal of glue, to say nothing of varnish necessarily enters, although quite perfect for home use, is of no value in the East Many firms are now importing motor cars into India and other of our great tropical and semi-tropical dependencies, so, unless buyers want to escape grievous disappointment, it is necessary in ordering a motor car to have a distinct understanding that all the coach-work is to be constructed to withstand very different conditions from those obtaining in the home country

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Judging by the increase in the use of steam wagons it is safe to predict that the time is not far distant when by the use of steam traction with electric, steam and petrol cabs, and other vehicles, the old order will change the congestion of traffic will be minimised and we shall have our streets cleaner and more sanitary than at present

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Two of the largest motor omnibuses in New Zealand are about to be put into service in the Hawkes Bay district They are constructed throughout by Messrs J I. Thornycroft & Co, and each has seating capacity for forty people. The engines have four cylinders and are capable of developing 30 h p The buses have been assembled and placed in running order by the Wellington and Wairarapa Motor Co Ltd at their new garage 2 Cuba street, Wellington

* * * * * *

Now that large strides have been made in the realm of the industrial motor vehicle, the desirability of standardisation of parts is well worth serious consideration by manufacturers The subject was discussed at some length in *Motor Traction*, and it was advocated that standardisation should be adopted which would render many of the details on all makes interchangeable The matter, however is attended with great difficulty

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The Russell motor car is fast gaining popularity in New Zealand, and the two interesting photos which we print in this issue, through the courtesy of the agents, Messrs Magnus, Sanderson & Co, depict this make of car in two very useful forms viz. as a hockey and golf brake, and as a char-a-banc The hockey and golf brake is made to seat ten passengers comfortably, or, if required, it can be made in larger sizes. The horse-power is 16 to 24 The char-a-banc is capable of seating twenty passengers and is of 24 h p A feature of both cars is that they are fitted with the Swinehart tyres, which are made on the solid principle, but have great resiliency and have proven highly satisfactory for very heavy services.

NEW THORNYCROFT 30-H P OMNIBUS FOR SERVICE IN THE HAWKES BAY DISTRICT

40 h.p. Six-Cylinder Napier Chassis.

It is universally acknowledged that British machinery is superior in durability and finish to that produced in any other part of the world, and in the construction of motors the Napier chassis is looked to uphold this reputation, representing as it does the highest possible standard of British motor engineering

It is claimed that the six-cylinder Napier chassis is better than any chassis made by other manufacturers at the present time. This claim is not made without proof being given on each point. The material and workmanship are an example of the reliability of the highest British engineering skill The proof of this is that a guarantee is given for three years Not many chassis will be found to combine so many refinements in detail with all-round efficiency, which has resulted in its gaining such distinction in International Hill-climbs, Reliability, Speed, Petrol Consumption and other contests during the past season which are requisite to prove the best all-round and most perfect automobile at the present day This car is not designed to shine merely in one type of competition only but to be efficient on all points.

In further proof of these facts it will be remembered that no other car has successfully run from Brighton to Edinburgh on top speed gear, no other car of similar horse-power has run over 18 miles per gallon of petrol, nor run six hours through dense London traffic with the radiating water remaining 47° below boiling point all of which points are certified by the A C G B & I

There are many points in design and construction in which this chassis shows advancement, for although many makes of chassis may equal this on some points, it will be found that they cannot compare with it in more than a few such points, whilst in all other points the Napier will be found to be undeniably better.

The cylinders are cast in pairs with the inlet and exhaust valves—which are the same size and interchangeable—on the same side of the engine and actuated by one cam shaft, on which the cams are part of the solid shaft, making it impossible for them to become loose, as is the case where they are only keyed on; while the whole valve operating mechanism is entirely enclosed and protected from dust, etc, and automatically lubricated

The perfected Napier Synchronised Ignition is the simplest form of electrical ignition appliance that has yet been designed It has only one coil which, with the commutator, etc., is on the dash and, therefore, easily accessible This ignition is the outcome of several years' experience and has always proved entirely successful in practical use on the Napier cars, giving, as it does, absolutely even firing on all cylinders

The system of lubricating the engine has already been described in PROGRESS columns

The Napier Clutch is all metal The faces being automatically oiled when the clutch is withdrawn, which ensures absolute lack of vibration as it is being inserted, and enables it to be slipped as much as required in traffic without fear of any damage or burning the face as is the case if a leather clutch is slipped Immediately the Napier clutch is let fully in the oil is pressed into grooves which are cut in the outer face to receive it, and the clutch grips firmly. By means of a double leverage device the clutch can be manipulated with the lightest possible touch on the foot pedal, thus doing away with all the strain and tiring effect of pressing against heavy clutch springs

Every detail of refinement for the comfort of those using the car is considered, and the important point of reducing discomfort from road vibration is thoroughly overcome by means of three point suspension, the two long road springs being connected at the rear of the frame by a third transverse spring, this system greatly minimising vibration throughout the car, and making the back seats even more comfortable than the front seats, if possible In addition to this, Napier Road Equalisers are fitted to all road springs which eliminate

THE RUSSELL CHAR-A-BANC OR OPEN MOTOR 'BUS.

all sudden jolts, and in fact cause the car to glide over the roughest roads, thus greatly minimising the fatigue of travelling

The use of the Napier Transmission, which has been so freely copied recently, is adhered to in this chassis. This transmission, which was introduced by Mr Napier in 1902, has the third or top speed directly driven from the engine crankshaft to the differential axle, without the use of any loose gear wheels. Thus not only is the maximum power of the engine transmitted to the road wheels, but the necessary noise of intermediate gear wheels is entirely eliminated The transmission shaft and differential run on ball bearings, and the road wheels are mounted on specially designed double ball bearings, which are practically frictionless

On this particular chassis the drive is transmitted to the road wheels by means of a shaft, but whether this form of transmission or the chain-driven type is used, the price remains the same

A further Napier refinement is the solid aluminium dashboard, which has many advantages over the old-fashioned wooden or painted dashboards, which crack and warp with the heat of the engine, and are soon spoiled by the oil and grease with which they are often smeared This aluminium dash is easily cleaned, cannot warp, is not affected by heat, grease, or weather, and always looks well

The few points given above are amongst the numerous interesting features and refinements which will be found on this chassis, which, together with the well-known advantages which are obtained by the use of a correctly-designed six-cylinder motor, such as Flexibility, Silence, Efficiency, Reliability and absence of Vibration enables it to be justly claimed for this six-cylinder Napier chassis that it is one of the most up-to-date and perfectly constructed chassis of the year

The fact that over seventy manufacturers of all nationalities are now noticing the six-cylinder Napier by starting to experiment with and build six-cylinder cars is sufficient proof that the six-cylinder Napier is in advance of many motors at present built

Above all, it is well to remember that good as is the six-cylinder principle at present with the exception of one or two other firms all are quite experimental in many cases not yet even having run on the road

The Practical Man and the Technical Press.

It sometimes happens that some matter-of-fact person who is without any appreciation of anything that is not intensely practical, finds fault with the technical press because from his way of seeing things, it is not technical enough This sort of man is strictly utilitarian He looks on the human element in the world as so many machines for grinding out work Judging from observation with him everything that does not fit into his peculiar methods of thought and of work are excrescences which should not be allowed, and if by any chance they should appear he considers that he is doing his fellow men a kindness in promptly trying to suppress them A formula is his delight as being the only proper way of expressing any technical information that can be expressed by one, and he is ready to take issue with the man who uses a figure or a letter unnecessarily even there When the formula cannot be made to express the desired information it should then be put into some other condensed form

There is a sort of food that is sometimes used for certain kinds of conditions. I am not sure of the proper designation for it, but I understand that it is composed of meat and vegetables which have been dried and pressed to such an extent that a few ounces contain all the chemical valuables which were in many pounds of the original substances in their natural form This is the ideal of what the technical press should be to some peaple It is well known that meat is a concentrated food, and that turnips, cabbage beets watermelons and most other vegetables are very bulky in proportion to the nourishment the scientific man finds in analysing them Perhaps it is a mistake, and some day some reformer will lead us from the error of our ways but at present it must be admitted that most of us like to have a liberal quantity of vegetables along with our meat, and so far as I know the extremely compacted food is only used by those so situated that it it not possible to get any other kind It is kept and only used in an emergency when no other kind is available

To my mind this concentrated mixture well represents the formula The meat might be said to be a representation of the strictly scientific article The vegetables naturally stand for the literature which has not a very high scientific value but which is consumed in large quantities because it tastes good, and makes people feel good after it is taken

