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[Illustration]

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THE RAPHAEL CELEBRATION AT ROME.

The most famous of Italian painters, Raffaele Sanzio, whom the world commonly calls Raphael, was born at Urbino, in Umbria, part of the Papal States, four hundred years ago. The anniversary was celebrated, on March 28, 1883, both in that town and in Rome, where he lived and worked, and where he died in 1520, with processions, orations, poetical recitations, performances of music, exhibitions of pictures, statues, and busts, visits to the tomb of the great artist in the Pantheon, and with banquets and other festivities. The King and Queen of Italy were present at the Capitol of Rome (the Palace of the City Municipality) where one part of these proceedings took place.

[Illustration: SKELETON OF RAPHAEL AS FOUND IN HIS TOMB IN THE PANTHEON, IN 1833.]

At ten o'clock in the morning a procession set forth from the Capitol to the Pantheon, to render homage at the tomb of Raphael. It was arranged in the following order: Two Fedeli, or municipal ushers, in picturesque costumes of the sixteenth century, headed the procession, carrying two laurel wreaths fastened with ribbons representing the colors of Rome, red and dark yellow; a company of Vigili, the Roman firemen; the municipal band; the standard of Rome, carried by an officer of the Vigili; and the banners of the fourteen quarters of the city. Then came the Minister of Public Instruction and the Minister of Public Works; the Syndic of Rome, Duke Leopoldo Torlonia; and the Prefect of Rome, the Marquis Gravina. The members of the communal giunta, the provincial deputation, and the communal and provincial council followed the principal authorities. Next in order came the presidents of Italian and foreign academies and art institutions, the president of the academy of the Licei, the representatives of all the foreign academies, the members of the academy of St. Luke, the general direction of antiquities, the members of the Permanent Commission of Fine Arts, the members of the Communal Archæological Commission, the guardians of the Pantheon, the members of the International Artistic Club, presided over by Prince Odescalchi; the members of the art schools, the pupils of the San Michele and Termini schools with their bands, the pupils of the elementary and female art schools. The procession was rendered more interesting by the presence of many Italian and foreign artists. Having arrived at the Pantheon, the chief personages took their place in front of Raphael's tomb. Every visitor to Rome knows this tomb, which is situated behind the third chapel on the left of the visitor entering the Pantheon. The altar was endowed by Raphael, and behind it is a picture of the Virgin and Child, known as the Madonna del Sasso, which was executed at his request and was produced by Lorenzo Lotto, a friend and pupil of the great painter. Above the inscription usually hang a few small pictures, which were presented by very poor artists who thought themselves cured by prayers at the shrine. This is confirmed by a crutch hanging up close to the pilaster. The bones of Raphael are laid in this tomb since 1520, with an epitaph recording the esteem in which he was held by Popes Julius II. and Leo X.; but they have not always been allowed to lie undisturbed. On Sept. 14, 1833, the tomb was opened to inspect the mouldering skeleton, of which drawings were made, and are reproduced in two of our illustrations. The proceedings at the tomb in the recent anniversary visit were brief and simple; a number of laurel or floral wreaths were suspended there, one sent by the president and members of the Royal Academy of London; and the Syndic of Rome unveiled a bronze bust of Raphael, which had been placed in a niche at the side.

[Illustration: THE ANCIENT ROMAN TEMPLE NOW KNOWN AS THE PANTHEON, AT ROME.]

This ceremony at the Pantheon was concluded by all visitors writing their names on two albums which had been placed near Victor Emmanuel's tomb and Raphael's tomb. The commemoration in the hall of the Horatii and Curiatii in the Capitol was a great success, their Majesties, the Ministers, the members of the diplomatic body, and a distinguished assembly being present. Signor Quirino Leoni read an admirable discourse on Raphael and his times.

The ancient city of Urbino, Raphael's birthplace, has fallen into decay, but has remembered its historic renown upon this occasion. The representatives of the Government and municipal authorities, and delegates of the leading Italian cities went in procession to visit the house where Raphael was born. Commemoration speeches were pronounced in the great hall of the ducal palace by Signor Minghetti and Senator Massarani. The commemoration ended with a cantata composed by Signor Rossi. The Via Raffaelle was illuminated in the evening, and a gala spectacle was given at the Sanzio Theater. Next day the exhibition of designs for a monument to Raphael was inaugurated at Urbino, and at night a great torchlight procession took place.--_Illustrated London News_.

