explosive is to be exploded electrically by reversing the current. The steering is also done electrically through the agency of a polarized relay.

Its operation from a shore station is limited in extent by the length of the connecting cable. In the large torpedoes this will be two miles. In operation from a war ship, it is proposed to run two or more boats along a parallel course with the ship and close to it, receiving their motive power from the ship's electric plant. Here, as the ship and torpedoes will all progress alike, and as the electric plant on board can supply power for an indefinite period, the ship and torpedoes can keep company for almost any number of miles. When the enemy is approached the course of the ship can be arrested or its speed can be slackened, and the torpedo sent ahead or to either side at high speed, in order to destroy the enemy. For fort use a special form of casemate with conning tower and other necessary features have been planned by the company. There is little question that a number of these torpedoes could do much to defend New York harbor, at the end of the East River, between Willets Point and Fort Schuyler, and at the Narrows, from entrance by hostile vessels. Our thanks are due to Mr. Everett Frazar, the president of the company, for courtesies received.

A Liquid Volatile Nickel Compound.

Nickel seems destined to startle the modern chemical world. From being a comparative rarity, except on plated goods, it became a common laboratory material but a little while ago, then its title to be considered an element was impugned, and now it is both triumphantly reinstated and its vapor density, for the first time, determined. These results have followed from the researches of Mr. Mond and Drs. Quincke and Langer, which were recently made the subject of a paper before the Chemical Society. The investigation owed its origin to the need for removing carbonic oxide from producer gas, in order to use it in the gas battery described in Mr. Mond's presidential address at the annual meeting of the Society of Chemical Industry last year, nickel and cobalt being found to effect this object.

Working in this direction, it has been found that a direct compound of nickel and carbonic oxide, viz., $Ni(CO)_4$, exists, the new substance being a *colorless liquid*, volatile at ordinary temperatures, boiling at 43° C., having a specific gravity of 1·3185 at 17° C., soluble in alcohol, benzine, and chloroform, and not acted upon by dilute acids and alkalies. Its vapor explodes when heated to 60° C. Its vapor density determined by Victor Meyer's method is 6·01, instead of the theoretical value, 5·9; from this, the atomic weight of nickel is found to be 58. The metal itself can be obtained from it in the form of brilliant metallic mirrors of such purity as to form a splendid raw material for the redetermination of the atomic weight. The mean value obtained by reducing nickel oxide from this source by heating in a stream of electrolytic hydrogen was 58·61, corresponding closely with that previously accepted, viz., 58·52. This proves conclusively that Kruss and Schmidt's assertion that the metal hitherto considered to be pure nickel is contaminated with another element, and that all data concerning it consequently need revision, cannot be sustained, and replaces nickel as we have always known it among the elements.

The constitution of the compound $Ni(CO)_4$ is still the subject of the keenest speculation. Mr. Mond declined to be "drawn" on this point, admitting the temptation to represent it by some fascinating ring formula, but contenting himself at present with a statement of the facts. In connection with this curious body, it is to be noted that no similar cobalt compound can be obtained, thus establishing another method of differentiation and separation between it and its twin brother nickel.

Interesting and Useful Books.

Several years ago the writer, traveling abroad, visited a monastery, and among other curiosities shown him was a series of bound volumes, the sides of which were made of polished boards from the forests of the country, showing the grain of the woods.

At first sight the volumes presented the aspect of bundles of wood. But after a more careful examination it was found that they contain a detailed account of the trees that they represent. On the back, the bark has been detached in order to describe the title of the book by its scientific and its common names.

One of the pages is formed by a broken piece of the wood of the tree, showing its fibers and natural fractures; the other shows the wood when it has been polished and varnished. At one of the ends the fibers are seen as they remain after the passage of the saw, and at the other, the wood finely polished. Upon opening the book, the fruit, the grain, the leafage and other productions of the tree, the moss which generally grows on the trunk, and the insects which live on its different parts are seen. Added to this is a well printed description of the habits of the tree, the places where it grows, and its method of growth.

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Contents.

(Illustrated articles are marked with an asterisk.)