Wishing to pay the highest compliment I can to the technical press, I think of it as the mental eating houses of the people Not hotels, understand me, but boarding houses The hotels more nearly represent the book stores where you call for what you want, pay for what is furnished to you, and. if your pocket book will stand it, get the dyspepsia and such things

If the boarding house is in the lumber woods it will set a different table from what one will, say, in the centre of New York but in any case it furnishes food to suit the general run of people who board there If it does not it loses its boarders. Even in the lumber woods men will leave one job and go to another because the board they have been getting is not to their taste

There is one other peculiarity with boarders The man who does the most kicking and growling is the dyspeptic, and the chances are that he is eating entirely too much meat and other concentrated food. When the man who fills up on vegetables is not suited he hunts another place and just quietly drops out, but the other fellow stays and kicks and sets up to represent the valuable part of the world

Beyond the choice of the things that are furnished is the way they are prepared and served Good cooking and nice, clean service is of the highest importance to most people, and there is no excuse for anything else that pretends to be fit for public patronage

There are fads and fads, and the fellow with a fad is the kind of a fellow who will make the most noise. Here is a fellow who believes in taking his food raw He wants all his information in formula

Here is the fellow who believes that the meat eaters rule the world, and that because some of the greatest of the world's workers are also great meat eaters, therefore everyone should stuff with meat He would burden the weakling with the food of the giant and wants every man to take a technical course whether he can digest it or not.

Here is the fellow who thinks the stomach should be saved from most of its work, and be fed with predigested food He wants all information reduced to the kindergarten level.

And here, worst of all, is the fellow who thinks that what he does is the only thing and that all should be guided in their eating by his tastes. He is an insufferable boor in any boarding house, either mental or physical

The wise boarder is a customer of the kind of a literary boarding house that most nearly supplies his wants as he sees them He makes use of the articles which appeal to his taste, and leaves those that do not, and generally prefers the abundance of vegetables which are easily digested to the concentrated foods It takes so much more care to properly consume the latter, and if carelessly done serious trouble is more apt to follow than with the more bulky material

Naturally, we expect the mass of articles in any trade paper to pertain to the things that interest the people of that trade, just as we expect the food of a country to be composed largely of the products of that country, but even here we find it is well not to be too narrow in the matter, for all sorts of tastes are to be satisfied

What sorts of things is it that the ordinary fellow remembers and remarks about? Is it the profound one that may really contain a germ that is to revolutionise the world? Question him closely and the chances are that he did not read the learned article at all, but he can tell you all about the device that was used to make some job a little easier and surer or the way in which some one made an emergency repair under adverse circumstances He understands the "roast" that some fellow gives to some sister trade, and is set to thinking by the one that is handed back in return

The trade paper is something that is meant for regular use It comes at intervals and sets up such a variety that we all can get something from it to suit our taste It is not necessary to eat the entire bill of fare to get a fair return for our money, nor to read articles that are not interesting or profitable to us just because we have paid for the paper

There is one thing that each one has a right to expect and that is that every thing is presented in a proper manner Coarseness should not have a place in any literature as it ranks with poor cooking

I have gone somewhat out of my way to give my ideas on these matters, for the reason that I hear some of the talk that comes from the fellow who would "scientific" everything so that it was as dry as dust, and I don't want him to make so much noise that you may think he is everything I do not want to miss my "vegetables" when I read *Wood Craft* even if I do wonder a bit what sort of pattern-maker puts three legs on a long table such as Mr Rowley shows. I give it credit for three The one coming between the fitter's feet must be near the centre on that side, and my imagination paints one at the far end of the right side I cannot quite decide whether it is ornamentation or peculiar shadow that makes the streaks on the end. The patternmaker and the fitter are so true to nature that I know the other things must be, although I am not acquainted with that particular style of table

Please, Mr Editor, do not cut out the "vegetables."—"*Practique*" in *Wood Craft*.

Perpetual Youth.

Is the elixir of life, that dream of the medieval alchemists, to be among the achievements of science in the future? Not, of course, in the sense of averting death altogether, but of staving it off of prolonging the period of youth? Certain aspects of the question are discussed by Dr Carl Snyder in an article in the *Monthly Review*, entitled "The Quest of Prolonged Youth." "It may be" he writes "that we shall never learn to avert old age It may be, but there is no *a priori* certainty Whether we do or not, it seems possible that we may at least learn its cause Of this we at present know practically nothing" Weismann, Metchnikoff, and Demange have put forward conjectures on the subject, but no comprehensive theory has yet been advanced. Weismann holds that death was brought about by natural selection, that, for the welfare of organisms, their increase must be limited. Even if this explanation be admitted, it takes us a very little way We want to know what changes take place in the organism that result in old age and death Metchnikoff conjectures that old age is the work of certain cells, which he calls "macrophags," that attack the most active elements of the tissues—brain cells, liver cells, kidney cells etc.—and convert them into a sort of connective tissue unable to carry on their former functions This hypothesis, however, is not yet generally accepted A more definite theory is based on some recent extraordinary experiments by Dr. Wolfgang Weichardt, a German physician. He submitted guinea pigs to exercise on a miniature treadmill until they fell dead from exhaustion Then he concocted from the fatigued muscles of the animals a juice or sap When this juice was injected into the veins of unworked guinea pigs it produced in them all the outward signs of fatigue, and in from twenty to forty hours they died Sap prepared from unworked animals had no such effect These experiments seem to show that prolonged muscular activity produces in the muscles a poison which, circulating through the body of an animal, causes its death In its action it is evidently similar to the poisons elaborated by bacteria. Dr Weichardt calls it "Ermudungs-Toxin" that is, fatigue toxin or poison. Following up these experiments, Dr Weichardt showed that, as in the case of bacterial poisons, a very little fatigue toxin injected into the veins of an animal acts as an anti-toxin It is possible to inoculate an animal against fatigue. Animals and even human beings thus inoculated are capable of much more prolonged exertion than they are without it These remarkable results are curiously near a conjecture by Metchnikoff, that cyto-toxins might be found which would reinforce the aging cells and stimulate them to renewed youth The bearing of Dr Weichardt's investigations on the greater problem, that biologists have been approaching from various points of view, will be seen from Dr. Snyder's remark that old age is, in some sense, merely accumulated fatigue.

Aluminium.

Up to the present time there is only one manufacturing company in the United States engaged in the production of aluminium This company is located at Niagara Falls, and has had a remarkable development The industry began in this country in 1883, with an output of only 83 pounds This was nearly doubled in the next year, and in 1885 amounted to 283 pounds In 1890 it had grown to over 61 000 pounds; in 1898 to 920,000, and in 1900, to 7,150,000 pounds The estimated output during 1905 reached the sum of 10,000,000 pounds, and the company is now increasing the capacity of its plant in the expectation that by the end of 1906 even the present enormous production will be doubled

Luck is a fool; pluck, a hero.

Pig-Iron Boom.

HUGE BRITISH EXPORTS TO GERMANY AND AMERICA.

Pig-iron is in the throes of a "boom," which will it is fondly believed, carry prices higher than for years It comes about from the busy trade proceeding abroad—in Germany especially—but American doings are now receiving a share of attention to which they have long been a stranger

There is absolutely not enough pig-iron and steel in Germany to give cousumers what they want

If proof of this is needed one piece of evidence will suffice From January to September, 1906, there were shipped from Middlesbrough close on 400 000 tons of common British pig-iron to Belgium, Holland, and Germany, and the bulk was for the last-named country Another proof is that Germany, which until a few months ago, had made a happy dumping-ground of the British market is not only unable to offer any iron or steel to Britain, but is months behind with deliveries already contracted for, and British buyers are at their wits' end to know where to get what they want as quickly as they want it

Six months or so ago the inability of Germany to sell to many British users would have been almost a matter of indifference, for America was then a seller To-day America, like Germany has not an ounce of stuff to spare On the contrary, she has bought tens of thousands of tons of pig-iron here

There seems really no one cause for the "boom" and the movement as a whole, can hardly be analysed further than to say that it is to all appearance one of the recurring periodical visitations of demand.

Shavings and Saw Dust.

