### A VISIT TO THE EXHIBIT OF THE NEW YORK ACADEMY OF SCIENCES.

BY PROFESSOR H. F. OSBORN.

The annual reception and exhibit of recent progress in science was instituted last year by the New York Academy, upon the model of the famous "conversazione" of the Royal Society of London. These social scientific meetings of the Royal Society, which are held on two or three evenings in the course of the winter, bring together savants from all parts of Great Britain. There are usually from forty to fifty exhibits, partly of a popular character, but mainly illustrating the most recent discoveries in England or the Continent. The distinctive feature of each discovery is set forth with great clearness, either by personal explanations given by the exhibitor himself or by some diagramatic method. Englishmen have a gift of exposition of scientific truth which is exemplified in a remarkable degree both by the writings and teaching methods of such men as Huxley and Tyndall.

From a study of the catalogue of this second exhibition of the New York Academy it is apparent that we have much to learn from the Englishmen in this respect, and that one result which these exhibitions should bring about is an improvement in the methods of extending scientific truths to wider circles. The exhibit of the Academy as a comparatively local society naturally presents a contrast in being of a less national character, and yet one cannot fail to be struck by the broad fields of research now being entered by the scientists of this city, with the promise of some really great results in the future.

Of five hundred exhibits displayed, it is only possible to mention a few. All of our educational institutions contribute, while a number of the most important objects come from great distances, such as the photographs from the Allegheny and Lick Observatories to be shown in the astronomical section. This section is in charge of Mr. Charles A. Post of the Strandhome Observatory, and among the ten exhibits he has brought together are photographs of star spectra between F and D shown by Professor Keeler of the Allegheny Observatory. This is the portion of the spectrum most easily observed by the eye, and these plates are referred to as evidence that photography is superior to the eye even on its own ground. Professor Barnard of the Lick Observatory exhibits valuable glass negatives of comets and the Milky Way made with the new six inch Willard portrait lens, refigured by Brashear. There are also other series of photographs from the Lick and Strandhome Observatories. In the mechanical section Professor Woodward exhibits models of the international prototype meters and kilogrammes, which have been lately adopted as the standard of length and mass respectively by nearly all nations. One of the most novel exhibits in physics is a series of "Chladni" figures shown by Professor Alfred M. Mayer of Stevens Institute, who has charge of this section. The figures are formed in white sand upon vibrating metallic plates, and Professor Mayer's process consists in fixing the sand upon a black background after the figures have been formed, by means of a fixative spray. These plates demonstrate the truth of Lord Rayleigh's theoretical deductions, and differ radically from all figures which are shown in modern text books in the fact that none of the lines intersect. The physical exhibit is an extensive one, including a large number of instruments for spectroscopic as well as for sound and light measurements, mainly devised by different members of the Columbia Physical Laboratory. The mineralogical exhibit has been arranged by Dr. L. P. Gratacap of the American Museum of Natural History, and includes about one hundred objects, the most notable being a series of Babylonian and Assyrian cylinders and seals arranged to illustrate the different mineralogical materials used for these purposes between 4,000 and 300 B. C. This is from the collections of Tiffany & Co. and of the Rev. W. A. Ward. The American Museum of Natural History contributes an attractive series in the line of zoology under the direction of Professor J. A. Allen. The rapid improvement in methods of taxidermy is illustrated by a series of comparisons between the work just completed at the museum and that of ten years ago. The most striking of these pairs is that of two chimpanzees, the modern example being the late Chico, so well known in New York, which has just been mounted by Mr. J. Rowley, Jr. Two wild turkeys mounted side by side show in the modeling of the head and wattles the greater naturalness of recent work. Adjoining this exhibit is that made in different lines of research by Columbia biologists. First is a series of preparations of nerve cells from the brain and spinal cord, illustrating the great advance in our knowledge of the nervous mechanism which has been made by the method discovered by Professor Golgi of Pavia. By a silver nitrate impregnation we secure a picture of the nerve cell with its finest processes standing out like a silhouette on a light background, a technical result which has worked a complete revolution in all our ideas regarding the relations of the nervous system. The exhibitor, Mr. O. S. Strong, shows two of his own improvements upon the original Golgi method.

A second series is that made by Messrs. Wilson, Calkins and Kean, showing the relations of the archoplasm and chromatin, the two substances which lie at the basis of all the phenomena of inheritance both in animals and plants.

These elements are seen in several different types of animals, the most novel series being that shown by Professor Wilson, which is the basis of a discovery of great significance, namely, that the paternal cell alone contributes the dynamic or cell-dividing substance to the new individual, from which we infer that the chromatin alone, as a product of both sexes, is the bearer of hereditary qualities, for it is evident from Galton's researches that such qualities are equally contributed by both parents.