[Illustration: RAPHAEL'S TOMB IN THE PANTHEON, AT ROME.]

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THE PANTHEON AT ROME.

The edifice known as the Pantheon, in Rome, is one of the best preserved specimens of Roman architecture. It was erected in the year 26 B.C., and is therefore now about one thousand nine hundred years old. It was consecrated as a Christian church in the year 608. Its rotunda is 143 ft. in diameter and also 143 ft. high. Its portico is remarkable for the elegance and number of its Corinthian columns.

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Seæor Felipe Poey, a famous ichthyologist of Cuba, has recently brought out an exhaustive work upon the fishes of Cuban waters, in which he describes and depicts no fewer than 782 distinct varieties, although he admits some doubts about 105 kinds, concerning which he has yet to get more exact information. There can be no question, however, he claims, about the 677 species remaining, more than half of which he first described in previous works upon this subject, which has been the study of his life.

*   *   *   *   *

THE GREAT INTERNATIONAL FISHERIES EXHIBITION.

Her Majesty the Queen has appointed the 12th of May for the opening of the International Fisheries Exhibition, which an influential and energetic committee, under the active presidency of the Prince of Wales, had developed to a magnitude undreamt of by those concerned in its early beginnings.

The idea of an _international_ Fisheries Exhibition arose out of the success of the show of British fishery held at Norwich a short time ago; and the president and executive of the latter formed the nucleus of the far more powerful body by whom the present enterprise has been brought about.

The plan of the buildings embraces the whole of the twenty-two acres of the Horticultural Gardens; the upper half, left in its usual state of cultivation, will form a pleasant lounge and resting place for visitors in the intervals of their study of the collections. This element of garden accommodation was one of the most attractive features at the Paris Exhibition of 1878.

As the plan of the buildings is straggling and extended, and widely separates the classes, the most convenient mode of seeing the show will probably be found by going through the surrounding buildings first, and then taking the annexes as they occur.

[Illustration: THE INTERNATIONAL FISHERIES EXHIBITION, LONDON.

BLOCK PLAN.--A, Switzerland; B, Isle of Man; C, Bahamas and W.I. Islands; D, Hawaii; E, Poland; F, Portugal; G, Austria; H, Germany; I, France; J, Italy; K, Greece; L, China; M, India and Ceylon; N, Straits Settlements; O, Japan; P, Tasmania; Q, New South Wales.--Scale 200 feet to the inch.]

On entering the main doors in the Exhibition Road, we pass through the Vestibule to the Council Room of the Royal Horticultural Society, which has been decorated for the reception of marine paintings, river subjects, and fish pictures of all sorts, by modern artists.

Leaving the Fine Arts behind, the principal building of the Exhibition is before us--that devoted to the deep sea fisheries of Great Britain. It is a handsome wooden structure, 750 feet in length, 50 feet wide, and 30 feet at its greatest height. The model of this, as well as of the other temporary wooden buildings, is the same as that of the annexes of the great Exhibition of 1862.

On our left are the Dining Rooms with the kitchens in the rear. The third room, set apart for cheap fish dinners (one of the features of the Exhibition), is to be decorated at the expense of the Baroness Burdett Coutts, and its walls are to be hung with pictures lent by the Fishmongers' Company, who have also furnished the requisite chairs and tables, and have made arrangements for a daily supply of cheap fish, while almost everything necessary to its maintenance (forks, spoons, table-linen, etc.) will be lent by various firms.

The apsidal building attached is to be devoted to lectures on the cooking of fish.

Having crossed the British Section, and turning to the right and passing by another entrance, we come upon what will be to all one of the most interesting features of the Exhibition, and to the scientific student of ichthyology a collection of paramount importance. We allude to the Western Arcade, in which are placed the Aquaria, which have in their construction given rise to more thoughtful care and deliberation than any other part of the works. On the right, in the bays, are the twenty large asphalt tanks, about 12 feet long, 3 feet wide, and 3 feet deep. These are the largest dimensions that the space at command will allow, but it is feared by some that it will be found somewhat confined for fast going fish. Along the wall on the left are ranged twenty smaller or table tanks of slate, which vary somewhat in size; the ten largest are about 5 feet 8 inches long, 2 feet 9 inches wide, and 1 foot 9 inches deep.

