vessel lies out of range of the fort's guns, and the balloon is allowed to ascend to a thousand feet or so before dropping its torpedo.

We are inclined to think that a good many practical difficulties would oppose themselves to the *Graphic* scheme, mostly arising from the necessity of keeping the balloon captive. The strain on a wire nearly six miles long would be great, and the weight of the wire would be a heavy load for a balloon to carry. The wire, besides the strain of its own weight, would be subjected to the pull of the balloon, which would vary in intensity according to the force of the wind. It probably would be necessary to employ steel wire at least as large as that used in the East River Bridge construction, which is capable of withstanding some 4,000 pounds tensile strain. Six miles of wire would be scant allowance to enable a vessel to keep out of range of improved modern rifled guns, and this quantity of the wire mentioned would weigh nearly 2,900 pounds. It might easily be imagined that the strain added, when the balloon is hauled in against its own ascensive power and against the wind, might increase the stress above the breaking point, and therefore still thicker wire or wire rope weighing still heavier might be needed. Assuming, however, that the bridge wire could be used, to the above weight of 2,900 pounds must be added, say, 500 pounds for the torpedo, and at least 700 more for weight of balloon car and occupant, making in all 4,100 pounds. Now it requires nearly 60,000 cubic feet of hydrogen to lift this weight with an ascensive force of 100 pounds, and the diameter of such a balloon would be in the neighborhood of 48 feet. It would be scarcely possible to manage and inflate a balloon of this size on board ship, while the wind pressure on it might easily cause its pull to exceed the tensile strength of the wire. To use thicker wire would be to necessitate still larger balloons, and, on the other hand, thinner wire still would be subjected to the same wind stress. We therefore doubt the practicability of any plan which involves a captive balloon and at the same time the keeping out of range of guns.

There are other ways, however, which might be resorted to to accomplish the same purpose. For example, the balloon might be sent up with no one in its car, thus saving that much weight. Connected with it might be simply a light double wire, capable of carrying an electric current to a magnet which would pull back a detent and so drop the torpedo. A favorable wind would have to be waited for to waft the balloon over the desired point, and its position at any time could easily be determined by measurement with the sextant. Or the balloon might be left entirely free, with simply a clockwork contrivance to drop the charge after a certain period. The movement of the works would be regulated according to the strength of the wind as indicated by the anemometer, and the estimated period of time which would elapse before the balloon would be carried over the required place. This, however, would be very inaccurate.

Defense against "dejectiles," as the *Graphic* proposes to call torpedoes dropped from the clouds, would consist in other balloons sent up to wage warfare aloft, or the invention of some kind of gun would be needed that would throw shells long distances at high elevations with accuracy. The projectile to use against torpedo balloons would be a shrapnel filled with explosive bullets, which, when the bomb burst, would be projected over a wide sphere. One bullet of this kind striking a gas bag would blow it up, and make it drop its charge where not intended by the enemy. Rockets would probably be revived again as defensive means against balloons, and doubtless would prove very useful. Of course, however, the main object would be to explode the torpedo in the air and some time before it could reach the ground and do damage, and over this problem we leave inventors to exercise their ingenuity.

As we have already taken occasion to point out, we think that if aerial torpedoes do become a seriously offensive means of warfare, it will be by the aid of the flying machine. Mechanical flight is not impossible, and all the means are at hand, requiring only ingenuity to adapt them to one another to insure success. The principles of flight are well understood, and it is possible to build light motors using electricity or even steam, which will keep an aerial ship aloft. This is the more important question bearing on future warfare. An easily managed and guided swift aerial ship carrying nitroglycerin torpedoes would be a terrible enemy.

Experiments with Floating Magnets.

Professor A. M. Mayer describes, in the *American Journal of Science and Arts*, some entertaining and easily performed experiments in magnetism. Several sewing needles, of No. 5 or 6 size, are magnetized with the same polarity, so that all their points are N. Each needle is passed into a small cork that will just float it upright; the corks may be $\frac{1}{4}$ inch long and $\frac{3}{16}$ inch across. The eye of the needle should barely be above the surface of the cork. Three, four or more of these needles are thus to be floated in a basin of water and the N. pole of a large cylindrical magnet is to be brought down over them. They will immediately take geometrical positions, the figure formed being smallest when the magnet above is brought most closely to them. Three needles thus take position at the points of an equilateral triangle; four form a square, or a triangle with one in the center; five form a pentagon, or a square with one in the center; six form a pentagon with one in the center, or a triangle of two to a side. Professor Mayer has obtained regular figures up to a combination of twenty needles.