These so-called fertilization phenomena are beautifully shown on a large scale to those not familiar with high powers of the microscope by a series of micro-photographs taken by Dr. Edward F. Leaming, who has charge of the entire photographic section. In this section we find some striking examples of the latest stages of perfection in pictures taken through the microscope, shown in connection with nerve preparations and also in photographs of bacteria. There is also here a large exhibit of the latest photographic apparatus, to which one of the side rooms of the galleries is devoted.

In operation during the evening is a triple lantern, designed by Mr. Frederic Ives, of Philadelphia, showing

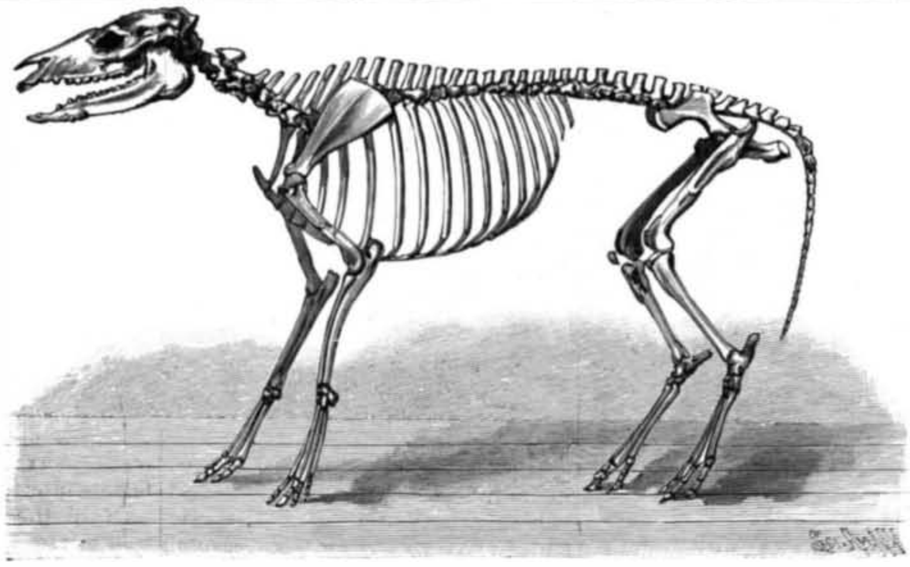


Fig. 1.—PRIMITIVE HORSE—HEIGHT, THREE AND ONE-HALF HANDS.

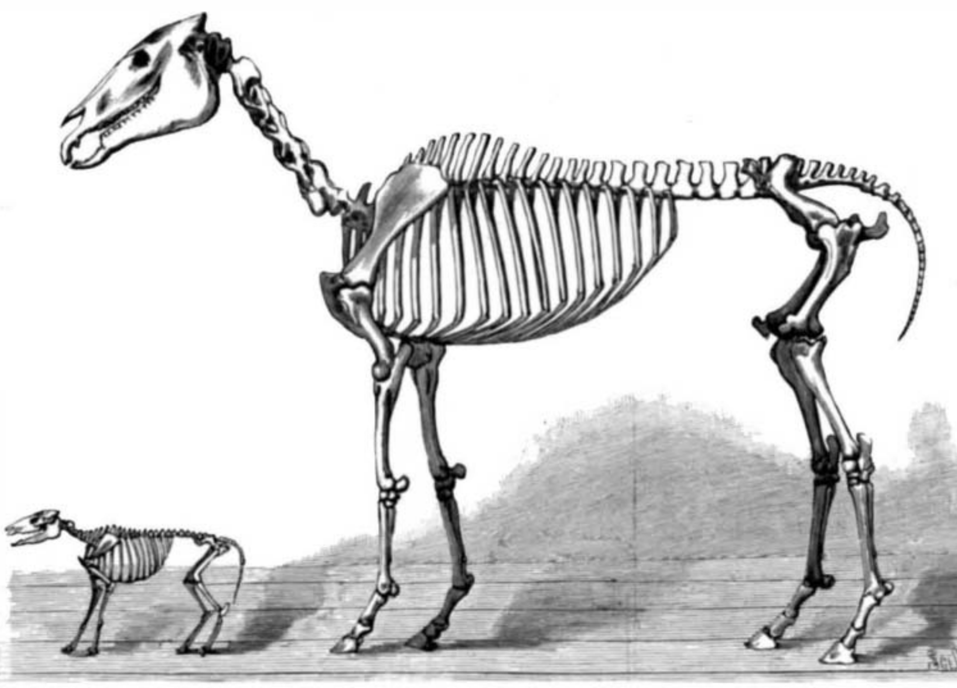


Fig. 2.—COMPARISON OF PRIMITIVE HORSE AND MODERN TROTTER.