In this Western Arcade will be found all the new inventions in fish culture--models of hatching, breeding, and rearing establishments, apparatus for the transporting of fish, ova, models and drawings of fish-passes and ladders, and representations of the development and growth of fish. The chief exhibitors are specialists, and are already well known to our readers. Sir James Gibson Maitland has taken an active part in the arrangement of this branch, and is himself one of the principal contributors.

In the north of the Arcade, where it curves toward the Conservatory, will be shown an enormous collection of examples of stuffed fish, contributed by many prominent angling societies. In front of these on the counter will be ranged microscopic preparations of parasites, etc., and a stand from the Norwich Exhibition of a fauna of fish and fish-eating birds.

Passing behind the Conservatory and down the Eastern Arcade--in which will be arranged algæsponges, mollusca, star-fish, worms used for bait, insects which destroy spawn or which serve as food for fish, etc.--on turning to the left, we find ourselves in the fish market, which will probably vie with the aquaria on the other side in attracting popular attention. This model Billingsgate is to be divided into two parts, the one for the sale of fresh, the other of dried and cured fish.

Next in order come the two long iron sheds appropriated respectively to life-boats and machinery in motion. Then past the Royal pavilion (the idea of which was doubtless taken from its prototype at the Paris Exhibition) to the southern end of the central block, which is shared by the Netherlands and Newfoundland; just to the north of the former Belgium has a place.

While the Committee of the Netherlands was one of the earliest formed, Belgium only came in at the eleventh hour; she will, however, owing to the zealous activity of Mr. Lenders, the consul in London, send an important contribution worthy of her interest in the North Sea fisheries. We ought also to mention that Newfoundland is among those colonies which have shown great energy, and she may be expected to send a large collection.

Passing northward we come to Sweden and Norway, with Chili between them. These two countries were, like the Netherlands, early in preparing to participate in the Exhibition. Each has had its own committee, which has been working hard since early in 1882.

Parallel to the Scandinavian section is that devoted to Canada and the United States, and each will occupy an equal space--ten thousand square feet.

In the northern Transept will be placed the inland fisheries of the United Kingdom. At each end of the building is aptly inclosed a basin formerly standing in the gardens: and over the eastern one will be erected the dais from which the Queen will formally declare the Exhibition open.

Shooting out at right angles are the Spanish annex, and the building shared by India and Ceylon. China and Japan and New South Wales; while corresponding to those at the western end are the Russian annex, and a shed allotted to several countries and colonies. The Isle of Man, the Bahamas, Switzerland, Germany, Hawaii, Italy, and Greece--all find their space under its roof.

After all the buildings were planned, the Governments of Russia and Spain declared their intention of participating; and accordingly for each of these countries a commodious iron building has been specially erected.

The Spanish collection will be of peculiar interest; it has been gathered together by a Government vessel ordered round the coast for the purpose, and taking up contributions at all the seaports as it passed.

Of the countries whose Governments for inscrutable reasons of state show disfavor and lack of sympathy, Germany is prominent; although by the active initiative of the London Committee some important contributions have been secured from private individuals; among them, we are happy to say, is Mr. Max von dem Borne, who will send his celebrated incubators, which the English Committee have arranged to exhibit in operation at their own expense.

Although the Italian Government, like that of Germany, holds aloof, individuals, especially Dr. Dohrn, of the Naples Zoological Station, will send contributions of great scientific value.

In the Chinese and Japanese annex, on the east, will be seen a large collection of specimens (including the gigantic crabs), which have been collected, to great extent, at the suggestion of Dr. Günther, of the British Museum.

It is at the same time fortunate and unfortunate that a similar Fisheries Exhibition is now being held at Yokohama, as many specimens which have been collected specially for their own use would otherwise be wanting; and on the other hand, many are held back for their own show.

China, of all foreign countries, was the first to send her goods, which arrived at the building on the 30th of March, accompanied by native workmen who are preparing to erect over a basin contiguous to their annex models of the summer house and bridge with which the willow pattern plate has made us familiar; while on the basin will float models of Chinese junks.