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ARGUMENTS FOR SECTION 11.

The proposed assimilation of our patent law to that of Great Britain, in the matter of periodical fees, was discussed before the House Committee on Patent Amendments by Messrs. Raymond, Christy, Storrow, Foote, and Smith. All but Judge Foote were decidedly in favor of the scheme; and we may fairly assume that they offered the strongest arguments they could command to sustain their position.

Mr. Raymond stood alone in his sweeping denunciation of the present working of the patent laws. He was not opposed to a wise patent system; for "a wise patent system does encourage inventions, and therefore promote public progress in science and the useful arts." But the working of our system during the past seventeen years has been the reverse of wise. Indeed, the law as it stands is, he said, so defective, and open to so many abuses, that he unhesitatingly and confidently asserted that "that part of the progress of recent years, during which the genius of the people has been exclusively directed to the arts of peace, which is directly the result of the patent system which has obtained during the same period, when put into the scales with the tax, the annoyance, the burden, the 'scare-crowing' of capital, the unnatural strifes, the unhealthy speculations, the inflated values, the exorbitant prices, the blackmailing, the tedious and expensive chancery litigation, and the other unholy practices which the patent law has of late hatched and fostered, the progress which it has brought about receives a shock which throws it up into thin air."

Mr. Raymond approves of Section 11 as a remedy for a considerable portion of the evils above enumerated—"evils resulting from trivial, impracticable, and invalid patents, and from those which become of value late in their existence, and then only for the purpose of infringement suits and speculations." The provision of this section, he goes on to say, has been criticised somewhat because the proposed tax was too great and too frequent. It has been criticised more as being too small and not frequent enough. In his opinion, if changed at all, it should be increased both in amount and frequency. "The grant, in any case, is a tax upon or a deprivation to the public, and should not be perpetuated unless it is worth a good fee."

We find no further reference to this section in Mr. Raymond's argument.

Mr. Hyde's friendship for the patent system as a whole is unmistakably genuine, and the same may be said of the rest of the list. His approval of the proposed amendment is based on its power to weed out "worthless patents that are lying about for speculators to pick up and use to the annoyance of subsequent successful patents. There is growing up," he says, "a class of men who, when they find an invention in successful use, go to the Patent Office and rake over all the patent files to see if they can find an old patent which will supersede the later successful one, and then buy it up for a nominal sum. After obtaining a reissue, if needed, they commence an onslaught on legitimate business." Section 11 would put an end to this nefarious business by killing perhaps 75 per cent of the patents issued.

Mr. Storrow's approval was based on the ground that undeveloped patents are a hinderance, not a help to progress. "If the invention at once takes place in the arts as a practical thing, or if it so clearly embodies a great step forward that the inventor or others are incited to develop it to a practical and pecuniarily profitable application, it constitutes a progress, and the purpose of the law is satisfied. But features are often patented which are afterwards found neither to be useful nor to hold out hopes of usefulness enough to lead to attempts to improve them. A subsequent inventor making a truly useful machine unconsciously uses one of those features and the patent stops him; it does not promote the progress of the useful arts that such a patent should live merely to hinder and not to constitute progress." The periodical fees will weed out such undeveloped inventions, to the great advantage of meritorious inventors and to the public. The result of a severer provision in England, Mr. Storrow goes on to say, "has been that the average life of a patent has been shortened from fourteen to about four years; we think that this section will shorten it from seventeen to about eight years, and it will not diminish the stimulus to invention, because it will only cut off those which after trial have been practically abandoned as worthless."

Mr. Smith thought that under the operation of this section fifty per cent of the patents granted would expire at the end of the first period and half of the remainder at the end of the second period, and thus their chance of doing mischief under reissues would be ended. "It has been a subject of frequent complaint," he said, "that old patents which have been idle and worthless in the hands of their owners have often been revived so as to cover subsequent patents and the industries which have grown up under them. It is certain that a large part of such patents will be swept away under the provisions of this bill. The fees will become payable generally before it is discovered that they can be used to embarrass subsequent inventors or manufacturers who have unwittingly used what might be covered by the reissues; and as they are worthless for legitimate purposes at the time, they will to a large extent be allowed to expire."

Further on, Mr. Hubbell asked: "If this country has prospered so long and so well, as compared with other nations, under small patent fees, so that we have superseded England, who, under her prerogative right, has taken excessive fees from inventors, why do you want to crush down inventors by exacting fees that will put them in the same condition as they are in England?"

