

THE PROPOSED GREAT SUSPENSION BRIDGE OVER THE HUDSON RIVER, NEW YORK CITY.

We illustrate in the present issue the general plans for a suspension bridge over the Hudson River at New York City—by far the greatest bridge of the kind ever projected. The plans are issued by the New York and New Jersey Bridge Company, they being authorized by Congress, subject to the direction of the Secretary of War, to construct the bridge in question. The bridge is to extend from a location between 59th and 69th Streets on the New York side to the opposite side of the river in Union Township, N. J.

The plans are largely self-explanatory. The bridge will have a clear span of 3,100 feet—which is almost double the span of the Brooklyn suspension bridge.

The board appointed by the Secretary of War decided that it is probable for \$23,000,000 a six-track railroad suspension bridge of 3,200 feet span could be built, and it considered the amount of traffic that such a bridge would accommodate sufficient to warrant its construction.

The plans and specifications were prepared by Mr. Theodore Cooper, of this city, a member of the commission of expert bridge engineers appointed by President Cleveland, and who has since been retained by the bridge company.

The structure he proposes is a stiffened suspension bridge, the cables carrying only the part between the piers, the approaches to the main span being carried by deck trusses. The main span is stiffened by two through trusses, which may be either continuous for the entire span, or may be hinged in the middle. On the illustration the general dimensions are quoted. There is to be 150 feet head room, and, as will be seen, the river is left intact, no pier being established outside the regular pier line. The towers are to be of steel, commencing about 50 feet above high water, below which level masonry is used. The lateral and sway bracing of the main span and towers is to be of members rigid enough for compression, although some of them may normally be in tension. The general details, such as length of versed sine, the number of and the arrangement of cables, and the depth of trusses, are left to the bidders.

The main piers are to be carried down to rock; the foundations of the viaduct piers are left to the approval of the chief engineer. Quite an exhaustive list of strains allowed and of strengths and of coefficients in general are given. Thus for the wire in the cables a maximum stress of 54,000 pounds per square inch is allowed. In the usual construction of a suspension bridge the saddles which are on top of the towers are movable, being mounted on balls or rollers. The specifications for the proposed bridge provide that the towers and cables must be treated on the supposition that the saddles are or may become immovable. No closed forms are allowed on the bridge, all parts of which must be open for inspection. In other matters the same thoroughness appears. Thus rivet holes, if punched, must be punched too small and must be brought to a proper size by reaming.

Some space is given to the question of the cables. These are to be of straight steel wire, which must be not less than 1/4 of an inch in diameter, and the wire may be twisted into ropes for compacting, or, as in the Brooklyn Bridge, may be formed by compacting the straight untwisted wires. The engineer notes that the unprecedentedly large diameter of the cables will demand that the inner strands of the cable be treated as a separate cable, around which the additional strands can be placed, squeezed, and wrapped. The wire must have a strength of 180,000 pounds per square

inch and elastic limit of 90,000 pounds per square inch, and an elongation of 4 per cent in a length of one foot. Each wire must be 1,800 feet long, without weld, joint, or splice.

Such are the general features of this structure—one which when completed will be at once a triumph of American engineering and an ornament to the city.

THE BIRDS OF THE CONGO.