Of British colonies, New South Wales will contribute a very interesting collection placed under the care of the Curator of the Sydney Museum; and from the Indian Empire will come a large gathering of specimens in spirits under the superintendence of Dr. Francis Day.

Of great scientific interest are the exhibits, to be placed in two neighboring sheds, of the Native Guano Company and the Millowners' Association. The former will show all the patents used for the purification of the rivers from sewage, and the latter will display in action their method of rendering innocuous the chemical pollutions which factories pour into the river.

In the large piece of water in the northern part of the gardens, which has been deepened on purpose, apparatus in connection with diving will be seen; and hard by, in a shed, Messrs. Siebe, Gorman & Co. will show a selection of beautiful minute shells dredged from the bottom of the Mediterranean.

In the open basins in the gardens will be seen beavers, seals, sea-lions, waders, and other aquatic birds.

From this preliminary walk round enough has, we think, been seen to show that the Great International Fisheries Exhibition will prove of interest alike to the ordinary visitor, to those anxious for the well-being of fishermen, to fishermen themselves of every degree, and to the scientific student of ichthyology in all its branches.--_Nature_.

*   *   *   *   *

PUPPET SHOWS AMONG THE GREEKS.

The ancients, especially the Greeks, were very fond of theatrical representations; but, as Mr. Magnin has remarked in his _Origines du ThØâtre Moderne_, public representations were very expensive, and for that very reason very rare. Moreover, those who were not in a condition of freedom were excluded from them; and, finally, all cities could not have a large theater, and provide for the expenses that it carried with it. It became necessary, then, for every day needs, for all conditions and for all places, that there should be comedians of an inferior order, charged with the duty of offering continuously and inexpensively the emotions of the drama to all classes of inhabitants.

Formerly, as to-day, there were seen wandering from village to village menageries, puppet shows, fortune tellers, jugglers, and performers of tricks of all kinds. These prestidigitators even obtained at times such celebrity that history has preserved their names for us--at least of two of them, Euclides and Theodosius, to whom statues were erected by their contemporaries. One of these was put up at Athens in the Theater of Bacchus, alongside of that of the great writer of tragedy, ˇschylus, and the other at the Theater of the Istiaians, holding in the hand a small ball. The grammarian Athenæus, who reports these facts in his "Banquet of the Sages," profits by the occasion to deplore the taste of the Athenians, who preferred the inventions of mechanics to the culture of mind and histrions to philosophers. He adds with vexation that Diophites of Locris passed down to posterity simply because he came one day to Thebes wearing around his body bladders filled with wine and milk, and so arranged that he could spurt at will one of these liquids in apparently drawing it from his mouth. What would Athenæus say if he knew that it was through him alone that the name of this histrion had come down to us?

[Illustration: FIG. 1.--THE MARVELOUS STATUE OF CYBELE.]

Philo, of Byzantium, and Heron, of Alexandria, to whom we always have to have recourse when we desire accurate information as to the mechanic arts of antiquity, both composed treatises on puppet shows. That of Philo is lost, but Heron’s treatise has been preserved to us, and has recently been translated in part by Mr. Victor Prou.

According to the Greek engineer, there were several kinds of puppet shows. The oldest and simplest consisted of a small stationary case, isolated on every side, in which the stage was closed by doors that opened automatically several times to exhibit the different tableaux. The programme of the representation was generally as follows: The first tableau showed a head, painted on the back of the stage, which moved its eyes, and lowered and raised them alternately. The door having been closed, and then opened again, there was seen, instead of the head, a group of persons. Finally, the stage opened a third time to show a new group, and this finished the representation. There were, then, only three movements to be made, that of the doors, that of the eyes, and that of the change of background.