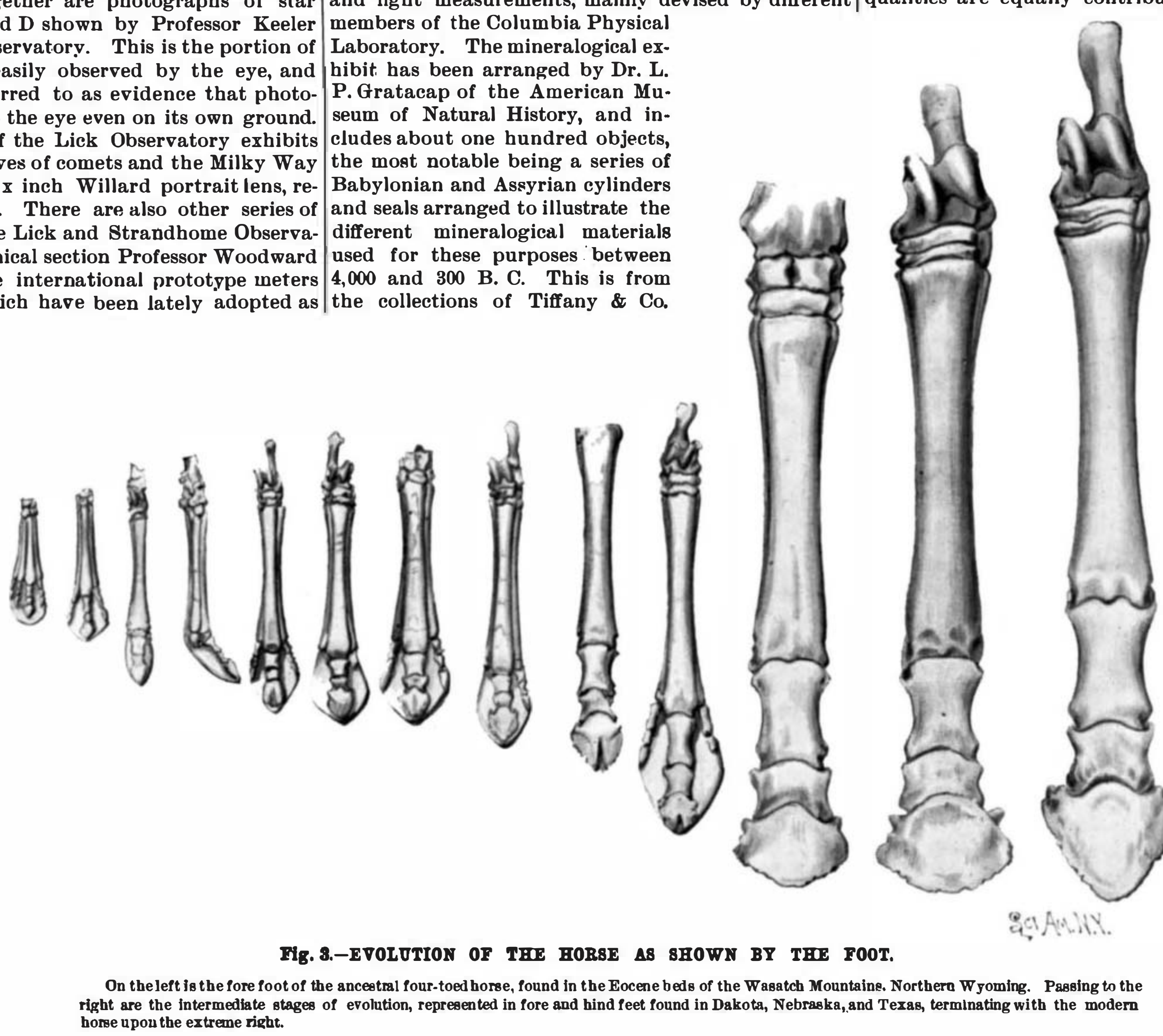


Fig. 3.—EVOLUTION OF THE HORSE AS SHOWN BY THE FOOT.

On the left is the fore foot of the ancestral four-toed horse, found in the Eocene beds of the Wasatch Mountains. Northern Wyoming. Passing to the right are the intermediate stages of evolution, represented in fore and hind feet found in Dakota, Nebraska, and Texas, terminating with the modern horse upon the extreme right.

the projection of the three primary colors in lantern slides so combined as to produce the effect on the screen of a picture in natural colors. All the recent advances in half tone and color printing are also shown.