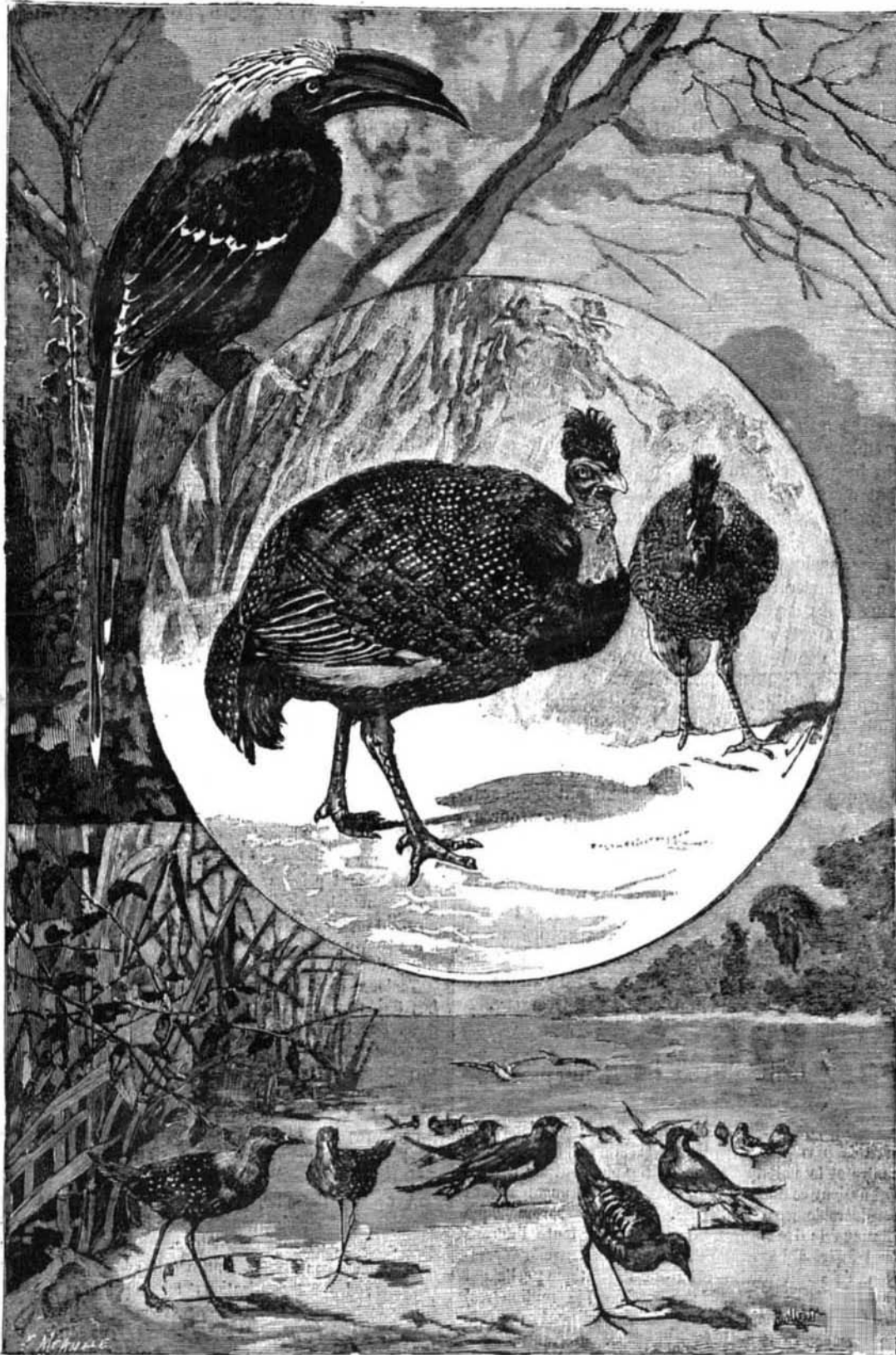
To pass in review here, without the aid of numerous figures, all the types of the birds of the Congo that have been made known to us by the explorations of Messrs. Dybowski, De Brazza, Schwebisch, Thollon, Petit and others, would be an almost impossible task, and an enumeration of the Latin names that ornithologists have given a host of African species that are absolutely different from those of our own country

have lived at the Zoological Garden of London, has a proud bearing and feeds almost exclusively upon fresh meat. It is met with not only in the country of Angola, but in Congo, Gaboon, on the Gold Coast, in Portuguese Guinea and in Senegambia, where it is already becoming very rare. To the south it does not extend beyond the country of Mossamedes, and upon the east coast of Africa it has been observed but once, and that at a single point, the island of Pemba, to the north of Zanzibar. It is a bird, then, that is essentially characteristic of West Africa. We shall say as much of the Scotopelies among the nocturnal birds of prey. The Scotopelies belong to the same family as our great horned owls and may be compared thereto as regards dimensions, but they differ from them markedly by the absence of egrets on the head and by the aspect of their feet, the tarsi of which are bare, and the toes of which are provided beneath with spiny papillæ, a feature that we observe only in the ospreys and the Asiatic horned owls of the genus *Ketupa*. Three species at least are known, which are distributed from Senegambia to the Quanza, and a single one of which, the same that inhabits Congo, has been met with on the east or rather the southeast coast, in the region of the Zambezi. They are accompanied in the west by the true horned owls, the scops-eared owls, the screech owls, common brown owls and barn owls.