As such representations were often given on the stages of large theaters, a method was devised later on of causing the case to start from the scenes behind which it was bidden from the spectators, and of moving automatically to the front of the stage, where it exhibited in succession the different tableaux; after which it returned automatically behind the scenes. Here is one of the scenes indicated by Heron, entitled the "Triumph of Bacchus":

The movable case shows, at its upper part, a platform from which arises a cylindrical temple, the roof of which, supported by six columns, is conical and surmounted by a figure of Victory with spread wings and holding a crown in her right hand. In the center of the temple Bacchus is seen standing, holding a thyrsus in his left hand, and a cup in his right. At his feet lies a panther. In front of and behind the god, on the platform of the stage, are two altars provided with combustible material. Very near the columns, but external to them, there are bacchantes placed in any posture that may be desired. All being thus prepared, says Heron, the automatic apparatus is set in motion. The theater then moves of itself to the spot selected, and there stops. Then the altar in front of Jupiter becomes lighted, and, at the same time, milk and water spurt from his thyrsus, while his cup pours wine over the panther. The four faces of the base become encircled with crowns, and, to the noise of drums and cymbals, the bacchantes dance round about the temple. Soon, the noise having ceased, Victory on the top of the temple, and Bacchus within it, face about. The altar that was behind the god is now in front of him, and becomes lighted in its turn. Then occurs another outflow from the thyrsus and cup, and another round of the bacchantes to the sound of drums and cymbals. The dance being finished, the theater returns to its former station. Thus ends the apotheosis.

I shall try to briefly indicate the processes which permitted of these different operations being performed, and which offer a much more general interest than one might at first sight be led to believe; for almost all of them had been employed in former times for producing the illusions to which ancient religions owed their power.

The automatic movement of the case was obtained by means of counterpoises and two cords wound about horizontal bobbins in such a way as to produce by their winding up a forward motion in a vertical plane, and subsequently a backward movement to the starting place. Supposing the motive cords properly wound around vertical bobbins, instead of a horizontal one, and we have the half revolution of Bacchus and Victory, as well as the complete revolution of the bacchantes.

The successive lighting of the two altars, the flow of milk and wine, and the noise of drums and cymbals were likewise obtained by the aid of cords moved by counterpoises, and the lengths of which were graduated in such a way as to open and close orifices, at the proper moment, by acting through traction on sliding valves which kept them closed.

Small pieces of combustible material were piled up beforehand on the two altars, the bodies of which were of metal, and in the interior of which were hidden small lamps that were separated from the combustible by a metal plate which was drawn aside at the proper moment by a small chain. The flame, on traversing the orifice, thus communicated with the combustible.

The milk and wine which flowed out at two different times through the thyrsus and cup of Bacchus came from a double reservoir hidden under the roof of the temple, over the orifices. The latter communicated, each of them, with one of the halves of the reservoir through two tubes inserted in the columns of the small edifice. These tubes were prolonged under the floor of the stage, and extended upward to the hands of Bacchus. A key, maneuvered by cords, alternately opened and closed the orifices which gave passage to the two liquids.

As for the noise of the drums and cymbals, that resulted from the falling of granules of lead, contained in an invisible box provided with an automatic sliding-valve, upon an inclined tambourine, whence they rebounded against little cymbals in the interior of the base of the car.

[Illustration: FIG. 2.--MARVELOUS ALTAR (According to Heron).]

Finally, the crowns and garlands that suddenly made their appearance on the four faces of the base of the stage were hidden there in advance between the two walls surrounding the base. The space thus made for the crowns was closed beneath, along each face, by a horizontal trap moving on hinges that connected it with the inner wall of the base, but which was held temporarily stationary by means of a catch. The crowns were attached to the top of their compartment by cords that would have allowed them to fall to the level of the pedestal, had they not been supported by the traps.

At the desired moment, the catch, which was controlled by a special cord, ceased to hold the trap, and the latter, falling vertically, gave passage to the festoons and crowns that small leaden weights then drew along with all the quickness necessary.

Two points here are specially worthy of attracting our attention, and these are the flow of wine or milk from the statue of Bacchus, and the spontaneous lighting of the altar. These, in fact, were the two illusions that were most admired in ancient times, and there were several processes of performing them. Father Kircher possessed in his museum an apparatus which he describes in _Oedipus Egyptiacus_ (t. ii., p. 333), and which probably came from some ancient Egyptian temple. (Fig. 1.)