In an adjoining room is the bacterial exhibit arranged by Dr. T. M. Cheeseman, of the College of Physicians and Surgeons, whose recent exposé of the impurities of the Croton water supply is familiar to New Yorkers. A very large number of pathogenic species are shown, the new feature in each case being that all the types have been preserved by the new formalin method. The recent discovery of the cure for diphtheria is illustrated by the specific germ of this disease, also by vials containing the "toxin" which is used to inoculate horses and other animals to induce immunity, and by the "anti-toxin" drawn from the serum of the blood of the horse. Professor John G. Curtis has charge of the physiological department in which many new forms of apparatus for experimental investigation are shown. The exhibit of experimental psychology arranged by Dr. Farrand is of a similar character. Geology and paleontology are in the care of Professor Kemp and Professor Osborn respectively. Here is a large collection of the evidences of the series of great volcanoes which extended along the Atlantic seaboard from New Brunswick to North Carolina during pre-Cambrian times. These eruptive rocks have been found to possess in greater or less perfection all the characteristic structures of recent lavas. The discovery and proof of the existence of these volcanoes is one of the most surprising results of recent geology work in this country. Various types of invertebrate fossils show the work which has been done in the ancient life of the Atlantic coast. The most striking is the rich collection made by Messrs. Van Ingen and Matthew at St. John, N. B., demonstrating the existence of a varied fauna in the middle and lower Cambrian, which has hitherto been considered extremely barren. In vertebrate paleontology the main exhibit is that showing the evolution of the horse, as here illustrated. The wonderful series connecting the oldest known horse of the lower Eocene period with the modern horse is probably the most complete which has ever been brought together. The American Museum of Natural History has recently acquired the famous little four-toed horse from the collection of Professor Cope, of Philadelphia, and it is here publicly exhibited for the first time (Fig. 1). This little animal, although fully matured, is only 3½ hands high, and is estimated at two million years of age. The skull and limbs, nevertheless, display the most undoubted characteristics of the horse, there being a broad space in the lower jaw corresponding to the space for the bit. The teeth are short and simple; the limbs are scarcely larger in diameter than a good sized pencil, and there are four toes, all resting upon the ground, in the fore foot. To those who still doubt whether this little animal is actually the ancestor of the modern horse, a remarkable series of feet is exhibited (Fig. 3), giving all the stages between this four-toed and the modern one-toed animal, in which the median toe is seen constantly increasing in size, and the side toes are constantly diminishing until they are reduced to the pair of splints. This evidence is further confirmed by an almost equally complete series of skulls showing every stage in this wonderful development. The two extremes of this remarkable series are shown in the little four-toed animal placed beneath the head of the modern trotting horse skeleton (Fig. 2), showing the exact relative size of each. This exhibit, together with botany and anatomy, is placed in the Vanderbilt gallery. Dr. Curtis, of Columbia, has charge of an extensive display from the botanical laboratories of Columbia and of Barnard, including the collections made by Messrs. Small and Nash in Georgia and Florida and the microscopic studies of Dr. Schneider upon the North American lichens. In anatomy, Professor Huntington has arranged a complete series, showing the comparative anatomy of the ileo-cæcum.

It is already informally decided to make this reception an annual affair. The galleries prove to be perfectly adapted to the purpose, with admirable wall space for charts and diagrams, very extensive floor and table space, and every facility for general and special electrical illumination.

### Natural History Notes.

The Eozoon.—Eozoon was a name applied to a supposed genus of animals, because when first examined by Dr. Dawson, of Montreal (1864), it was the oldest fossil then known to exist, and its appearance was held to be, as the name denotes, the dawn of life upon the globe. Some naturalists have believed it not organic, while others, such as Dr. William Carpenter and Prof. T. Rupert Jones, have considered it a rhizopod or a foraminifer. It occurs in the Laurentian of Canada, and is called Eozoon Canadense.

Messrs. Johnston Lavis and J. W. Gregory, in a memoir recently published in the Transactions of the Royal Society of Dublin, finish the history of this supposed fossil animal. Doubts were expressed as long ago as 1865 as to the organic nature of this object, and the conclusions of Moebius upon the subject have now been fully confirmed by the English investigators above mentioned, who have not been able to find in the specimens of Eozoon examined by them anything but traces of mechanical and chemical alterations of the rock. It is very interesting to note that the vestiges of the pretended "dawn of life" are particularly abundant in the rocks thrown out by Monte Somma, and the authors conclude that the Eozoon is due to an alteration of calcareous rocks inclosed in an igneous magma in fusion, in fact, to a true metamorphosis.

Varieties of Chlorophyl.—Mr. Etard has previously shown that the green coloring matter of phanerogamous plants consists of a mixture of pigments, and he now points out (Comptes Rendus, cxx., 328) that chlorophyl may be more or less blue, green or yellow, according to the plants from which it is obtained and the treatment to which it has been subjected. He finds that lucerne (Medicago sativa) contains several distinct chlorophyls, among others $\alpha$-medicagophyl and $\beta$-medicagophyl. Certain chlorophyls, soluble in pentane, are, by their decomposition in the plant cells, the cause of the formation of essences and oils by chemical means. Others again, which are not so soluble, mix with water. These are very rich in oxygen and become decomposed to produce carbo-hydrates, tannins, etc.