In Congo the parrots are but slightly varied. Besides the gray parrot or jacko, which is observed with its squat varieties, there is hardly any but the green parrot with red forehead and shoulders (*Pæocephalus ubryanus*), which is everywhere rare, another species with yellow forehead (*P. Gulielmi*) and the small inseparable parroquet (*Psittacula pullaria*), which is distributed throughout the whole of equatorial Africa. As for the banded parroquet (*Ps. docilis*), so common in Senegambia, that does not descend so far as the basin of the Congo.

The other birds that Cuvier arranged in the order Scansores appear to be still more common in this region than the parrots, judging from the number of specimens belonging to the group of barbels, woodpeckers and cuckoos that figured in the collections received from the Gaboon and Congo by the Museum of Natural History. The barbels, which owe their vulgar name to the coarse hairs that clothe the base of the bill, which is laterally compressed and usually denticulate upon the edges of the upper mandible, belong to a dozen species of small size, and of dark brown, deep black or yellowish green plumage.

The woodpeckers make themselves remarked neither by their large size nor by the brilliancy of their colors. They are generally small and of green plumage, ornamented with red spots, with stripes or with numerous white dots upon the lower parts of the body, but in the eyes of naturalists they offer great interest, because they belong either to species that have been recently described or are still rare in collections, or to species whose area of habitat was believed to be much less extensive. The same is the case with the wrynecks, those odd birds that have the curious habit of turning their heads in all directions and bristling their feathers when they are frightened. It was already known that the common wryneck (*Jynx torquilla*) remains in our country only during the summer, and emigrates toward the south before the end of this season. It had been found in Morocco, Algeria, Abyssinia, Kordofan, and even in Senegal, but it was not known that it descended as far as to the Congo. Mr. Dybowski discovered it in this region, where it is met with in company with one of its near relatives, the *Jynx pectoralis*, of Southern Africa, which advances in



BIRDS OF THE CONGO—HORNBILL, GUINEA FOWLS, BAILES, AND SEA PARTRIDGES.

would prove exceedingly tiresome to our readers. We shall therefore confine ourselves to making known those species that are most remarkable by their form or color, the most interesting from the standpoint of geographical distribution, or the most important as regards the profit that man can derive from them. Leaving aside from among the diurnal birds of prey the vultures, fish-hawks, buzzards, falcons, etc., we shall have a few words to say of the *Gypohierox Angolensis*. This bird of prey, notably smaller than an eagle, slightly recalls the latter and especially the *Perenopters* of Egypt by certain features of its physiognomy. In fact, a circle around its eyes and the sides of its bill and at its feet are bare and of a pale rose color, and its plumage, after having been brown, passes to pure white varied with black upon the wings and tail; but its strong bill denotes affinities with the eagles that are belied neither by the attitude nor the food of the bird. The *Gypohierox*, several specimens of which