Mr. Smith's reply was that it was for the interest of inventors that worthless patents should be put out of the way. "It is important that inventors should have the opportunity to protect their inventions if they think them worth protecting. If they do not deem them worth preserving, it is important that they should not stand in the way of other inventors, and the requirement of a small fee after the lapse of a few years will make it necessary for the owner of a patent to decide for himself whether he thinks it is worth preserving, and, if it is, the profits of the patent will enable him to pay it."

Judge Foote's objection to periodical fees arose from the simple fact that the Patent Office fees were already unnecessarily high. The office is now accumulating one hundred thousand dollars a year over and above its expenses; and if the object is to encourage invention, the fee should be made as light as possible. He preferred the issuing of a preliminary patent, at a low fee, to run three or four years, and a completed patent on the invention, as perfected, at the end of that time, should the inventor choose to apply for one.

We have recited the arguments of these gentlemen at length and with many repetitions, that our readers may see how few they really are. Boiled down, they amount to these two, and no more: 1st. Speculators have bought up and misused neglected patents. 2d. Inventors have been inconvenienced by pre-existing patents; in other words, they have been barred the free use of devices they wanted, or have been made to pay for such use, owing to the inconvenient fact that some one had patented the thing before they thought of it. Let these arguments be granted their fullest weight. Admit that designing speculators have been able to buy up and do mischief with rights apparently abandoned by the original patentees. Admit that inventors, as well as manufacturers, have found it unpleasant to have to pay for or let alone the fruits of other men's brains. Shall we, therefore, subject the entire class of inventors to charges not needed for the support of the Patent Office? Shall we open the door to gross injustice to worthy inventors of limited means, as shown in our issue of March 16? Shall we emasculate our patent system, as shown in our issue of April 13? In short, shall we punish the deserving many that we may forestall the wicked designs of a few?

It seems to us that the attempted justification of this Section 11, as a matter of policy even, hinges on the two assumptions that all patents not speedily developed are worthless, and that four or five years, or even ten years, are sufficient in every case to develop the value of an invention and bring it into profitable use if it is worth using—assumptions by no means justified by the history of great inventions, as we propose to show at length hereafter.

A NATIONAL SANITARY PRECAUTION.

A sanitary measure of more than ordinary importance, not only to the Southern seaboard States but to the country at large, has recently been passed in the form of a bill to be known as the "National Quarantine Act of 1878," the object of which shall be, by means of an efficient, uniform, national system of quarantine, to prevent the introduction of contagious or infectious diseases into the United States. It is to be understood, however, that while it may assist, it shall in no wise interfere with, the present or future rules, regulations, or workings of any State or municipal boards of health. The diseases against which the provisions of this bill are more particularly designed to guard the people are those two scourges to humanity—Asiatic cholera and yellow fever—the ravages of which have frequently been so appalling. The hope that the measures proposed in this act—vigorously carried out, and aided by the coöperation of local State officials—may in time succeed in shutting out these two diseases from the country, is encouraged by the fact that science has conclusively demonstrated that both are of foreign origin, and that there is no place within the United States where they have been naturalized.

In Asiatic cholera we have a disease caused by the access to the alimentary canal of a specific form of organic poison, which is portable, communicable, and capable of reproducing itself in every body in which it obtains lodgment. It always has its origin in Hindostan; and whenever it appears outside of the limits of that country it is absolutely certain that is an exotic. It was in 1756 that the fact was first recognized that the disease is a periodically returning twelve-yearly epidemic, connected with the twelve-yearly Hindoo festivals at the great temples. The prevailing direction in which the epidemic always advances from its birthplace is to the West and North, always proceeding along the lines of the greatest and most rapid travel; and, at each periodical recurrence, extending its limits and spreading itself over an increase of territory. It made its first visit to the United States in 1832, starting from Quebec, where it had been introduced by ten or twelve Irish emigrant ships. From this time on, its periodical returns have been pretty uniform; and judging from the past, we should expect another outburst either during the present or next year.

In our next contest with the epidemic, our whole safety lies in efficient quarantine and thorough disinfection.

As of cholera, so we may say of yellow fever, it comes in every case from without; there is no spot in the United States where it is indigenous. Its birthplaces are the West Indies, the South American coast, and, possibly, Vera Cruz in Mexico. From these neighboring countries it invades, almost every summer, our sea-board cities, and occasionally produces a desolation such as words fail to describe. This disease made its first appearance in this country in 1668; and from that time down to 1877 it had visited us seven hundred and forty-one times, spread its ravages to two hundred and twenty-eight cities and towns, and extended to twenty-eight States of the Union, causing 65,311 deaths counted—besides the innumerable deaths of which no record was made. Of all these numerous appearances of the disease among us, 45 per cent are directly traceable to foreign origin.