Sight in Insects.—Dr. C. V. Riley, in his recent address as president of the Biological Society of Washington, said: Of the five ordinary senses recognized in ourselves and most higher animals, insects have, beyond all doubt, the sense of sight, and there can be as little question that they possess the sense of touch, taste, smell and hearing. Yet, save, perhaps, that of touch, none of these senses, as possessed by insects, can be strictly compared with our own, while there is the best of evidence that insects possess other senses that we do not, and that they have sense organs with which we have none to compare.

Taking the sense of sight, much has been written as to the picture that the compound eye of insects produces upon the brain or upon the nerve centers. Most insects that undergo complete metamorphoses possess, in their adolescent states, simple eyes or ocelli, and sometimes groups of them of varying size and in varying situations.

It is difficult, if not impossible, to demonstrate experimentally their efficiency as organs of sight; the probabilities are that they give but the faintest impressions, but otherwise act as do our own. The fact that they are possessed only by larvæ which are exposed more or less fully to the light, while those larvæ which are endophytous, or otherwise hidden from light, generally lack them, is in itself proof that they perform the ordinary functions of sight, however low in degree. In the imago state the great majority of insects have their simple eyes in addition to the compound eyes. In many cases, however, the former are more or less covered with vestiture, which is another evidence that their function is of a low order, and lends weight to the view that they are useful chiefly for near vision and in dark places. The compound eyes are prominent and adjustable in proportion as they are of service to the species.

It is obvious from the structure of these compound eyes that impressions through them must be very different from those received through our own, and, in point of fact, the late experimental researches of Hickson, Plateau, Tocke and Lemmermann, Pankrath, Exner and Viallanes, practically established the fact that while insects are shortsighted and perceive stationary objects imperfectly, yet their compound eyes are better fitted than the vertebrate eye for apprehending objects set in relief or in motion, and are likewise keenly sensitive to color.

So far as experiments have gone, they show that insects have a keen color sense, though here again their sensations of color are different from those produced upon us. Thus, as Lubbock has shown, ants are very sensitive to the ultra-violet rays of the spectrum, which we cannot perceive, though he was led to conclude that to the ant the general aspect of nature is presented in an aspect very different from that in which it appears to us. In reference to bees, the experiments of the same author prove clearly that they have this sense of color highly developed, as indeed might be expected when we consider the part they have played in the development of flowers. While these experiments seem to show that blue is the bee's favorite color, this does not accord with Albert Muller's experience in nature, nor with the general experience of apiarians, who, if asked, would very generally agree that bees show a preference for white flowers.

Economic Uses of Insects.—Lowly as they seem in point of organization, there are few animals that exceed insects in commercial importance. The finest red dyes known to manufacturers before the introduction of coal oil colors were derived from insects. The Lecanium Ilicis, an inhabitant of the evergreen oak, was employed for this purpose by the ancient Greeks and Romans, as it is still by the Arabs; and, until the introduction of the Mexican cochineal, another species, the Coccus Polonicus, living on the roots of the Scleranthus annuus in Central Europe, was much used for the same purpose. The Mexican cochineal, which drove all other kinds out of market, is one of the species of Coccinia. This insect was long regarded as a parasite upon the prickly pear. For many years the cultivation, or rather feeding, of the cochineal insect was entirely confined to Mexico, but it has now been introduced into Spain and the French possessions of Africa. A fourth species of great importance is the lac insect, Coccus lacoa, an inhabitant of the East Indies, where it feeds upon the banyan and other trees. It is to this insect that we are indebted, not only for the dye stuffs known as lac dye and lac lake, but also for the well-known substance called shellac, so much used in the preparation of varnishes and sealing wax. It is somewhat remarkable that only the female insects yield a good coloring matter.

Of all the secretions peculiar to insects, silk may well be regarded as the most valuable, since it has become as much an essential to the purposes of mankind as to the economy of its producers. The fluid, before it comes in contact with the air, is viscous and transparent in the young larva, but thick and opaque in the more mature. By chemical analysis, it is found to be chiefly composed of bombic acid, a gummy matter, a substance resembling wax, and a little coloring matter. Silk may be placed in boiling water without undergoing any change, the strongest acids are required to dissolve it, and it is only quite recently that it has been imitated artificially.

Then we have large sums of money changing hands from the labors of the useful little bee, tons of weight of honey and beeswax being yearly consumed.

The Spanish fly is an indispensable article in the treatment of certain forms of disease, and that invaluable agent, chloroform, was first made from formic acid, an acid discovered in the formic ant and from which it has derived its name. Then there are nutgalls, produced by a small fly, and for which a substitute could not be found in dyeing and ink making.