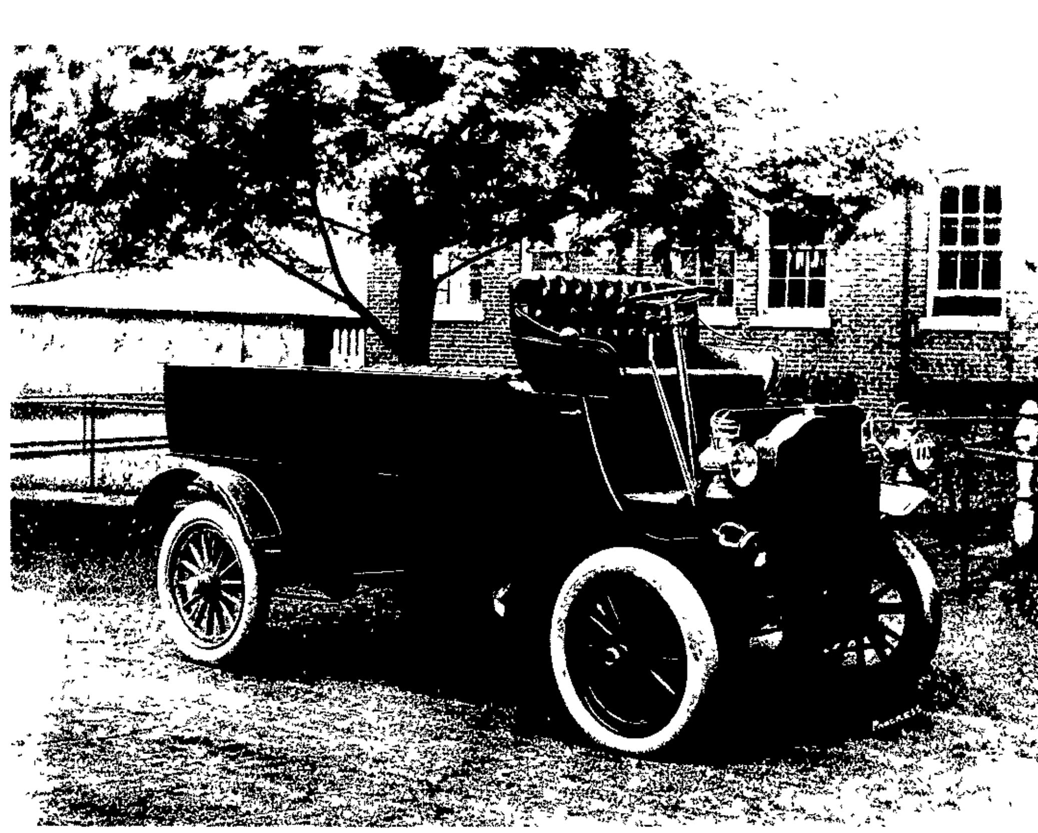
A correspondent raises the question of what to do with the large quantities of shavings and saw dust incidental to the working of saw mills and wood-ware factories, now that their use in the furnaces of steam boilers is eclipsed by the substitution of engines driven by producer gas. He asks whether there is any other use, which invention if not custom may suggest, to the factory owner encumbered with the waste products of his working In reply we have to remind our correspondent that some years ago there was a remarkable example of the profitable use of saw dust in Germany In the year 1902, this waste product was used as fuel with good results It was made into briquettes, octagon-shaped, 6½ in. by 3½ in. of a thickness of three quarters of an inch, weighing about half a pound In the district surrounding the factory where these briquettes were made the schools were heated by them, the combustion leaving very little ash and proceeding without a large flame. No binding ingredient was required, the saw dust being simply dried and pressed into the desired briquette state, and owing thus to the absence of tarry or oily substances there was no smoke in burning The weight of each briquette indicated the pressure under which it took its shape, and the edges—the authority was the United States Consul at Berne, Mr. Frankenthal, who had investigated the subject and reported—looked like polished oak The briquette in fact, was heavier than a piece of hard wood of the same size The demand created by the popularity of the fuel exceeded the supply of saw dust obtainable in the vicinity of the factory, and ship loads were therefore procured from Sweden, and cart loads from distant manufactories. Saw dust, which previously could be had for the asking, commanded a price as soon as it was known that a certain factory could make use of it Even then it was profitable to manufacture the briquettes; but unfortunately the factory was destroyed by fire, and operations came to a stand still. There is certainly room for an invention for the utilisation of shavings, and perhaps the enquiry of our correspondent may lead to some development in this direction

British Coal Trade.

The present year has been an astonishingly successful one for the British coal trade During the first nine months total exports of coal, coke, and patent fuel amounted to 42,872,853 tons, as against 36,679,755 tons during the same period in 1905, an increase of over 6,000 000 tons This is an extremely satisfactory result, and it points to 1906 being a record year for the export trade As regards the value here again the figures are distinctly cheering as will be seen from the following table extracted from the Board of Trade returns —

Coal	1905 £	1906 £
Anthracite	649,379	868 300
Steam ..	14,196,453	16 957,004
Gas	2 549,835	3,088 778
Household	508,872	558,347
Other sorts	617,442	872,430
Total coal	18,521,981	22,344 859
Coke ..	385 699	424,974
Manufactured fuel	497 163	648,045
Total of coal, coke & manufactured fuel	19 404 843	23,417,878

As regards bunker coal shipments, the total for 1906 is 13,845,545 tons an increase of 774 178 tons over last year's figure



THE RUSSELL HOCKEY AND GOLF BRAKE

ALCOHOLIC FERMENTATION.

By PERCY B PHIPSON, F C S

ALTHOUGH from time immemorial man has evidently had a very extensive and practical knowledge of the phenomenon of fermentation it is only during comparatively recent times that we find any attempt made to give a theoretical explanation of that phenomenon

Needless to say these explanations were at first as varied as they were incorrect and this can be well understood when we remember that in the days of the alchemists all chemical actions that were accompanied by effervescence were called "fermentations."

Coming to a later period we find the subject receiving a considerable amount of attention from men of science, but as these theories have, in the light of our present knowledge of the subject, merely a historical interest, they may in a short article of this description be ignored

In the year 1839 Liebig propounded the theory that yeast was a lifeless albuminous body undergoing decomposition, the molecules of which are in a state of movement and have the power of imparting this disturbance of the equilibrium to the molecule of sugar, and of thus splitting the molecule up into alcohol and carbon dioxide * In spite of the fact that Schwann and Cagniard Latour, following in the steps of Leeuwenhoek, discovered by microscopical examination that yeast consisted of cells, which under proper conditions increase and multiply and have all the characteristics of vegetable cells, Liebig's theory was accepted as a perfectly satisfactory explanation, and had firm hold for thirty years or so, when this hypothesis was shattered by the publication of the results of Pasteur's epoch-making researches on this subject, which proved incontestably that fermentation was connected with the vital action of the yeast, and although these conclusions had been arrived at by Schwann in 1836–7, it remained for Pasteur by means of extensive research to prove that Schwann's views were correct

Pasteur's theory as given in his publication "*Etudes sur la Biere*," is as follows "Fermentation by yeast, that is, by the type of ferments so called, is presented to us as the direct consequence of the process of nutrition, assimilation and life when these are carried on *without the agency of free oxygen*

"Fermentation by means of yeast appears, therefore to be essentially connected with the property possessed by the minute cellular plant of performing its respiratory functions somehow or other with oxygen existing combined in the sugar." In short, Pasteur's theory was that in the absence of free oxygen yeast had the power of taking the required oxygen from the sugar molecule and therefore, to further quote from his book "fermentation is life without air" Pasteur maintained that yeast will only ferment in the absence of free oxygen and that if there is present sufficient free oxygen for the requirements of the yeast cell it ceases to be a ferment

To better appreciate the differences that existed between the opinion of Liebig and Pasteur on the subject it will perhaps be as well to leave the theoretical side of the subject for a few minutes and study the structure of the individual yeast cells themselves In bulk the appearance of yeast is familiar to most, but, if instead of viewing it with the naked eye we make a microscopical examination of it using a strong power of say 500 or 600 diameters, we shall find that instead of appearing as a homogeneous pasty mass, it is consisted of innumerable cells either singly or in groups

The cells consist of protoplasm enclosed by a membrane called the cell wall, this cell wall has considerable resisting power, but may be burst by pressing on the cover glass, when it will appear as a thin transparent membrane

It will also be noticed that some portions of the protoplasm are clearer than others These clear portions consist of cell sap and are called vacuoles, each cell usually showing one or two of them

The cell wall is continuous, that is to say there is no opening for the introduction of food, consequently all food must be conveyed into the interior through the cell wall by means of diffusion or osmosis, therefore no food can be assimilated by the yeast unless it is in solution and is also diffusable

Now, all animals and plants for their nutriment require certain complex nitrogenous bodies known as proteins, with this difference that whereas animals require protein bodies ready formed, that is to say they are unable to form protein, which is an organic compound, out of mineral, the reverse is the case with plants This law establishes a fundamental difference between the two