It consisted of a hollow hemispherical dome, supported by four columns, and placed over the statue of the goddess of many breasts. To two of these columns were adapted movable brackets, at whose extremities there were fixed lamps. The hemisphere was hermetically closed underneath by a metal plate. The small altar which supported the statue, and which was filled with milk, communicated with the interior of the statue by a tube reaching nearly to the bottom. The altar likewise communicated with the hollow dome by a tube having a double bend. At the moment of the sacrifice the two lamps were lighted and the brackets turned so that the flames should come in contact with and heat the bottom of the dome. The air contained in the latter, being dilated, issued through the tube, X M, pressed on the milk contained in the altar, and caused it to rise through the straight tube into the interior of the statue as high as the breasts. A series of small conduits, into which the principal tube divided, carried the liquid to the breasts, whence it spurted out, to the great admiration of the spectators, who cried out at the miracle. The sacrifice being ended, the lamps were put out, and the milk ceased to flow.

Heron, of Alexandria, describes in his _Pneumatics_ several analogous apparatus. Here is one of them. (We translate the Greek text literally.)

[Illustration: Fig. 3.--MARVELOUS ALTAR (According to Heron).]

"To construct an altar in such a way that, when a fire is lighted thereon, the statues at the side of it shall make libations. (Fig. 2.)

"Let there be a pedestal. A B [Gamma] [Delta], on which are placed statues, and an altar, E Z H, closed on every side. The pedestal should also be hermetically closed, but is communicated with the altar through a central tube. It is traversed likewise by the tube, e [Lambda] (in the interior of the statue to the right), not far from the bottom which terminates in a cup held by the statue, e. Water is poured into the pedestal through a hole, M, which is afterward corked up.

"If, then, a fire be lighted on the altar, the internal air will be dilated and will enter the pedestal and drive out the water contained in it. But the latter, having no other exit than the tube, e [Lambda], will rise into the cup, and so the statue will make a libation. This will last as long as the fire does. On extinguishing the fire the libation ceases, and occurs anew as often as the fire is relighted.

"It is necessary that the tube through which the heat is to introduce itself shall be wider in the middle; and it is necessary, in fact, that the heat, or rather that the draught that it produces, shall accumulate in an inflation in order to have more effect."

According to Father Kircher (_l. c._), an author whom he calls Bitho reports that there was at Sais a temple of Minerva in which there was an altar on which, when a fire was lighted, Dyonysos and Artemis (Bacchus and Diana) poured milk and wine, while a dragon hissed.

It is easy to conceive of the modification to be introduced into the apparatus above described by Heron, in order to cause the outflow of milk from one side and of wine from the other.

After having indicated it, Father Kircher adds: "It is thus that Bacchus and Diana appeared to pour, one of them wine, and the other milk, and that the dragon seemed to applaud their action by hisses. As the people who were present at the spectacle did not see what was going on within, it is not astonishing that they believed it due to divine intervention. We know, in fact, that Osiris or Bacchus was considered as the discoverer of the vine and of milk; that Iris was the genius of the waters of the Nile; and that the Serpent, or good genius, was the first cause of all these things. Since, moreover, sacrifices had to be made to the gods in order to obtain benefits, the flow of milk, wine, or water, as well as the hissing of the serpent, when the sacrificial flame was lighted, appeared to demonstrate clearly the existence of the gods."

In another analogous apparatus of Heron’s, it is steam that performs the role that we have just seen played by dilated air. But the ancients do not appear to have perceived the essential difference, as regards motive power, that exists between these two agents; indeed, their preferences were wholly for air, although the effects produced were not very great.

We might cite several small machines of this sort, but we shall confine ourselves to one example that has some relation to our subject. This also is borrowed from Heron’s _Pneumatics_. (Fig. 3.)

"Fire being lighted on an altar, figures will appear to execute a round dance. The altars should be transparent, and of glass or horn. From the fire-place there starts a tube which runs to the base of the altar, where it revolves on a pivot, while its upper part revolves in a tube fixed to the fire-place. To the tube there should be adjusted other tubes (horizontal) in communication with it, which cross each other at right angles, and which are bent in opposite directions at their extremities. There is likewise fixed to it a disk upon which are attached figures which form a round. When the fire of the altar is lighted, the air, becoming heated, will pass into the tube; but being driven from the latter, it will pass through the small bent tubes and ... cause the tube as well as the figures to revolve."

Father Kircher, who had at his disposal either many documents that we are not acquainted with, or else a very lively imagination, alleges (_Oedip. ˘g._, t. ii., p. 338) that King Menes took much delight in seeing such figures revolve.