Advertisements that pay........ 48
Anilin, medical uses of........ 54
Ants, remedy for........ 52
Areca nut, the........ 54
Arizona, precious stones in........ 57
Armor plates asked for........ 57
Axle nut, adjustable, Thorp's*.... 51
Bacilli, the kidney........ 54
Beetles in furniture........ 50
Blasting car, Shannon's*........ 51
Bolt-threading machine, Wiley & Russel's*........ 50
Books, interesting and useful........ 48
Books and publications, new........ 58
Boyden, Seth, a statue to........ 56
Building, estimating the cost of.. 52
California, redwood logging in*... 55
Chicago, cruiser, as she appeared in the Mediterranean* 54
Dampness........ 49
Dynamite, unfreezable........ 52
Electric power rates........ 52
Electrical alternating system........ 57
Electrical units, names of scientists for........ 51
Fast passenger train, a........ 57
Fluorspar, metallurgical use of... 53
Hand rest for penmen, Ellis'*. ... 51
Inventions recently patented........ 58
Kitchen sink, the........ 52
Knowing how, charging for........ 54
Lantern slides, new method of preparing........ 53
Log wagons, Miller's block and clevis for*........ 51
Moth, gypsy, the, in Massachusetts........ 48
New York City, population of.... 49
Nickel compound, a liquid volatile 48
Notes and queries........ 58
Paper in Japan........ 50
Patents that pay........ 51
Patents on fruits and plants.... 53
Patents granted, weekly record of 58
Phonograph, scientific use of the* 57
Photographing buildings, legal aspects of........ 52
Railway enterprises, two great... 52
Redwood logging California*........ 55
Sawing, a wrinkle in........ 57
Ship railways........ 55
Steam boilers, contraction and expansion of........ 57
Subsidies for American ships.... 56
Surveyor's instrument, Hanlon's* 50
Table, folding, Delavigne's*........ 51
Telephony, nickel-in-the-slot.... 56
Torpedo, Sims-Edison, experiments*........ 47
Typhoid fever in Waterbury, Conn 55
Umbrella exhibitor, Kinsley's*.... 50
Venice and stolen property........ 53
War vessels, new British........ 56
Window screen attachment, Horton's*........ 50
Wood, food from........ 49

TABLE OF CONTENTS OF SCIENTIFIC AMERICAN SUPPLEMENT No. 760.

For the Week Ending July 26, 1890.

Price 10 cents. For sale by all newsdealers.

PAGE

I. BIOGRAPHY.—Miss Fawcett.—Portrait of and note on Miss Fawcett, graded above the senior wrangler in Cambridge University.. 12142

II. BIOLOGY.—Protective Mimicry in a Fish.—The curious little sea horse.—Its resemblance to the plants among which it lives.—1 illustration........ 12146
Paste Eels.—Note on identity of vinegar eels and paste eels..... 12142

III. CHEMISTRY.—The Quantitative Estimation of Coloring Matters by Means of their Absorption Spectra.—By T. L. PATTERSON.—An interesting paper, indicating a method of spectroscopic determination of quantities.—With full description and illustrations of apparatus employed.—4 illustrations 12148

IV. CIVIL ENGINEERING.—The Railways of India.—A picturesque account of the achievements of the civil engineer in the empire of India, with map of railroad lines.—1 illustration 12136

V. ELECTRICITY.—A Very Simple Rheostat.—A home-made piece of electrical apparatus for changing the intensity of a current.—1 illustration 12143
Increase of Locomotive Traction by Means of Electricity.—Attempts to replace the locomotive sand box by the electric current.—Possibilities and probabilities of the invention........ 12142
To Adjust and Readjust Compasses at Sea.—The causes of errors in a ship's compass.—The primary adjustment and subsequent adjustments reqired to counteract the same........ 12137

VI. FORESTRY.—The Cultivation of the Chestnut.—A new industry.—The formation of chestnut orchards, with hints on the possible future uses of the product........ 12147

VII. MECHANICAL ENGINEERING.—Angle Iron Beveling Machine.—A machine for use principally in ship yards for working out ships' frames.—4 illustrations........ 12136

VIII. MEDICINE AND HYGIENE.—La Couveuse for Preserving the Life of Feeble and Prematurely Born Infants.—A curious advance in medical practice, a species of infant incubator.—1 illustration.. 12145
Ohm's Law and its Practical Application to Electro-Therapeutics.—By HENRY N. WINTON.—A valuable paper for physicians, enabling them to understandingly apply the electric current in the treatment of diseases........ 12144

IX. MICROSCOPY.—Some Practical Business Applications of the Microscope.—By Dr. FREDERICK GAERTNER.—A list of practical uses for the microscope in the courts and in general business life. 12141