In the case of yeast Pasteur found that while yeast was capable of fermenting a solution of sugar, after a time the yeast arrived at a stage when it ceases to act as a ferment, although only a portion of the sugar has been fermented This was because sugar contains no food available for its development If on the other hand the yeast is added to a solution composed of the following (Pasteur's Solution) —

Potassic phosphate	20 parts
Calcic phosphate	2 do
Magnesic sulphate	2 do
Ammonic tartrate	100 do
Cane sugar	1500 do
Water	8376 do
	10,000 parts

the growth and development of the yeast goes on as readily as it would in a prepared malt wort This clearly proves that yeast has this power, a property common only to plants, and, in short, is a plant As to what position should be assigned to it in the vegetable world, it is now usually considered to belong to the fungi Meyer creating for it a new genus the Saccharomycetes

Yeast under normal conditions reproduces itself by budding commencing in the form of a protuberance on the cell This protuberance goes on increasing until it assumes a spherical form and finally separates from the mother cell Under starvation conditions yeast has the power of forming spores

To return to the controversy that raged between the adherents of Pasteur and Liebig while the views of the latter scientist commenced to make considerable headway and gained some acceptance in Germany Liebig continued to make strenuous efforts to overturn it and although he had eventually to acknowledge that yeast was a living organism, he considered that this in no way affected the conclusion that he had arrived at, and later on (1870) he was forced to modify his views to such an extent that while he would not accept the theory of Pasteur that fermentation was essentially a vital action he renounced his theory of 1839, and attempted to explain the process on the assumption that during the lifetime of the yeast there was formed within the yeast cell an enzyme that effected the decomposition of sugar Why the yeast cell should secrete an enzyme to decompose the sugar if it was to derive no benefit from so doing apparently Liebig did not satisfactorily explain and this was evidently merely an attempt to wriggle out of an untenable position

Although Pasteur proved that yeast, or, as we may now call them the saccharomycetes, are living vegetable organisms his doctrine that "fermentation is life without air" was not so readily accepted and after a time was strongly controverted, but it remained for Adrian Brown (Director of the School of Brewing at Birmingham University) to prove by some striking experiments that fermentation always takes place with greater rapidity in those cases where the fermenting liquid is well supplied with air These results directly contradict Pasteur's hypothesis that the activity of yeast is greatest in the absence of air Prior to this Pasteur's theory was the usually accepted one, but in view of more recent investigations it cannot now be accepted without modifications, nevertheless too much praise cannot be given Pasteur for the invaluable research work he has done proving not only that fermentation was caused by a minute vegetable organism, but that no fermentation could take place without the introduction either by design or accident of the ferment (as opposed to the theory of Spontaneous Generation current at the time) and the importance of these results in placing the fermentation industries upon a scientific basis cannot be over-estimated

Although Pasteur's researches were carried out by means of cultures, it remained for Hansen (a Danish investigator) to bring this system to a state of perfection, the difference between the two being that while the former obtained his growths from minute portions of yeast, the latter evolved a process by which his cultures were obtained from a single cell with the result that he was always certain that his cultures were absolutely pure and represented only one type, a fact that Pasteur could naturally never be certain of Hansen's researches showed that there existed innumerable types and sub-types of the saccharomycetes, and although Pasteur had to a certain extent proved this it remained for the later savant to satisfactorily classify them and discover means by which these various types might be identified.

Hansen further showed that while many of the saccharomycetes were useful, others on the contrary were exceedingly injurious, and he consequently adapted his process of securing cultures from a single cell, so that "single cell" yeast might be cultivated in sufficient quantities for commercial use and now many continental breweries are using this yeast with great success This method has, for reasons that need not be entered into here not been extensively adopted in England, but this in no way detracts from the value of Hansen's work

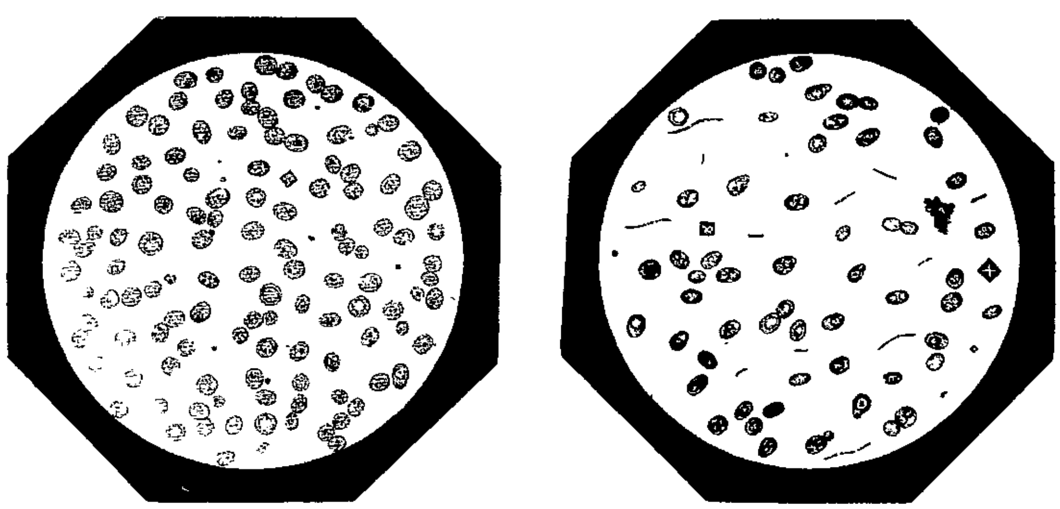
The next step in the solution of the problem was the important discovery a few years ago by Buchner who by triturating yeast with quartz sand kieselguhr and water, and then submitting this to a pressure of 400–500 atmospheres between double filter clothes, obtained a faintly opalescent liquid which had the power of decomposing sugar into alcohol and carbon dioxide, and as this liquid contained no living yeast cells, it undoubtedly proved the existence of a soluble ferment or enzyme within the yeast cell capable of bringing about these changes Buchner has given this enzyme the name of zymase

What the chemical nature of this substance is has not yet been settled, except that it is of an albuminous nature

In view of this discovery we must now conclude that fermentation is caused by the presence of a minute vegetable organism (saccharomycetes), commonly known as yeast, this decomposition by the yeast cell is only a vital action so far as that the splitting up of the sugar molecule is necessary for the nutrition and development of the yeast, the actual breaking up of the sugar being brought about by an enzyme (zymase) secreted for this purpose by the cell itself although in what manner the zymase brings about this change has not yet been ascertained

It will perhaps be noticed that I have not mentioned the exceedingly interesting moleculo-physical theory put forward by Nageli, but as it cannot be accepted after the discovery of Buchner, I have accordingly omitted it

The accompanying illustrations are taken from "The Microscope in the Brewery and Malthouse" by Matthews and Lott They show typical "fields" of Burton and London brewing yeast the latter a sample of deteriorated yeast, in this, apart from the worn appearance of the cells, a considerable number of bacteria (the various rod-like forms) can be observed



TWO VIEWS OF HIGHLY MAGNIFIED YEAST CELLS

* Besides alcohol and carbon dioxide, a considerable number of by-products are formed, the most important of which are glycerine and succinic acid, so far little is known as to how they are formed

Applications for Patents.