Diastatic Ferment in Plants.—From experiments on seedlings of Canna, Platanus, Phaseolus, etc., Dr. J. Gruss concludes the existence in seedlings of a soluble diastase which is capable of diffusion through the cell wall in the same way as sugar. It appears to pass, with maltose, out of the cotyledons into the stem; for the removal of the cotyledons diminishes the amount of diastase in the stem. The quantity of diastase present was ascertained by its action on starch, the iodine test being used to determine the extent to which the starch had been destroyed. The penetration of the diastase into the substance acted on is accompanied with a simultaneous change in the latter, and to this process the author applies the term "allenolysis." The action of the diatase on the reserve cellulose in the seed of the date is very slow, and ends in its transformation into soluble products, probably mannose. It is by this action of diastase that the absorption of reserve cellulose takes place in the germinating date.

Vitality of Seeds.—Dr. Peters, of the Botanic Garden of Gottingen, has been experimenting with seeds taken from different depths of soil in a dense wood from 100 to 150 years old, which had been arable land for many years before it became woodland. His object was to discover how long the seeds of weeds would retain the power of germinating after they had been buried in the soil to a depth where they could not sprout. Soil samples were taken at various distances from the surface to the depth of a foot. These samples were placed under genial conditions and the seeds which germinated were raised and cultivated to a flowering stage. Although the land had ceased to be arable between 300 and 400 years before, the weeds of cultivation were abundantly represented, and Dr. Peters claims to have proved that the seeds of many field and pasture plants retain their vitality considerably more than half a century.

The Flight of Birds.—Hawks, says Fleming, in his Philosophy of Zoology, probably fly at the rate of 150 miles an hour, and an eider duck at 90 miles. Sir George Cayley estimates that the common crow flies at nearly 25 miles an hour. Spallanzani found the rate of the swallow to be 92 miles an hour; while he conjectures the velocity of the swift to be nearly three times greater. A falcon that belonged to Henri IV, of France, escaped fron Fontainebleau, and in twenty-four hours afterward was found at Malta, a distance of not less than 1,530 miles; a velocity equal to nearly 57 miles an hour, supposing the bird to have been unceasingly on the wing. But, since such birds never fly by night, and allowing the day to be at the longest, its flight was, perhaps, equal to 75 miles an hour. If we even restrict the migratory flight of birds to 50 miles an hour, how easily can they perform their most extensive migrations. Fair winds may perhaps aid them at the rate of 30 or 40 miles an hour, or even help them attain three times greater rapidity.

Two sections of the great Russian railway across Siberia are now in operation. The aggregate of the two is 761 miles. The total length of the road is to be 4,000 miles.

### Loss of a Spanish War Ship.

The sad intelligence is announced of the foundering at sea of the splendid armored cruiser of the Spanish navy, the Reina Regente, with loss of some 420 officers and crew. On the 10th of March the ship sailed from Tangier for Cadiz, and sank, it is believed, the following day during the prevalence of a great storm. The tips of her topmasts were found projecting from the water near Gibraltar and the Spanish coast.

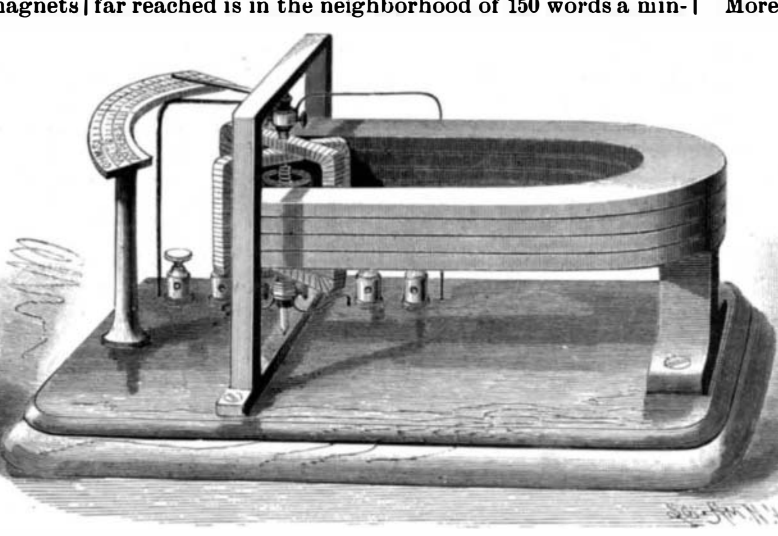
The Reina Regente was built and engined by Messrs. James & George Thomson, of Clydebank, for the Spanish government. The following were her measurements: Length over all, 330 feet, and 307 feet between perpendiculars; breadth, 50½ feet; and her draught was 20 feet; displacement, 5,600 tons when fully equipped.

There was a very minute subdivision in the hull of the ship, there being, in all, 156 water-tight compartments, 83 of which are between the armored deck and the one immediately above it, or between wind and water. Most of these compartments were used as coal bunkers, and appear to have been of no avail in preventing the fatal catastrophe.

The Reina Regente was one of the ships which took part in the grand naval parade in New York harbor in 1893, when she attracted much attention from her graceful lines and formidable appearance.