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an opposite direction on the side of the equator. The cuckoos present themselves in Congo under varied forms. Some belong to the category of golden and cupreous species that are so much esteemed as ornamental birds, and among which the foitocole (*Chrysococcyx smaragdineus*) stands in the first rank; others to the category of coucals (*Centropus*), including species of large size with coarse and plain plumage, varied with brown, black and fawn color; and others to European species, such as the common cuckoo (*Cuculus canorus*), which rejoins in tropical Africa a species characteristic of the Ethiopian fauna, the *Ceuthmocaræ æneus* or bronze gray cuckoo. Finally, some of the cuckoos, and those are not the least interesting, belong to the genus *Indicator*, and one to the species *Sparrmanni*, which was observed more than a century ago, in Southern Africa, by Andre Sparrmann, the companion of Captain Cook, and the curious habits of which were described more anciently still by Father Lobo, a traveler in Abyssinia. According to Father Lobo and Sparrmann, whose assertions have been verified by Mr. Dybowski and other modern travelers, the *Indicator* or cuckoo or "honeywyzer" (honey guide) of the Dutch colonists, has the instinct (it would be juster to call it intelligence) of attracting the attention of the hunter by its cries, and, by flying before him, of leading him to the nest of wild bees, with the hope of obtaining a part of the booty. The *Indicators* are, in fact, particularly fond of the eggs and larvæ of the bee and of the adult bees themselves, and, when man is not there to lend them assistance, they address themselves, it is said, to the ratel (*Ratelus Capensis*), a carnivore related to the badgers, which actively hunts hymenopterous insects. In the woods in the vicinity of Franceville, trogons (*Trogon narina*) with golden green plumage and a bright red belly, like those that inhabit Angola, are met with, and the great forest of Mayombe, which seems to be uninhabited, so profound is the silence that reigns there during the greater part of the day, echoes toward night with the cries of the hornbills. We have not to sketch here the portrait of those odd birds with carnivalesque physiognomy, whose huge bill covers the entire face and is often further exaggerated at the top by a horny protuberance. Suffice it to say that some of these hornbills are of very large size, with a black bill, and plumage of a somber color, greenish black in the male and maroon in the female (*Ceratogymnia*); others of smaller size, with yellowish bill, the plumage black and white (*Bycanistes*); others provided with a long tail and a tuft of white feathers (*Ortholophus*); and others, finally, of small size, with plumage varied with black, brown, and white (*Lophoceros*).

Being given the nature of the country, watered by two rivers, the Agowe and the Congo, broad streams like the Aubangui, the Sangha, the Alima, and a host of watercourses of less importance, one might predict that the regions traversed by Mr. Dybowski would be infinitely richer than our country in birds of the group of kingfishers. Such is the case, in fact, and we have counted at least a dozen species living between the equator and the sixth degree of south latitude. Several of these species, it is true, are not as strictly attached to the vicinity of water, and feed upon insects and small reptiles rather than upon fishes. These are the halcyons, easily recognizable by their large red and black bill and their azure or aqua marine blue plumage, set off with velvety black. On the contrary, the *Ceryles*, which are much larger than the European kingfisher, and have a piebald plumage, feed largely upon fish. They appear like true giants alongside of the *Corythornides* and the *Ispidinæ*, which are scarcely larger than wrens.

The bee eaters, which generally lay their eggs in galleries excavated in sandy banks along watercourses, and which pursue bees, wasps, and other insects through the air, are almost as numerous as the kingfishers in the basin of the Congo, where, besides the Nubian bee eater (*Merops Nubiens*) and the Angolan bee eater (*M. Angolensis*), we find the bicolored bee eater (*M. bicolor*), with rosy abdomen, and other species still more brilliantly colored.

Among the brilliantly colored sparrows, we may mention the blue, red, and lilac rollers, the tooracos and fly catchers, frugivorous and granivorous birds of the size of a jay; soul-mangas, which here, as in entire tropical Africa, play the role of humming birds; shrikes, with yellow or red breast; blue fly catchers; bronzed blackbirds, that have in reality nothing in common with the blackbirds, but which are true starlings, more sumptuously plumaged than ours, and, consequently, in much more demand in commerce and the feather industry. Let us not forget, either, the weaver birds, which suspend their artistically woven bag-like nests from the branches of the gigantic sycamores that grow upon the high plains. All these charming swallows, the astrilids, the bangalies, the widows and the cardinals, swarm in this region, whose tufted grasses furnish them with an abundance of food.

In addition to this brilliant assemblage, in field and forest, there flutters about a host of swallows of more

modest plumage—buntings, sparrows, larks, black, gray and ruddy shrikes, ravens, warblers, bustards, ousels, gray and brown fly catchers, daws, hoopoes, etc. During fine weather, drongos, swallows, and martins perform their evolutions in the air and give chase to the insects.