In a commercial point of view, likewise, have the losses to the country been incalculable. In a memorial accompanying this bill, from a convention of representatives of the Southern seaport towns, held at Jacksonville, it is asserted that the losses produced by the epidemic which raged in the city of Savannah in 1876 amount to $5,800,000, or nearly one half the present value of the whole taxable real estate of the city. Multiplying this particular loss by the many similar ones occurring annually in our other cotton ports, the result will be found to be startling indeed.

Since, then, the fact is so well established that these two fearful diseases which carry such destruction to life and property in their trail are entirely of foreign origin; that they must cross oceans before they can obtain a lodgment on our shores; that they must be brought in ships, hidden in clothing, bedding or personal luggage, or actively at work on the systems of passengers, and they thus become a part and parcel of our commercial intercourse with other nations, surely Congress—which has authority to regulate this commerce—can, and probably will, with the earnest coöperation of local authorities, aided by the provisions of this bill, control the visits of these terrible concomitants of our foreign trade.

TEACHING SCIENCE.

Professor W. K. Clifford has recently published an essay on the teaching of science, reviewing Virchow's address on the same subject, delivered at the jubilee meeting of German naturalists and physicians last year. Professor Virchow's utterances have attracted marked attention, both on account of their forming one of a trio of reviews on the present state of science, the other contributors being Häckel and Nageli, and also on account of their dealing with many important questions which have long vexed the minds of unprejudiced thinkers.

Häckel devoted his discourse to the present position of the evolution theory, the evidence supporting it, and its bearing on morals, education, and mental science. Nageli followed with a discussion of the limits of natural knowledge, pointing out the restricted nature of our senses, and suggesting that, "if we will be satisfied with such kind of knowledge as we can get, we do really know something, and may come to know a great deal more." Lastly, Virchow dealt with the liberty of science in the modern state, and in that portion of his admirable address, on which Professor Clifford bases his equally admirable review, he referred to parts of the evolution theory which are not yet established scientific doctrines in the sense that they ought to be taught dogmatically in schools. Of these he specially named two—the spontaneous generation of living matter out of organic bodies, without the presence of previously living matter; and the descent of man from some non-human vertebrate animal. These, he said, are problems our solution of which we may consider never so probable, and that the evidence will shortly be forthcoming to establish the same; but we must not teach them as known and established scientific facts. We ought to say, "Do not take this for established truth, but be prepared to find it otherwise; only for the moment we are of opinion that it may be true."

Professor Clifford puts this doctrine before the world in its practical bearing by applying it at once to the broad question of what should be taught to children, and in so doing, as we have already intimated, we believe he enters upon a subject which has been a source of incalculable doubt and misgivings to thousands of earnest people. Some idea of the evolution theory is now possessed by every one of ordinary intelligence, and to have any reasonable idea of it is also to perceive its conflict with the Mosaic hypothesis. It is perfectly true that many anchoring their faith to the latter decline, as is their undoubted right, to think on the question of antagonism at all, or to countenance any discussion thereupon; but on the other hand, while they can thus escape the consequences of their own reasoning, it is manifestly impossible for them to check the reasoning process in others. A knowledge of the evolution theory must come from the teaching of any department of natural science. To teach it is likely to exhibit its antagonism to the opposing hypothesis, and to excite thought and question. The parent, firm in his own faith, may well gravely view the alternative of what appears to him the dangerous knowledge on the one hand, or the equally dangerous ignorance on the other, which confronts the child, and eagerly seeks the middle ground in which he may reach a decision satisfactory to his own conscience. It is just here that Virchow's doctrine is illusory, for it is easy to take refuge in his caution, not to teach any but known facts, to brush aside the whole question with the assertion that the evolution theory is only a probability, and hence not to be taught; but then the same reasoning must apply to the Mosaic theory, which is equally based on other than positive fact, and in brief, it might be added, to anything whatever resting on faith.