### A COMBINATION ELECTRICAL METER.

The meter shown in the illustration is adapted to measure and indicate with nicety the ohms, volts, amperes, or watts, in measuring an electric current. It has been patented by Mr. Herschel C. Parker, of No. 21 Fort Greene Place, Brooklyn, N. Y. Supported on a suitable base is a permanent magnet, between the poles of which, on a common axis, turn coils wound respectively for high and low resistance, the coils as they turn moving a hand over a segmental graduation indicating ohms, volts, and amperes, and which may be marked to indicate watts. The coils and magnets may, if desired, be differently arranged, but as shown the inner coil is wound for low resistance and the outer one for high resistance, both coils being secured to upper and lower axles on which are insulating collars with binding posts. Two of the binding posts are connected by light flexible wires with the low resistance coil, and by other wires with binding posts on the base, while two other binding posts on the axles are connected with the high resistance coil and with other binding posts on the base, the posts on the base being adapted for connection with the current wires to be measured. The coils turn against the tension of a light spring secured to the coils and to a bracket which supports a core centrally within the coils. The top axle carries the indicating hand, and the current may be brought to the coils, if desired, through the torsion spring. In use as an ohm meter the high resistance coil is joined in parallel with the resistance to be measured, and the low resistance coil is joined in series, the action then being proportional to the ratio of the potential difference to the current, or from Ohm's law, $R = E \div C$. By giving the coils the proper resistance the deflection will be proportional to the ohms in the circuit, the ohms being indicated by the indicator hand on the segmental graduation. For use as an ammeter, the low resistance coil is employed, and for a volt meter the high resistance coil, and the coils are arranged parallel instead of at an angle to each other for use as a watt meter.



PARKER'S ELECTRICAL METER.

### The Rubies of Burma.

At a recent meeting of the Royal Society a paper by Mr. C. Barrington Brown and Professor J. W. Judd, F.R.S., was read on "The Rubies of Burma and Associated Minerals: their Mode of Occurrence, Origin, and Metamorphoses." The ruby district of Upper Burma, it was stated, so far as explored, is about 26 miles long and 12 broad, and lies at elevations varying from 4,000 feet to 5,500 feet above the sea level. The principal mining center in this district is Mogok, and the present workings for rubies extend over an area of 45 square miles, old workings, however, being found over an area of 66 square miles. It is also probable that ruby-bearing limestones and the alluvial earths derived from them may be found in portions of the Shan states. It is in the lower clay beds of the river alluvia, and in similar deposits formed in gullies in the hill wash, that the rubies, spinels, and other gems of the district are found. Operations for the obtaining of rubies are carried on in Burma in four different ways. In the alluvia, square pits from 2 feet to 9 feet across, ingeniously timbered with bamboo, are sunk to the ruby earth, the drainage of the pits and the removal of material being effected by baskets attached to balance poles, both made of bamboo. In the hill wash long open trenches are carried from the sides of a gulley. Regular mines are opened in some places, while the limestones are at one or two points quarried.

### Speed of Typewriters.

The speed of typewriters is a vexed and much discussed question. A few years ago manufacturers used to get up contests to test the speed of the various machines. The competition grew very keen, and the number of words written in a minute became so high (about 150) that a record was established. Then as the unsuccessful machines were hurt more than the successful ones were benefited, the race was dropped, as the game was not worth the candle. As a matter of fact, the only thing settled by such contests was which concern could produce the most expert operator. The races were contests of skill among the operators, and had little, if anything, to do with the actual merit of the machines. Indeed, the only material difference between the leading machines as regards speed is the size of the keyboard or number of keys operated. Some have more than seventy, or as many keys as there are characters, while others have less than forty, each key actuating several characters that are brought into alignment by shifting mechanism. Naturally, both systems have their adherents, but, owing to the inability of either side to prove any superiority, it may fairly be concluded that no advantage exists.

A truer test than the contests referred to is to set the several machines on a lathe, and construct a cylinder or barrel similar to that of a music box, which shall depress the several keys required to produce words and sentences, and in that way reach the actual limit to which each would respond by increasing the speed of rotations of the barrel. This has actually been done, and the result was so far ahead of what is possible for human capacity to perform with the fingers, that there seems no doubt that even the poorest typewriter will respond far beyond the capabilities of any operator.

Since every machine is capable of more rapidity than the human operator can get out of it, the next point to be considered is the speed an expert operator can keep up for a short space of time. As stated, the limit so far reached is in the neighborhood of 150 words a minute, but it must be understood that this record was made by writing a sentence which had been long practiced. The reason for picking out a particular sentence and practicing it is very simple. The use of letters whose keys are close together, and convenient for alternate action of the hands, greatly assists the speed, and the more a particular sentence is practiced, the more rapidly can it be typewritten. Take the very operator who has shown a speed of, say, 150 words, and get him to write a sentence composed of the same letters, but made up of different words, so that the letters are in a different order, and the speed will fall very materially. The loss may be, perhaps, one-third. It is possible for a comparative novice to practice a well selected sentence and in a short time reach about the same speed as the expert, but in the case of the novice the speed would fall tremendously on new matter. The strain on the eyes and mind increases with the speed, until a point is reached where it cannot be kept up for any length of time, and it is worthy of note that some operators have had the keys blank, without any characters marked, in order to relieve the strain on the eyes.