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

22181—A. Parker, Dannevirke Ticket-issuing machine.
22182—C. Cooper, Mangatoki Scales
22183—C. Harper, Guildford W A Disposal of effluent from septic tanks.
22184—J. Attwill, Perth, W A Railway-ticket dater.
22185—L. Decker, Sturgis, U S A Whiffle-tree attachments.
22186—E B Baker, Melbourne, Vic Treating substances under pressure
22187—W. C V. Harwood and S Reed, London, Eng. Supplying disinfectant to flushing-cistern.
22188—J. Layfield and A V Crisp, Vancouver, B.C. Cement building-blocks
22189—H. Braby, Sydney, N S W Liquid-fuel burner.
22190—A. E Moir, Melbourne, Vic Milk-can
22191—W. E Hughes, Wellington Bicycle support.
22192—H. E. Billson, Christchurch Tapered plug for soles of boots and shoes
22193—S A. Bradley, Merrigum, Vic. Fruit-carrying case.
22194—S. A Bradley, Merrigum, Vic Punnet
22195—T. Sutherland, Wellington Cooking-vessel
22196—M. Fry, Port Awanui Sheep-race
22197—G. Gilchrist, Invercargill, and J A Milne, Alexandra South Water-motor
22198—R J Turnbull, Dunedin Rotary shaking-table
22199—T. J. P. Cobb, Masterton Folding crate
22200—C S. Bayley and W H Markle, Auckland Ticket-holder.
22201—G. Stevenson, Christchurch Bottle
22202—R. Hopkins, Dunedin Vehicle-tire.
22203—C. M. Trebilcock, Malvern, Vic Milk-bucket cover and strainer.
22204—J Eddey, Dunedin Wire cheese-cutter.
22205—J. Graham, Auckland Street-watering method.
22206—W. B. Eyre, Auckland Rendering and keeping accounts.
22207—A. McLean, Brae Side Wheel.
22208—F. F Twemlow, sen Invercargill Skimmer for ploughs.
22209—W. Robinson, Riverton Trolley-brake
22210—T. Smith, Dunedin Dinner-plate
22211—W. Wilson and T P Burke Dunedin Egg-carrier.
22212—T R. Christie Dunedin Skylight
22213—A. H Imbert, Grand-Montrouge, France Treating zinc and lead sulphide ores
22214—E. A. Holman, Opotiki Cart-jack
22215—L Anderson, New York, U S A Hydro-carbon-engine
22216—A C. Raine Melbourne Vic Germ-excluder
22217—A Morgan, Palmerston North Operating electric bells.
22218—W. J Prouse, Wellington Rusticated boarding.
22219—A. C Webber, Marrickville, N S W Tool for removing and replacing tires
22220—F. E Penfold, Sydney N S W Hand-sweeper for street-cleaning
22221—J T Keane, Bendigo Vic Displaying mathematical tables
22222—United Shoe Machinery Company Patterson U S A Machine for inserting fastenings
22223—H S Marks, Leongatha Vic Door or gate holder.
22224—A. J Webster Pirron Yallock, Vic Milking-bail
22225—R S. Badger Christchurch System of advertising
22226—H E Parry Guildford W A Compound counting-machine
22227—D. Houston, St George Queensland. Acetylene-gas generator
22228—J D Jackson Prahran Vic Bath-water heater.
22229—H J Best Fitzroy Vic Boot or shoe sole sewing-machine
22230—A. A Carson, Palmerston North Water-heater
22231—F E McLean, Henley Fastening for mouth-piece of teat cup
22232—A. Jack, Palmerston North Gas-production from hydrocarbon oils
22233—F. W. Munt, Wellington Stamp-affixer
22234—J O Galbally Wellington Weather-boarding.
22235—J S Plummer, Auckland Portable cot or stretcher.
22236—J K Hitchens, Petone Axe-handle attachment
22237—T F McGarva, Christchurch Cradle
22238—H. C Kettle, Dunedin Heating water from waste heat of gas-engines
22239—R R Woodcock, Napier Flushing apparatus
22240—J B Davies Melbourne Vic Spouting-bracket
22241—T J Heskett, Brunswick, Vic Extraction of zinc from its sulphide.
22242—R O Clark Hobsonville Surface-glazed earthenware blocks
22243—R O Clark Hobsonville Yard-sinks
22244—R O Clark Hobsonville Strengthening earthenware pipes
22245—R O Clark Hobsonville Grate fastening for drains
22246—James Hanslow Cambridge Tas Wire gripper and strainer
22247—J Mackie and A G Huggins Riverlea Milk-weighing can
22248—J Darnell, Brisbane Queensland Boot-heel
22249—C. Butters, London, Eng Slimes-filter
22250—J S Heithersay, Adelaide S A Perpetual calendar
22251—T. S Humble, Geelong, Vic Combustion chamber of gas-engines
22252—J W. Manley, New Barnet, Eng Electrical Indicator.
22253—C Bristow Christchurch Milking-machine.
22254—W Platt, Highbank Potato, etc, peeler.
22255—C F Pimmer, Christchurch Centrifugal separator
22256—G Drummond Waipahi Artificial minnow.
22257—T B Sutton, Rongotea Cardboard butter-box.
22258—G M. Nichol Hauiti Axe-heads
22259—F W. Smith Blenheim Milk-sampler
22260—J Taucher Wellington Clothes-pegs
22261—The Malcolm Fraser Wheel Syndicate Ltd, London, E C Tire
22262—J T Hunter Wellington Magnetic Separator
22263—J J Weaver, Southport, Eng. Incubator.
22264—R H. Lucas Melbourne, Vic. Puncture-seal
22265—A LeBlanc Carlton, Vic Fumigating rabbits
22266—S A M Rose Richmond, Vic and H B Crowle, St Kilda, Vic Target
22267—H Quertier, Dunedin Rail-cleaner
22268—H S Griffiths, Wai-iti Axe-head
22269—J. F. P Berendsen, Wellington. Extracting gold from sand and gravel
22270—S H Frankland, Wellington Gas burner.
22271—W. Wilson and T P. Burht, Dunedin Egg carrier.
22272—A Belk Palmerston North Carcase brander.
22273—J R Jillett Titahi Bay Pleasure-boat window
22274—A H. Byron and R R Richmond, Wellington Signal lamp
22275—S J Shelton, Wellington Acetylene generator.
22276—H. Mander, Feilding Tyre furnace
22277—J D Jackson Prahran, Vic Water heater.
22278—E Brandt Melbourne, Vic Kerosene pump and cutter
22279—R K Sinclair, London Windguard for tobacco pipe
22280—A G Brandram Southsea Eng Pipe joints
22281—G Westinghouse Pittsburg U.S A Draw gear and coupling.
22282—A Cowall Blackall Queensland, and John Phillips, Tapuga Queensland Fencing dropper and wire fastener
22283—T Whittle Traralgon Vic and G G Turri Melbourne Vic (W Cummings, Malvern, Vic) Ship's progress indicator
22284—H Patanel, Paris France Wheel felloe
22285—E S Baldwin and H H Rayward, Wellington W Hubbard Dulwich Hill, N S W Lock nut
22286—M Juriss, Wellington Dumbbells clubs, etc
22287—G Hutchinson Wellington Fencing standard or dropper
22288—United Shoe Machinery Company Patterson, U S A (J. B Hadaway Brockton U S A) Shoe sewing machine
22289—D Murchison Orawia Seed sower
22290—F Sheaf Tomoana Swaith turner
22291—A H Byron and R R Richmond, Wellington Pipe joint
22292—C. D E Usher, Johannesburg S A. Slimes treatment
22293—C S Woledge, Christchurch Teapot and kettle
22294—D Cooper Christchurch Road watering method
22295—T W McDonald Port Fairy Vic Can soldering machine
22296—T H Wilson, Brisbane: Sash adjuster.
22297—W. G. Windham, London, Engl.: Vehicle body
22298—Barcock & Wilcox Limited, London (A. E. Parker, London) Chain grate stoker.
22299—C J. Johnson, Dunedin · Trolley pole.
22300—C E Muggeridge, Chapel-en-le-Frith, Eng., and The Van Kannel Revolving Door Company Limited, Eng. (C. E Muggeridge, Eng.). Door.
22301—W. Stone, Dunedin Tent peg.
22302—W. E. Potts, Gore. Dredge bucket cleaner.
22303—D. Mahoney, Christchurch. Cycle crank.
22304—E G. Kennedy, Feilding Boot.
22305—F. Parker and B. T. Wiggins, Gisborne. Scaffolding bracket.
22306—T. W. Coulthard, Mangapai Fencing dropper.
22307—P. L Smith, Northcote, Vic. Pneumatic pump connection.
22308—D. Dickie and D C. McMoth, Balfour Skim coulter and plough
22309—B. Bidwell, Chicago, U.S A.: Electric motor cooler
22310—J. Whiting, Paraparaumu Target-repairing apparatus.
22311—J. M. Johnson, Woodville · Fattening calves.

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

Wireless Telegraphy as Applied to Trains.

Along the railway line running from Madrid to Villa del Prado some highly interesting experiments have just been carried out with a very ingenious apparatus invented by Señor Balsera, telegraphist, of Madrid, for placing a train in motion in continual communication with the nearest railway station by means of wireless telegraphy

A special train was run from Madrid direct to Villa del Prado, and a receiver of the Marconi radio-telegraphic type was placed in one of the cars; the necessary "earth" was obtained through the wheels of the cars and the railway lines.

Hardly had the train started when calls began to be received from the transmitting station, which was located in the telegraph office at the Madrid terminus, the messages were received with a Morse apparatus steadily, in a perfectly clear manner, without any hitch, and the working continued quite smoothly even when the train was running at a speed of over thirty miles an hour.

When crossing a bridge of over 500 ft. in length spanning the Jarana river, the speed of the train was reduced to ten miles an hour to enable the action (if any) of the materials of the bridge upon the telegraphic apparatus to be observed. As a matter of fact, some slight changes in the signals received were observed, but they did not suffice to interrupt communication between the two stations.