X. MISCELLANEOUS.—Attempt to Rob a Diamond Car.—An attempt to rob a South African train on its way from the diamond field to the coast.—1 illustration........ 12144
Bertrand's Automatons and Puppets.—A recent puppet show, the last developments in this curious and interesting species of theatrical display.—5 illustrations........ 12143
The Japanese Headdress and Pillow.—Some interesting features of life in Japan, the dress and daily customs of the people.—1 illustration........ 12144

XI. NAVAL ENGINEERING.—The Forbin.—A recent development of the French navy, a third class cruiser, of exceedingly high speed, her merits and defects.—1 illustration........ 12135

XII. PHARMACY.—Some Improvements in Pharmacy.—By A. BALL.—A valuable review of the advances recently made in the pharmaceutical art, a good prognosis for future progress........ 12145

XIII. TECHNOLOGY.—Cane Culture and Sugar Manufacture in Cuba.—A Southern industry, the cost and economies of cultivating the sugar cane and manufacturing the sugar........ 12147
Lighting by Compressed Gas.—The use of compressed gas for maintenance of illuminated buoys, the plant for its production and buoys from which it is burned.—8 illustrations........ 12140
Pick's System of Manufacturing Salt in Vacuo.—The application of the triple effect apparatus and the well known strike pan of the sugar manufacturer to the salt process, full details of apparatus and process.—1 illustration........ 12138

IT PAYS TO ADVERTISE IN THE SCIENTIFIC AMERICAN.

In a letter to the publishers of this paper G. M. Robinson, Esq., president of the Charter Gas Engine Company, Sterling, Ill., writes that they are overwhelmed with orders, and that "inquiries from the SCIENTIFIC AMERICAN advertisement are so numerous and from so many points, both foreign and domestic, that we often wonder if there will ever be an end to them."

THE GYPSY MOTH IN MASSACHUSETTS.

The ravages of the gypsy moth (Ocneria dispar) in Massachusetts have been of such a very serious nature that, in March last, the legislature passed a bill creating a commission of three members, who were called upon by the terms of the act to carry into execution all possible and reasonable means and measures to prevent the spreading and to secure the extermination of the pest. Twenty-five thousand dollars was appropriated to defray the expense of the commission, and this sum has been increased by a subsequent appropriation to $50,000.

In June, 1889, several caterpillars were sent to the Hatch experiment station, at Amherst, which is a part of the Massachusetts Agricultural College. Prof. C. H. Fernald, of the Division of Entomology, was absent in Europe, but Mrs. Fernald, who had charge of the entomological work during her husband's absence, immediately designated the insect as the gypsy moth (Ocneria dispar, Linn.) of Europe. In November, 1889, Prof. Fernald issued a special bulletin in which the following interesting facts regarding the history of the moth appear.

The gypsy moth is abundant in nearly all parts of Europe, Northern and Western Asia, and it even extends as far as Japan. In 1817 the cork oaks of Southern France suffered severely from the attacks of this insect. One of the papers of that time stated that the beautiful cork oaks which extended from Barboste to the city of Podenas were nearly destroyed by the caterpillars of the gypsy moth. After having devoured the leaves and young acorns, they attacked the fields of corn and millet and also the grape lands and fruit trees. In 1878 the plane trees of the public promenades of Lyons were nearly ruined by the same insect. In regard to his personal observations in Europe, Prof. Fernald says: "Only last summer I saw the moths in immense numbers on the trees in the Zoological Gardens in Berlin, where the caterpillars had done great injury; and the European works on entomology abound with instances of the destructiveness of this insect."

Authorities seem to agree in stating that the introduction of the gypsy moth into this country was accidental. In 1870, Mr. L. Trouvelat, a Frenchman residing at Medford, was experimenting with silkworms, and a few of these caterpillars were among the silkworms, and some of them escaped. It is a curious fact that, although the insect has been in this country since 1870, it did not become a pest until last season, and according to the entomologists of the United States Department of Agriculture, had not, up to about March 1, found its way into the collections or been mentioned in the check lists.

One of the first acts of the commissioners appointed to conduct the campaign against the gypsy moth was to advertise for specimens, for the purpose of ascertaining if they were to be found in any other portion of the State than about Medford and Malden. A number of specimens were received, but none proved to be the gypsy moth. It is therefore deemed to be certain that they are only found in this country in the same region where they were originally liberated twenty years ago. The section which has been devastated by them extended last season three miles in length and one in width, but this season the territory has been extended until it is fifteen miles long and four wide.