Where then is the safe middle ground? Our author believes in the rule, "Before teaching any doctrine wait until the nature of the evidence for it can be understood;" and it seems to us that there is a world of sound sense in this. Nine tenths of all human antagonism is based on misapprehension, and that between science and theology is the reverse of an exception to the rule. The well-meaning "family" periodicals which cater to the tastes of their readers by assaults on what they are pleased to call "Darwin's ape theory," are ingenious in devising new evidences of their misunderstanding of the subject, and misapplication of its deductions. Ignorance even more profound is equally manifested by those who mistake their own incompetency to comprehend the great doctrines underlying religious faith, for flaws in the doctrines themselves, and who glory in their supposed stand on that summit of logical absurdities, atheism. It may be laid down as an axiom that it is not that which we do not know that retards progress, but that which we half know; better ignorance than wrong ideas which lead to worse error. It is intelligent education which lies at the basis of prosperity. The gulls of such men as Keely owe their gullibility to insufficient knowledge, and the same may be said of every enthusiast who formulates wild theories from his own consciousness and spends life and money seeking the impossible. The duty of science is to establish facts. Any one may make his own deductions; no one is bound to accept those of others. Facts once rightly established remain; conclusions based on them are always shifting; and the latter can never be right unless based on a knowledge of all the former.

Professor Clifford's rule has the especial merit of working both ways. "Much education," he says, "is required to enable the learner really to estimate the evidence for the many-toed horse; much more is wanted for the clear comprehension of the evidence for the simpler brained man." This evidence cannot be taught until a late period in education, otherwise the learner's head is confused with abstractions, which prevent his learning properly in the future. Finally, the writer elsewhere continues, "Teach your children to do good, and to eschew evil; if in later life they can find hope of an eternity of such action it will make them happier, and may make them better. But the experience of centuries condemns the practice of teaching the doctrine (of immortality) to little children, so as to make it familiar as an ill-understood conception, to weaken the power it might have for good, and to help the perversion of it to superstitious uses."

A READY MEANS OF ESTIMATING THE VALUABLE CONSTITUENTS OF CEREALS, ETC.

By means of a very ingenious method, first discovered by Mr. A. A. Hayes, of Roxbury, and Dr. Chas. T. Jackson, of Boston, it will be found that if a kernel of corn be split longitudinally, and immersed in an aqueous solution of sulphate of copper, the germ, or "chit," only, becomes colored green, thereby beautifully defining the limits of the phosphates by the formation of phosphate of copper. The same process may be applied to all seeds (except those of an oily nature), tubers, roots, and stems of vegetables for defining the parts containing phosphoric acid.

If a kernel of corn be split open, as before described, and thrown into a solution of sulph-hydrate of ammonia, the "chit" will soon be changed to a dark olive color, which is due to a change of the salts of iron in the seed to a sulphuret of that metal; a dark colored matter forming with the ammonia turns the vegetable coloring matter yellow, and the two colors combined produce an olive. Again, by taking split specimens of corn, or other grains, and soaking them in a tincture of iodine, the limits of the starch and dextrine will be distinctly defined—the iodine striking an intense blue with the starch, and a deep port wine red with the dextrine; so that, from this test, a rich violet (being the combination of the blue and red colors) will indicate the presence of both the starch and the dextrine in the grain. If the oil be extracted from the transparent horny part of the corn by means of alcohol or ether, the tincture of iodine will show the presence of starch in that part of the grain, associated with the gluten. By these means we may easily cause any of our cereal grains to represent to us the extent and precise limits of its phosphates, iron, dextrine, starch, and oil; and thus, by the eye alone, we may form an approximate estimate of the relative proportions of these ingredients.

Among other curious results of some experiments made by Dr. Jackson is the proof that the relative proportions of the phosphates in grain depend on the appropriating power of each species or variety; for, an ear of corn having been selected which had on it two different kinds, namely, the Tuscarora and a variety of sweet corn, and these seeds having been split and immersed in the same copper solution, soon gave evidence that there was more than double the amount of phosphates in the sweet than there was in the Tuscarora variety. Now since the kernels came from the same ear, and grew side by side, they obtained unequal amounts of phosphates from the same sap, derived from the same soil. A crop of sweet corn will take twice as much of the phosphates as the other variety, and consequently will sooner exhaust the soil of them.

Some interesting facts were observed, too, in the variable proportions of phosphates in different varieties of the same species of other grains. The fact that the smaller grains, such as wheat, oats, and barley, contain so much less than Indian corn would seem to explain their peculiar properties as food for animals; the more highly phosphatic grain being more likely to surcharge the system of adult animals with the elements of bony matter, producing concretions of phosphate of lime, like those resulting from gout. Perhaps that stiffness of the joints and lameness of the feet common in horses fed too freely with corn may be accounted for by this preponderance of the phosphates. Young animals cannot fail to derive more osseous matter from corn than from other food.