It was found that the greatest degree of perfection in transmission was obtained when the train was running in a direction perpendicular to the line which connected it to the transmitting station, on the contrary it increased in ratio as the angle formed by the direction of the train and by the telegraphic line which connected it to the transmitting station became more acute.

The experiments made gave very satisfactory results, but Señor Balsera is now arranging for more extensive tests, covering a long stretch of railway line. This gentleman is also busy making improvements in another interesting apparatus he has just invented, for firing and guiding torpedoes by the aid of wireless telegraphy

A New Explosive.

Very interesting trials have just been made at Stockholm with a new grenade and explosive invented by Dr Holmgrey Amongst the visitors present were General Wille (German), two delegates from the firm of Krupp, Mr Jamasaki a Japanese artillery officer, and several Swedish notables A 12 cm mortar was used The new explosive is extremely powerful, but it can be handled safely and there is no risk of the shell exploding in the mortar To show this the inventor bored a hole in the jacket of the shell, and set light to the explosive which burnt with a steady flame for a few seconds and then went out. The whole was then stopped up and the shell fired off No explosion occurred till it reached the point of impact. Further details as to this material are being kept rather secret

..Legal..

CONTRIBUTED BY H F VON HAAST M A LL B

RECENT DECISIONS.

COMPANY ARTICLE APPOINTING MANAGING DIRECTOR FOR FIXED PERIOD IMPLIED AGREEMENT STATUTE OF FRAUDS—The Pioneer Rubber Works of Australia Ltd. bought the business of Barnet Glass & Sons. Article 55 of its Articles of Association provided that Barnet Glass should be managing director for ten years at a salary of £500 a year. Mr Glass signed the articles and a consent to act as managing director, and for over four years acted as managing director, and received his salary as such. In 1905 negotiations between the company and the Dunlop Company resulted in the amalgamation of the two companies by way of purchase and absorption by the Dunlop Company of the undertaking and assets of the Pioneer Company, and the taking over and discharging the Pioneer Company's liabilities. Mr. Glass was party to the negotiations and attested the affixing of the company's seal to the final agreement between the two companies. Throughout, however, he asserted his right to be maintained as managing director at a salary of £500 Three weeks after the resolution to wind up the Pioneer Company had been passed, the liquidator, Mr. Shackell, took possession of the company's warehouse, and from that date Mr Glass received no salary Mr Glass had previously written a letter to Mr Shackell claiming by virtue of article 55 to be retained as managing director at a salary of £500 Mr Shackell, instructed by the directors, replied that the contemplated sale to the Dunlop Company would carry with it the obligation to carry out the "contract with you" so far as regards the salary of £500 per annum for the balance of the term of ten years. After some fruitless negotiations with the Dunlop Company for employment, Mr. Glass sued the Pioneer Company for breach of contract. The company argued that the contract (if any) was made before the incorporation of the company and the company was therefore incapable of ratifying it that no fresh agreement had been entered into after the company's incorporation, that there was no note or memorandum of the contract as required by the Statute of Frauds, and that, if there were a binding contract, Mr. Glass had waived his rights under it by concurring in the acts resulting in the agreement to transfer to the Dunlop Company, which rendered the performance by the company of the contract with him impossible HELD by the Full Court of Victoria that a contract was effectually made between the company and Mr Glass to employ him on the terms of article 55 and was to be implied partly from the articles and partly from the conduct of the parties that Mr Shackell's letter referring to "the contract with you" was a sufficient memorandum under the Statute of Frauds, that Mr Glass's own concurrence as a director in the acts which rendered the company unable to perform its contract with him left his personal rights, in respect of the breach of contract, unaffected, and that he had never waived his rights or led the company to suppose that he would not assert them He was therefore awarded £1000 damages *Glass v The Pioneer Rubber Works of Australia Ltd XI Victorian L R* 754

PATENT SALE BEFORE PATENT OBTAINED BURDEN OF PROOF —The Welsbach Light Company sued Mr Robert Lascelles for infringement of its patent granted in 1894 for mantles for incandescent burners He alleged (*inter alia*) that the invention had been publicly used in Victoria before the patent was obtained, and that the patent was invalid because the words "preferably uranium" in the specification were misleading It was shown that McEwan & Co had sold and the Gast Co had used mantles similar to those patented some years prior to 1894 HELD by the Full Court that if a man who had invented a new means of making a new article has sold that article in the ordinary course of trade for profit before he obtains a patent for it, a patent subsequently obtained by him for the manufacture of that article is void But the substantial identity in manufature of the article patented with that previously sold must be proved by the objector in a suit for the infringement of the patent and mere conjectures formed from external resemblances will not be sufficient to shift the burden of proof and the objectors had failed to prove this identity HELD further that the mistake of the patentee in expressing his preference for urania over ceria whereas subsequent experience showed that ceria produced a better illumination did not invalidate the patent and that a patentee is not to be deprived of the whole benefit of his patent for a mistake in something which he does not claim, and which is not an essential to the performance of his invention *Welsbach Light Company of Australia Ltd v Lascelles XI Victorian L R* 677

TRADE MARK RESEMBLANCE REGISTRATION.—Messrs Lever Brothers are the holders of four trade-marks for soap "Sunlight Soap," "Sunlight," "Sunbeam," and "Sunshine" The Registrar of Patents granted Messrs Newton & Son's application to register as a trade-mark for their brand of soap the words "Rising Sun" Against this decision Messrs Lever Brothers appealed Some of the latter's advertisements contained a representation of the sun either rising or setting but there was no resemblance between the wrappers or the get-up of the soaps of the rival firms HELD the sound of the words "Rising Sun" would not be likely to deceive, so as to mislead any ordinary person into buying "Rising Sun" soap, thinking that he was getting "Sunlight" soap The appeal was therefore dismissed *Lever Brothers v Newton and Sons IX Gaz L R* 157

MOTOR CAR GIVING WARNING OF POLICE TRAP OBSTRUCTION OF POLICE IN THE EXECUTION OF THEIR DUTY —Mr Little, having a strong sympathy with motorists and a patriotic dislike of police devices for entrapping unwary and too speedy chauffeurs observed at Croydon two constables lying in wait by the road-side with stop-watches and timing motor cars as they passed over certain measured distances, with a view to prosecuting those who drove at an unlawful rate of speed He therefore waved his hand and a newspaper and called out "Police-trap" to approaching drivers who promptly slackened speed and proceeded slowly over the measured distances The police as usual, were furious and prosecuted Mr. Little for wilfully obstructing the constables in the execution of their duty Mr Little's counsel contended that he had not obstructed the police but had merely done a perfectly lawful act in preventing people from committing offences Mr Little was not acting in concert with the drivers warned and there was no evidence that at the time he gave his warnings the cars were travelling at an unlawful rate of speed and that Mr Little prevented the police from obtaining evidence thereof The justices who heard the information dismissed the case and it was HELD by Lord Alverstone C J Darling and Ridley J J that although the case was very near the line there had been no obstruction of the police in Mr Little's warning people that there was a police-trap in front, and by the two former judges that the obstruction need not be physical obstruction *Bastable v. Little* 23 *Time's L R* 39

COMMON CARRIER SPECIAL CONTRACT BURDEN OF PROOF —Messrs Silbert & Sharp consigned 179 cases of apples from Fremantle to Perth by the Government Railways under a special agreement that the Commissioner of Railways was not to be liable for loss except by the wilful negligence of the Commissioner or his servants On arrival of the consignment at Perth, three cases were missing The Commissioner, on a claim being made for their value, denied liability and gave no explanation as to non-delivery In an action by Messrs Silbert & Sharp against the Commissioner HELD that on proof of the special contract and the non-delivery of the goods the burden of proof was on the Commissioner to show that the goods had been lost and that as he had not done so, Messrs Silbert & Sharp were entitled to judgment *VIII Western Australian L R* 77

BY-LAW OF TRAMWAY DELIVERING UP TICKET — A by-law of the Norwich Electric Tramway Company provided that "each passenger shall, when required to do so, either deliver up his ticket or pay the fare legally demandable for the distance travelled over by such passenger" Mr Green who was travelling by one of the company's cars paid his fare and received a ticket When the car became crowded he courteously gave up his seat to a lady and as often happens in such cases was thereby occasioned much inconvenience When the inspector asked him to produce his ticket he could not find it and declined to accede to the inspector's demand to "Produce your ticket, pay your fare, or leave the car" A charge was therefore laid against him for infringement of the by-laws, but the justices dismissed the information on the ground that no request had been made to Mr Green to "deliver up" his ticket HELD by Lord Alverstone, C J Ridley and Darling, J J that the by-law was reasonable and applied as the demand made was equivalent to a request to the passenger to deliver up his ticket or pay his fare and that the case must go back to the justices for further consideration —*Hunt v Green* 23 *Time L R* 19.