As the depredations of this insect and the means which are being used to check them are attracting wide attention, the following minute description by Prof. Fernald in its various stages of development may be of interest, especially as the vigorous measures which have been adopted in Massachusetts may result in driving it to other localities.

This insect was first described by Linneus in 1758, in the tenth edition of his Systema Naturæ, Vol. 1, page 501, under the name of *Bombyx dispar*, and while it has retained the specific name of *dispar*, the European entomologists, since the time of Linneus, have given several different generic names, as *Liparis*, *Hypogymna*, *Porthetria*, *Ocneria* and *Psilura*, but I have adopted that given by Staudinger in his Catalogue of the Lepidoptera of Europe—*Ocneria dispar*.

Several different common names have also been given to it in Europe, as the sponge moth, the gypsy moth, the great-headed moth, the fungus moth and others, but I have adopted the one used by the English entomologists—the gypsy moth.

The males are of a yellowish brown color, with two dark brown lines crossing the forewings, one at the basal third, the other on the outer third, somewhat curved, and with teeth pointing outward on the veins, The outer ends of all the wings are dark brown. A curved dark brown spot (*reniform*) rests a little above the middle of the wing, and a small round spot of the same color (*orbicular*) is situated between this and the base of the wing, just outside of the inner cross line. A similar spot rests near the middle of the base of the wing. The fringes on the forewings are dull yellowish, and broken by eight brown spots. The antennæ are strongly bipectinated, or feather-like. The forewings expand about an inch and a half.

The females are pale yellowish white, with dark brown cross lines and spots similar to those of the males. The cross lines in both sexes are much darker and more prominent on the forward edge of the wings (*costa*) than elsewhere. In some specimens there is a faint strip of brown across the middle of the wing (*median shade*), and a toothed line across the wing near the outer edge (*subterminal line*). The fringes of the forewings have eight dark spots between the ends of the veins, as in the males, and similar but fainter spots often occur in the fringes of the hind wings. The body is much stouter than in the males, and the antennæ are not so heavily feathered. The expanse of wings is from one and three-fourths to two and three-fourths inches.

The eggs are globular, about one-eighteenth of an inch in diameter, nearly salmon colored, and with a smooth surface. They are laid on the under side of the branches, on the trunks of the trees, often below the surface of the ground where the latter has shrunk away from the tree, and not unfrequently on the fences or on the sides of buildings. They are laid in oval or rounded masses, often to the number of 400 or 500, and covered with ocher yellow hairs from the abdomen of the female. The eggs are laid in the early part of July, but do not hatch till the following spring. The caterpillars remain together, feeding upon the leaves, and when not feeding they habitually rest side by side on the branches and trunks of the trees.

The full grown caterpillar is about an inch and three-fourths in length, very dark brown or black, finely reticulated with pale yellow. There is a pale yellow line along the middle of the back and a similar one along each side. On the first six segments following the head there is a bluish tubercle armed with several black spines on each side of the dorsal line, and on the remaining segments these tubercles are dark crimson red. On the middle of the tenth and eleventh segments there is a smaller red tubercle notched at the top. The whole surface of the body is somewhat hairy, but along each side the hairs are long and form quite dense clusters.

The pupa is from three-fourths of an inch to an inch in length, and varies in color from chocolate to reddish brown. On each side, at the base of the wing covers, is a dark reddish brown, oval, velvety spot. The wing cases are quite broad and reach to the posterior third of the fifth segment. The antennæ cases are strongly curved, and are quite wide in the middle. There are a few yellowish brown hairs on the face and head, also on the first five segments, arranged in broken circles or clusters, which are in longitudinal and transverse rows. The *cremaster* or spine at the posterior end is flattened, rounded at the outer end, grooved longitudinally, and has twelve or more minute hooks at the end.

The first aggressive move of the commission appointed to exterminate the gypsy moth was to send men through the district infested with them, in the early spring before the leaves were out. Where they saw evidences of the eggs, they marked the trees. Then gangs of men were sent around with torches and burned the places which had previously been marked. The torches are made of sheet iron and asbestos, which is saturated with kerosene. The handle of the torch is so arranged that it can be lengthened or shortened as required. One hundred men were employed in this work, and it was carried on vigorously until May 1, when the eggs began to hatch and the burning was no longer of any avail. Then the spraying of the trees with Paris green was commenced. One pound of the powder was put into 150 gallons of water. A hogshead containing this mixture is placed on a dray, and it is drawn by a horse from place to place. Large force pumps are placed upon the hogsheads, and with two men upon the brake and another to stir up the liquid, so that the poisonous element will not all settle at the bottom, the remedy has been very effectually applied. The 10th of July is the date when the cocoons begin to be formed, and in two weeks thereafter the moth appears.