Equatorial Africa is much less rich in pigeons than certain islands of Oceanica. In Congo, however, we see doves with green plumage and partly naked face (*Trevo calvus*), banded turtle doves (*Turtur semitorquatus*), pretty doves, with wings marked with metallic spots (*Chalcopelia afra* and *C. Brehmeri*), and the iron mask doves (*Æna Capensis*). Our partridges are replaced by francolins, which sport amid the brushwood upon the plains and in swampy places where rushes and reeds grow; and in place of pheasants, there are beautiful pintadoes, some provided with a crest like the common Guinea fowl, and others having the head ornamented with a plume or a tuft of drooping feathers. These latter (*Numidia plumifera* and *N. cristata*) are replaced beyond Bangui by the crested pintadoes (*N. Marcheri*), which, according to Mr. Dybowski, do not extend to the north beyond the limits of the great equatorial forest. Everything leads to the belief that these pintadoes, which are very abundant upon the banks of the Congo and Oubangui, might be domesticated, as well as the francolins, and become barnyard fowls, much superior to the lean fowls of the natives.

Large bustards (*O. is Cafra*) wander over the plains between the Oubangui and the Chari, whose shores are frequented by ædicnemes, gray and purple herons like those of Europe, by herons of still larger size (*Ardea Goliath*), by small bitterns, rails and jacanas. Anhingas (*Plotus Levallanti*), commonly called serpent birds, on account of their long flexible neck, nest in numerous colonies upon the high branches of the silk cotton trees that grow upon the banks of the Oubangui, while here and there, upon the banks of sand, sport ducks of different species; Egyptian ducks, plovers, lapwings, sacred ibises, pelicans, argils, etc. A few sea birds, crossbills, so called on account of the conformation of their mandibles, ascend the Congo as far as to Stanley Pool.

It will be seen that the fauna of the Congo is as rich as it is varied. Upon studying the elements of which it consists, we recognize therein in the first place a few special forms that have not been found up to the present in any other part of Africa, and then a large number of species that descend along the west coast from the Senegambia to the Congo, and even to the Portuguese possessions, and others which ascend, on the contrary, from the Cape to the Congo through Benguela and Angola. Another category is formed of species that may be qualified as equatorial, because they are found between the tropics, from the shores of the Indian Ocean to those of the Atlantic. Afterward come a few birds which, like the Egyptian goose and sacred ibis, seem to have come from the northeast, in passing from the basin of the Nile to that of the Congo, then an important group of species widely distributed through the entire African continent, to the south of the Sahara, and another group of cosmopolitan species, and, finally, intermixed with the whole, a few European birds which we are surprised to meet with so far from their own country. Among the latter, we have already mentioned the gray cuckoo, the wryneck, the gray heron and the purple heron, and to these we may add the scops-eared owl, the black kite, the chimney swallow, the fauret, the warbler, the sylvan wagtail, the meadow titling, the stone chat, the shrike, the nightingale, etc. These birds are emigrants that come to take up their winter quarters in Central Africa, some of them in crossing the Sahara, and others in ascending the Nile as far as to its source, which is not very distant from that of the Oubangui, and in following this river up to the Congo. This latter way, which is longer, but easier, is perhaps the one most followed, since the celebrated Emin Pasha found to the north of the great lakes the same European species, accompanied by many others which doubtless do not push their migrations so far, and stop in the eastern Soudan.—Le Genie Civil.

A Cheap Substitute for Selenite.

BY HANS M. WILDER.

A set of selenite plates (generally three) is an indispensable adjunct to the polarizing outfit, because of the beautiful display of colors caused by their use.