ENGINES, MACHINERY, APPLIANCES,
&c., WANTED AND FOR SALE.

FOR SALE — Two Astronomical Telescopes. One 3½ in and one 6in. (Cook & Son). Apply to F. Hitchings, Sydenham Observatory

WANTED to sell two small Dynamos, one of 6 amperes, the other 12. Both will work at any voltage up to 50. Apply to ' X," PROGRESS Office.

PICTURE FRAMING executed in all the latest and most up-to-date styles; Antique Brown Stained Moulding a speciality. Write for our illustrated catalogue. R. & E. Tingey & Co., Ltd., Wellington.

MOTOR CARS.

THE GARAGE, 81 Manners St. Motor Cars for Sale · Beeston Humber, 6½ h.p, £225 terms; new Covert chainless, any trial, £215; Winton Touring Car, 4 seat, £175. Cars cleaned and stabled from 2/6 per week. Nicholls, The Garage, 81 Manners St., Wellington.

WALTER GEE & COMPANY—Manufacturers of Self-coiling Revolving Shutters and Venetian and Holland Blinds of every description. Factory · Quin St., off Dixon St., Wellington.

PURCHASERS of real estate, either houses, sections or farms, should apply to H. Ernest Leighton 9 Featherston St., or Hutt, who has the finest selection on the market.

WANTED KNOWN—All Classes of Electro-Plating and Engraving executed at Chas. H. Williams & Sons, 85 Willis street, Wellington. We are not experimenters but have been established over 30 years. Write for Price List.

WANTED—Everyone to know that they can have their old electroplate ware made equal to new; Bedsteads relacquered, Fenders, Lamps, Screens, etc., antique coppered; Bicycle and Coach-builder's work, Nickel or Brass Plated, Electro-plating of all descriptions executed at the Sterling Electro-Plating Co., 34 Lower Cuba street, Wellington.

A New Aerial Torpedo.

Of late there seems to have been a veritable epidemic of warlike inventions Major Unge a Swedish officer, has invented (and has just tested at the Marna shooting-grounds near Stockholm, in the presence of Field-Marshal Leth) a new aerial torpedo. At the tests in question they were charged with 1 kilo 600 of cotton fulminate steeped in water. The torpedo-tube is only 1 m. 70 in length, and the entire apparatus weighs so little that one man can easily carry it under his arm. In spite of this the torpedo can make a hole (at the point of impact) of 2 m in depth by 2 m in diameter, the stones and turf being hurled to a distance of several hundred metres

Great English Bridge.

The King Edward bridge recently opened on the North-Eastern Railway at Newcastle-on-Tyne, is the greatest feat of British engineering since the Forth bridge was built It has been in course of construction for over five years, and cost £500,000.

It is always better to take things as they come than to attempt to catch them as they go

S. C. Stubberfield,
Diamond Mounter, Gold and Silversmith,
Moller's Buildings
Worcester Street, Christchurch

DO YOU WANT A PROPERTY
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Whether requiring properties in town or country anywhere in New Zealand, you will find something in our extensive List to suit you.

FORD & HADFIELD,
Auctioneers, Sharebrokers, Estate Agents,
158-160 Hereford Street, CHRISTCHURCH.

A PREMIUM ON THRIFT.

THE chances now offering put a premium on thrift. Never were more openings for a safe, legitimate 10 %. But you haven't studied Gold, Coal, Patents, Real Estate and you're too shrewd to back dark horses.

You want a proposition put before you in plain, square terms Then you can rely on your common sense Exactly. It was to meet your case we started broking.

We have built up a sound, steady business on **Satisfied Clients.** Just this way we aim to increase it

SEND US A LINE

J. S. SCHWARTZ & CO.,
Brokers,
176 Hereford Street.. CHRISTCHURCH.
The Bank of New Zealand is next door.

Canterbury Builders

If you require New Zealand or Foreign Timbers in any quantity, Picton Cement, Stone or Hydraulic Lime, T T or O K Stone, Fancy, or other Bricks, Pipes, etc., let us quote you

We will undertake to deliver with the least possible delay, and furnish only the best obtainable always

PROMPTITUDE! SATISFACTION!

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MIRACLE Concrete Building Blocks. Double Staggered Air Space. Frost-proof, Moisture-proof Investments small, profits large. Block and Brick Machines Sewer Pipe Moulds, etc Everything in the concrete line. Manufactured by the Miracle Pressed Stone Co., U.S.A.

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SOLE AGENTS.

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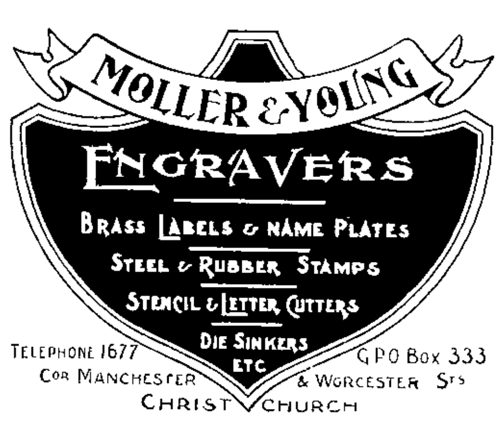
Fine Catalogue Work
Our Specialty.

Progress Printing Co.
Limited,
96 Cuba Street, Wellington.
Telephone 2234. Printers of "Progress."



DO YOU KNOW,

MR ADVERTISER, how many different sorts of advertising there are?

Probably always looked on advertising as all the same, eh? But it is not There are three great classes of advertising.

Perhaps the reason yours is not so effective as you would like, is because you are pursuing methods belonging by right to an altogether different kind of proposition

Care to talk it over? No obligation.

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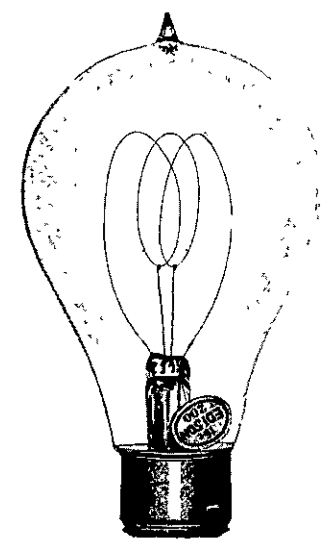
GENERAL ELECTRIC CO., U.S.A.

British Thomson-Houston Co., Rugby, England.



THE EDISON LAMP.

Edison Lamps.

BUY only the Genuine Edison Lamp. Its quality is the best; its useful life the longest; its cost less than others in the end; and it is the most extensively used Lamp in the world.

The EDISON LAMP is at present supplied exclusively to the following bodies:—

Melbourne City Council	Sydney Tramways
Launceston City Council	Brisbane Tramways
Wellington Municipal Council	Perth Tramways
Ch ch. Municipal Council	Kalgoorlie Tramways

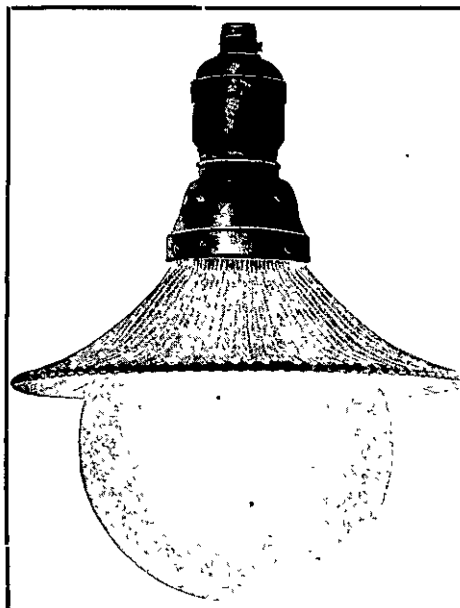
and numerous electrical supply bodies.

The total supplied to the above customers during the last twelve months is 200,000. Total output of factory, 26,000,000 per year.

Exhaustive tests on various makes of incandescent lamps have been made by most of the above customers to determine their efficiency, economy, life, and candle power, and, without exception, the EDISON LAMP, manufactured by the

GENERAL ELECTRIC CO. of U.S.A.,

has been given first place.



2.5 Watts per C.P. Ordinary incandescent lamp, 3.75 to 4.5 Watts per c.p.

THE MERIDIAN LAMP.