The third line of effort which the commission has pursued is the appointment of inspectors whose duty it is to prevent the moths from being carried from the section where their depredations have become of a serious nature to adjoining regions where they are yet entirely unknown. One hundred men are thus employed. There are two superintendents and one foreman to each gang of five men. The foremen receive $2.50 per day each, and the men $1.75 each. Every street leading out of the gypsy moth region has been covered by these inspectors, and teams leaving the town are all examined by them. These officers carry long-handled dusters with which to brush the insects to the ground, when they are destroyed.

The gypsy moth is reported as feeding upon the leaves of apple, cherry, quince, elm, linden, maple, balm of Gilead, birch, oak, willow, wisteria, Norway spruce, and corn. Many trees in the infested district in Massachusetts have been defoliated, and when the insects in large numbers attack tree or shrub, they generally strip them of their leaves. Entomologists in Europe state that if the insect should get a foothold in this country, it would become a far greater pest than the Colorado potato beetle, because it is prolific and feeds on so many different plants, while the potato beetle confines itself to a small number.

The work of destruction does not appear to be aided by any parasite, as is the case with many other insects, though the United States Entomological Department claims that the insect has a number of natural enemies.

As to the results of the vigorous fight now going on against the gypsy moth, it is probably too early to judge accurately. In reply to a communication, Mr. W. W. Rawson, chairman of the commission which is conducting the campaign, says: "The people say that a great work has been accomplished."

The commonwealth of Massachusetts, by her vigorous effort to stamp out the gypsy moth, has placed the whole country under obligations, for it must be plain, from the facts above presented, that if such measures are not taken whenever and wherever it appears, it is liable to become the most dangerous pest with which we have yet been afflicted.

Dampness.

It is not to be wondered at that the ancients regarded water as one of the elements of which all things are composed; for it is a truth demonstrated by modern chemistry that almost all natural objects contain a large proportion of water. Not only the plants that drink the summer showers, and show by their juicy succulence that they have incorporated the liquid streams into their substance, but the very soil in which these plants grow, and the solid rocks themselves, contain a large proportion of water. And, when we take away from animals, and even from man himself, the water which they contain, the amount of solid residue left behind is surprisingly small. It is true that, in all these cases, our senses give evidence of the presence of water, and do not require the corroborative testimony of chemical analysis. The moisture adhering to soil and to rocks, the juice of plants, and the blood and other fluids present in animals, all evidently acknowledge water as one of their chief constituents and testify plainly to the presence of this liquid. But if we were to suppose that water is always absent from those substances which to our senses give no evidence of its presence, we should commit a great mistake. The dry and solid rock consists largely of water; and clay, though baked in the summer sun and dried in the summer breeze, cannot be robbed of all its moisture. When the washerwoman buys fourteen pounds of transparent and apparently perfectly dry soda, she in reality pays for nine pounds of water, and gets but seven pounds of real soda, instead of the fourteen that she supposes she is getting. In short, water is present everywhere—in the dry wood that has for years formed our furniture, and even in the apparently perfectly dry dust that blows about our streets. Even the air, on a dry and sultry day when everything is parched and when every breath seems to burn our throats, is charged with moisture. That warm and apparently dry air contains moisture is easily proved. An ice pitcher becomes covered with dew, not because the pitcher *sweats* through from the inside as it is said to do, but because the water held in suspension by the hot air, even when apparently dry, contains a considerable amount of moisture. Procure a small quantity of salt of tartar, a cheap drug that may be obtained from any apothecary, and, on a dry day, lay it on a common plate, and expose it to the atmosphere. In a short time it will have attracted from the air an amount of water sufficient to dissolve it, and it will have become converted into an apparently oily liquid, called by the old chemists who did not fully understand the changes that take place, oil of tartar. The experiment will be more convincing, perhaps, if the salt with its containing vessel—which in this case, however, should be as light as possible—be placed in the pan of a moderately delicate pair of scales, and carefully counterbalanced. In this case, the abstraction of the moisture from the air is rendered evident by the gradual increase in the weight of the salt and the descent of the pan in which it is placed.