In considering the speed of the average operator, considerable difficulty is experienced in arriving at any accurate conclusion, owing to the tendency of all operators to put on extra steam when timed or watched. By far the greater part of the work done on typewriters is copying, either from stenographic notes or other manuscript, and a fair average would be below forty words a minute.

There is, of course, some time lost in reading from the copy, when no writing is done, and the practice of a good many operators of continually reading over what they have written to see that it is correct. The time required to correct mistakes has been figured as high as 15 per cent. Another reason for the tremendous fall in speed is probably the strain on the eyes, which are constantly dancing over the characters marked on the keys. This strain should not be underestimated, as the eyes of many operators have been affected by it, and it is further evidenced by the experts, who prefer blank keys, so as to avoid the blurring caused in rapid writing.

It is interesting to note the number of strokes each minute that the hands are capable of, if depressed alternately. More than 700 strokes can be made in a minute, and more than 400 can be performed without undue exertion or effort. Now, taking five strokes to a word (which is about the average), that would mean 80 words a minute comfortably, and after making due allowance for the time occupied in entering the paper and returning the paper carriage after each line, it would still be about double what is done ordinarily on a typewriter. The fault for the loss of speed appears to lie in either the method of operation or the keyboard. If a keyboard could be constructed that could be readily memorized, the eyes would be relieved and the speed increased, especially in copying, when the eyes could be kept on the copy and would not have to keep shifting the eyes from the keys to the copy. Such a keyboard would necessarily have to be compact, and with a very limited number of keys, but for that very reason there would be a gain in limiting the motion of the hands required to select the required key. If, furthermore, such a keyboard could allow an alternate action of the hands without deviation, the speed would be increased without extra exertion. Then concerning the mistakes that occur from depressing the wrong key, and which are realized the instant they are made, but too late to avoid the wrong impression, they could be partially avoided if the printing did not occur till the next depression. That would mean that the machine would always be one letter behind.

It may be that the typewriting machine has reached its highest perfection, but in view of these facts it seems strange that there has been no radical improvement for fifteen years.—N. Y. Sun.

### Wood Pulp.

More than 50 per cent of the saw mill owners to-day could make more money to sell their logs to be manufactured into wood pulp and paper than they can possibly expect to secure through sales of the same in the form of manufactured lumber. The wood pulp industry has far outstripped the manufactured lumber industry.

One factor in the pulp and paper business is not always recognized by the owners of spruce forests. When a pulp mill grinds up a million feet of logs into paper product, and the same is sold to the great newspaper corporations and printed upon day after day, that paper practically goes out of existence. Few think of saving a newspaper. The individual newspaper reader throws his paper after reading into the waste basket or kindles a fire with it, or it becomes the property of the old junk dealer, and practically passes out of existence. On the other hand, the piece of lumber which is manufactured goes into a substantial building, which lasts for generations. So that the great consumption of spruce for pulp and paper really amounts to so much raw material taken out of the market forever, and practically wasted so far as any subsequent use to which it may be applied is concerned.—Manuf. Gazette.

### Lights and Colors.

It has often been observed that a bright scarlet uniform will, in a good photographic dark room with ruby-glass windows, appear perfectly white. On this subject Herr H. W. Vogel made some interesting communications to the Physical Society of Berlin at a recent meeting. Experimenting with oil lamps provided with pure red, green, and blue color screens, he found that when white light was rigidly excluded, all sense of color disappeared to the observers, and nothing but shades of black and white could be distinguished on objects in the room. He further found that a scale of colors illuminated by red light showed the red pigments as white or gray, which abruptly turned into yellow, and not red, on adding blue light. Hence a color was perceived which was not contained in either of the sources. Red and yellow patches appeared of the same color, so that they could hardly be distinguished. But the difference was at once brought out by adding green instead of blue light. How very much the kind of sensation experienced depends upon the intensity of illumination is easily seen in the case of the region of the spectrum near the G line of Fraunhofer. This region appears violet when its luminosity is feeble, blue when it is stronger, and may even appear bluish-white with strong sunlight, so that the assertion often made that with normal eyes a definite color sensation corresponds to a definite wave length, cannot be upheld. Herr Vogel comes to the conclusion that our opinion as to the color of a pigment is guided by our preception of the absence of certain constituents. Thus a red substance is only recognized as such when light of other colors is admitted, and we perceive its inability to reflect these.