SOLE REPRESENTATIVES AUSTRALIAN GENERAL ELECTRIC COMPANY,

NEW ZEALAND—Harcourt's Buildings, Lambton Quay, Wellington. **MELBOURNE—Equitable Buildings—SYDNEY.**

TANGYES, LTD.,

Have now over 25,000 BRAKE HORSE POWER at work and on order in

SUCTION GAS PLANTS.

The following Plants are now at work or on order in New Zealand:—

23 Brake horse-power—R. N. Speirs, Cabinetmaker, Foxton.
39 Brake horse-power—Redwood Bros., Flourmillers, Blenheim.
29 Brake horse-power—Friedlander Bros., Grain Mchts., Ashburton.
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88 Brake horse-power—Mephan Ferguson Steel Pipe Co., New Lynn.
115 Brake horse-power—Canterbury Roller Flourmills Co.
44 Brake horse-power—Tonson, Garlick and Co., Auckland.
4½ Brake horse-power—Mr J. M. Chambers, private electric installation, Auckland.
9 Brake horse-power—Alfred Nathan, Esq., private electric installation, Auckland.
Two 88 brake horse-power—W. Dimock and Co., Wellington.
10 Brake horse-power—Stock, Auckland.
17½ Brake horse-power—Stock, Auckland.
6 Brake horse-power—Macky, Logan, and Caldwell, Auckland.
13 Brake horse-power—W. T. Davies Co., Boot Manufacturers, Auckland.
52 Brake horse-power—West Coast Refrigerating Co., Ltd., Patea.
63 Brake horse-power—Conditional order, if 52 h.p. successful.
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39 Brake horse-power—Anderson & Donald, Featherston.
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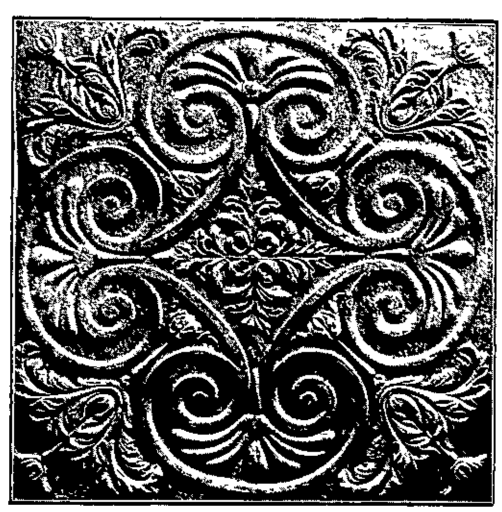
FOR CEILINGS AND WALLS.

FIRE PROOF! SOUND-PROOF!
STRENGTH AND DURABILITY!
MARBLE-WHITE FINISH!



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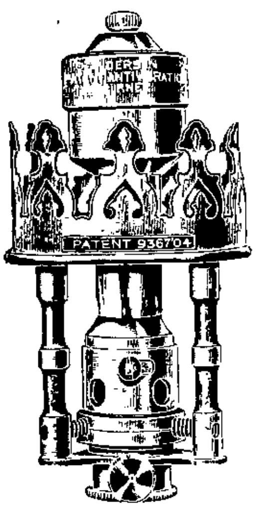
TELEPHONE 2129. **47 INGESTRE STREET. WELLINGTON.**

THE "ANDERSON" ANTI-VIBRATION
Incandescent Gas Burner.

Patented in all Countries.

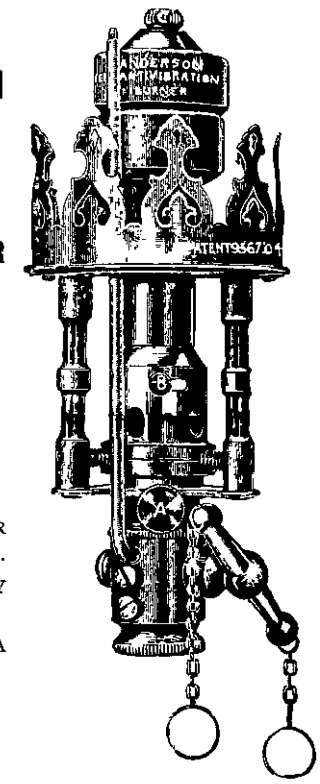
THE CHEAPEST AND MOST SCIENTIFICALLY DESIGNED ANTI-VIBRATION BURNER ON THE MARKET.



Ordinary Anti-Vibration Burner.

PROLONGS THE LIFE OF MANTLES FROM 8 TO 15 TIMES THEIR PRESENT DURABILITY.

British Manufactured Goods.



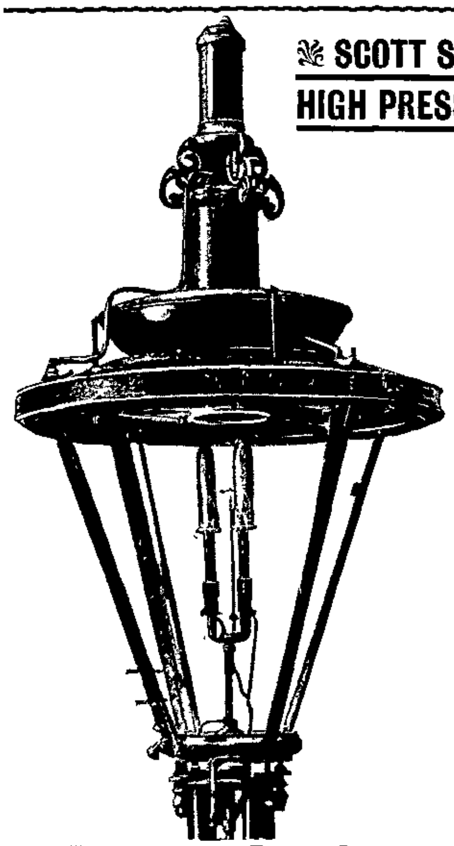
Complete Anti-Vibration Burner.

ADVANTAGES.

- Does Not Obstruct the Downward Light.
- Patent Anti-Vibrator and Burner Combined
- Burner Easily and Instantly Detached from Nipple.
- Does Not Light Back.
- Free from Roaring.
- Mantle Rod Securely Held Fast or Instantly Released if Broken.
- Steatite Ring Fitted to Every Burner Head.
- Every Burner Fitted with a Standardised Brass Nipple.

For Street Lighting, Railway Stations, Factories, Workshops, Warehouses, Churches, Licensed Houses, Shops, and Household Use.

SCOTT SNELL HIGH PRESSURE Gas Lamp.



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

THIS Lamp has been scientifically tested in London, Paris, Berlin New York, Chicago, St Louis, Boston, and various other British and Foreign towns. All tests show **Maximum Efficiency.**

It has been applied to Docks—over 200 installed in one Dock. It has been applied to streets too numerous to specify. A typical installation may be seen in Whitehall and Parliament Street Westminster, **saving over £100 a year** in cost, and **giving seven times the amount of light** of previous system.

It has been applied to various **Halls, Hotels, Shops, Railway Stations,** and various other establishments.

COMPARED WITH COMPRESSING SYSTEMS

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

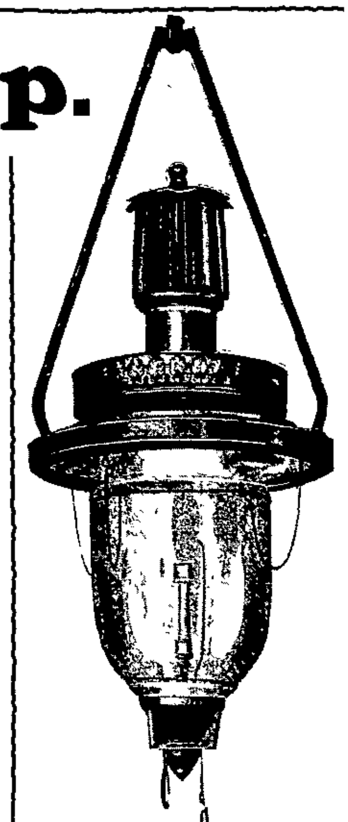
A street may be transformed in a single day by installing Scott Snell Lamps, **without disturbing street surface or traffic.**

Free of Cost, by means of **Waste Heat,** this Lamp provides itself with compressed air at nearly 2lb per square inch pressure

COMPOSITE BODY LAMPS.

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

Guaranteed gas consumption, 15ft. per hour



Type of Suspension Circular Lamp. Over-all height, 54in. Width 16in. without globe.

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Telegrams : "DACOLIGHT, LONDON."

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