Having on a certain occasion mislaid my selenites, I looked about for a substitute, and bethought myself of trying what mica, which is stated to possess similar light-retarding power as selenite, might do. To my agreeable surprise, mica (the common stove door kind) proved to be equal to any ordinary selenite, the colors being quite as handsome. Mica possesses two advantages: It is much cheaper, a piece three inches square costing about two cents, while a selenite (the usual size of which is $\frac{5}{8}$ of an inch) costs from one dollar up, and mica can be cut with scissors and handled without much fear of breaking it. The best way to proceed is as follows:

Put a slide of any polarizing substance (starch for

instance) on the stage of the microscope, having previously put the two nicols in their places, and slip a piece of mica under the slide. Some kind of color will be observed. If not satisfactory or especially handsome, give the mica a slight turn around its axis, and try in this way whether in any position a satisfactory color is obtained. When found, cut one end square so as to be parallel with the slide; by always slipping in the mica in the same way, the same color display will be obtained, since the retarding power, and consequently the color, varies with the thickness. Quite a variety of beautiful color effects may be obtained by either using mica plates of varying thickness or by merely using two or more layers of thin plates superimposed. The colors may be varied still more by altering the relative positions of the superimposed plates; in fact, three plates of varying thickness will be all that are necessary to keep. As stated before, mica costs next to nothing. If, therefore, the first piece does not suit, throw it away and try another. Select the clearest pieces. The mica plates may be cut and mounted to suit. Personally, I prefer strips about $1\frac{1}{2}$ inches wide, and somewhat longer than the stage from front to back, so as to be easily slipped in under the slide, and as easily removed.—Am. Jour. Pharm.

Street Car Compressed Air Motor.

The Rome (N. Y.) Daily Sentinel gives an account of the recent trial in that city of the Hardie air motor. A number of prominent street railway men, from various parts of the country, were present.

Robert Hardie, inventor of the motor, directed its operation. Mr. Stebbins, of the draughting department of the works, assisted in giving the visitors information. The trial was made on the 800 feet of rough track in the yard of the works, with Engineer Williams at the lever. The car started out with 1,800 pounds of air pressure to the square inch and a temperature of 310 degrees on its hot water tank, which is used to great advantage in heating the air before it passes at reduced pressure to the engine cylinders. A valve constructed for the purpose reduces the pressure of the stored air to 140 or 150 pounds, and this is the working pressure, or the pressure at which the air enters the engine cylinders. The motor starts gently, runs smoothly at a rapid rate and stops by air brake without jerk or jar. It was run back and forth repeatedly for upward of forty trips, and the test showed that under the conditions applied the motor would run twelve miles from one charging of compressed air, and make seventy stops.

The method of recharging the storage cylinders with compressed air was shown. It is a very simple operation, and, with the flexible couplings contemplated for the purpose, the recharging of a car with power need not occupy more than a minute or two. The same is true as to recharging with hot water, and the two can be done at the same time. The temperature of the hot water tank, covered with asbestos, on the occasion of the trial, was reduced from 310 to about 200 degrees in one working hour. Under more favorable conditions, especially in summer, this reduction would be much less, probably not more than half as much.

The Hardie motor and car are hung on elliptic springs, and the ease with which the car passes over wide joints, frogs or imperfections in the track is something admirable. This very important feature attracted the attention and favorable comment of the inspecting visitors from the East, all of whom know too well the terrible pounding that the trolley car gives the railroad track, because, like the lumber wagon, it is absolutely without springs. In this respect the Hardie motor indicates a sure and great saving in wear of rails and cars, while affording the utmost ease to passengers riding.

The principles of the Hardie compressed air motor are apparently above criticism. In the initial machine there are one or two minor respects—one the escape of vapor on a cold day like the breathing of a horse—in which the motor will be improved, without any difficulty, until the car shall appear as a noiseless, breathless vehicle that glides over the iron rails more smoothly than any heretofore produced, while under the most perfect control in starting and stopping.

The visitors were very much pleased with what they saw of the Hardie motor, and they watched and inspected and tallied it very thoroughly. As a result of their visit they have negotiated for the construction of six to ten of the motors to be used on Eastern lines. The order is upon certain conditions, one of which is the introduction of Pintsch gas light into the cars. This, Mr. Hardie says, can easily be done, and any other mechanical requirements can easily be met.

The air motor can be used on the simplest kind of a track. No trolleys or cables are necessary and the great expense of overhead or underground fixtures and the cost of great power plants are avoided. Besides, the economy of compressed air is greater than any other power. In electricity 60 per cent is lost; in compressed air but 20 per cent. An equipped street railway that for air motors might cost \$10,000 a mile would cost many times that amount for any other system.