If, then, moisture may be regarded as everywhere present, it becomes a nice point to determine when anything, such, for example, as the air we breathe, our houses, beds, clothes, etc., may be considered damp. To look for perfect dryness would be a vain search; nor would it do us much good if we could find it. Perfectly dry air would remove the moisture from our bodies so rapidly that we should wither as if smitten with the blast of the simoom. In such an atmosphere, out throats would be parched as if in an oven, plants would wither; and nature become one universal desert. But, on the other hand, air that is too moist—that is to say, air that is really damp—produces effects that are equally disastrous. In such an atmosphere, metals rust or corrode, vegetable matters rot, and the growth of fungi, such as mildew, mould, etc., is greatly promoted. Air in this condition is universally regarded as unwholesome; and it consequently becomes an important practical question to determine when our dwellings are really damp, and to distinguish between this condition and that in which bodies may be considered as ordinarily and properly moist. Theoretically, the question is one that is not easily solved; but practically, it is not so difficult. Let us consider the case of the air; and find out, if we can, what the conditions are in which it may be said to be damp.

When perfectly dry air is brought into contact with bodies containing water in a free state, there instantly begins a strife for the possession of the liquid. Since water evaporates at all temperatures, even when it is frozen solid, the air surrounding the moist body becomes loaded with vapor, and, as it then gradually mixes with the air in its neighborhood, its place is supplied with drier air, until the whole air contained in the room or vessel has been saturated with water. The point at which this saturation occurs depends chiefly upon the temperature of the atmosphere. On a warm day the air is dry, not because there is little or no water present in it, but because, owing to its high temperature, it is capable of receiving and retaining a considerable additional quantity of moisture. In other words, air and everything else is capable of holding in its substance a certain definite quantity of water. If the amount of water present is so great that it appears in the form of moisture, or if the proportion even approaches the limit which the body is capable of holding even before it becomes evident to our senses, we call it damp. Absolute dryness, then, is to be carefully avoided, and so is that degree of moistness in which objects part easily with the water which they hold. The evil effects of the first condition are to be seen in the dry and oppressive condition of an atmosphere heated by a stove or furnace; the results of an excess in the opposite direction are most clearly seen in unwholesome basements and damp and malarious cellars. The best means of determining and regulating the amount of moisture in our dwellings is an important one.—*The American Engineer.*

Food from Wood.

Probably no modern science presents a wider field for speculation than that of chemistry, and more especially, perhaps, that branch of the science which treats of organic compounds. Since the day when Wohler overthrew for ever the notion that organic substances were exclusively the products of the operation of a so-called vital force, by his discovery of the synthesis of urea, a great number of bodies, hitherto obtained only in nature's laboratory, have been successfully built up as the result of a careful and most minute study of their exact nature. The discovery of the preparation of substances by artifice, more particularly the dyes, has, as a matter of course, influenced very considerably home and foreign industries. What shall be said, then, when chemistry promises to solve hard problems of political and social economy?

In an address delivered at Heidelberg, by no less eminent an authority than Victor Meyer, it is announced that "we may reasonably hope that chemistry will teach us to make the fiber of wood a source of human food." What an enormous stock of food, then, will be found, if this becomes possible, in the wood of our forests, or even in grass or straw. The fiber of wood consists essentially of cellulin. Can this be made to change into starch? Starch has exactly the same percentage in composition, but, as every one knows, it differs very much in its properties, and the nature of its molecule is probably much more complex. Cellulin is of little or no dietetic value, and is not altered, like starch, in boiling water. It readily gives glucose when treated with sulphuric acid, as is easily shown when cotton wool, which is practically pure cellulin, is merely immersed in it. Starch gives the same product when boiled with weak acid.

The author further quotes the researches of Hellreigel, which go to show beyond dispute that certain plants transform atmospheric nitrogen into albumen, and that this process can be improved by suitable treatment. The production, therefore, of starch from cellulin, together with the enforced increase of albumen in plants, would, he adds, in reality signify the abolition of the bread question. It must be borne in mind, however, that theory, fascinating and promising though it may be, is not always capable of being followed up by a practical result.—*Kuhlow.*

Population of New York City.

The first or preliminary official returns of the census of 1890 give 1,513,501 as the present population of the city of New York, being an increase of a little more than 25 per cent within ten years. One million two hundred and six thousand two hundred and ninety-nine was the population in 1880.