Nor are the examples of holy fire-places that kindled spontaneously wanting in antiquity.

Pliny (_Hist. Nat_., ii., 7) and Horace (_Serm., Sat. v._) tell us that this phenomenon occurred in the temple of Gnatia, and Solin (Ch. V.) says that it was observed likewise on an altar near Agrigentum. Athenæs (_Deipn_. i., 15) says that the celebrated prestidigitator, Cratisthenes, of Phlius, pupil of another celebrated prestidigitator named Xenophon, knew the art of preparing a fire which lighted spontaneously.

Pausanias tells us that in a city of Lydia, whose inhabitants, having fallen under the yoke of the Persians, had embraced the religion of the Magi, "there exists an altar upon which there are ashes which, in color, resemble no other. The priest puts wood on the altar, and invokes I know not what god by harangues taken from a book written in a barbarous tongue unknown to the Greeks, when the wood soon lights of itself without fire, and the flame from it is very clear."

The secret, or rather one of the secrets of the Magi, has been revealed to us by one of the Fathers of the Church (Saint Hippolytus, it is thought), who has left, in a work entitled _Philosophumena_, which is designed to refute the doctrines of the pagans, a chapter on the illusions of their priests. According to him, the altars on which this miracle took place contained, instead of ashes, calcined lime and a large quantity of incense reduced to powder; and this would explain the unusual color of the ashes observed by Pausanias. The process, moreover, is excellent; for it is only necessary to throw a little water on the lime, with certain precautions, to develop a heat capable of setting on fire incense or any other material that is more readily combustible, such as sulphur and phosphorus. The same author points out still another means, and this consists in hiding firebrands in small bells that were afterward covered with shavings, the latter having previously been covered with a composition made of naphtha and bitumen (Greek fire). As may be seen, a very small movement sufficed to bring about combustion.--_A. De Rochas, in La Nature_.

* * * * *

TORPEDO BOATS.

There are several kinds of torpedoes. The one which is most used in the French navy is called the "carried" torpedo (_torpille portØe_), thus named because the torpedo boat literally _carries_ it right under the sides of the enemy's ship. It consists of a cartridge of about 20 kilogrammes of gun cotton, placed at the extremity of an iron rod, 12 meters in length, projecting in a downward direction from the fore part of the boat. The charge is fired by an electric spark by means of an apparatus placed in the lookout compartment. Our engraving represents an attack on an ironclad by means of one of these torpedoes. Under cover of darkness, the torpedo boat has been enabled to approach without being disabled by the projectiles from the revolving guns of the man-of-war, and has stopped suddenly and ignited the torpedo as soon as the latter came in contact with the enemy's hull.

The water spout produced by the explosion sometimes completely covers the torpedo boat, and the latter would be sunk by it were not all apertures closed so as to make her a true buoy. What appears extraordinary is that the explosion does not prove as dangerous to the assailant as to the adversary. To understand this it must be remembered that, although the material with which the cartridges are filled is of an extreme _shattering_ nature, and makes a breach in the most resistant armor plate, when in _contact_ with it, yet, at a distance of a few meters, no other effect is felt from it than the disturbance caused by the water. This is why a space of 12 meters, represented by the length of the torpedo spar, is sufficient to protect the torpedo boat. The attack of an ironclad, however, under the conditions that we have just described, is, nevertheless, a perilous operation, and one that requires men of coolness, courage, and great experience.

[Illustration: ATTACK BY A TORPEDO BOAT UPON AN IRON CLAD SHIP OF WAR.]

There is another system which is likewise in use in the French navy, and that is the Whitehead torpedo. This consists of a metallic cylinder, tapering at each end, and containing not only a charge of gun cotton, but a compressed air engine which actuates two helices. It is, in fact, a small submarine vessel, which moves of itself in the direction toward which it has been launched, and at a depth that has been regulated beforehand by a special apparatus which is a secret with the inventor. The torpedo is placed in a tube situated in the fore part of the torpedo boat, and whence it is driven out by means of compressed air. Once fired, it makes its way under the surface to the spot where the shock of its point is to bring about an explosion, and the torpedo boat is thus enabled to operate at a distance and avoid the dangers of an immediate contact with the enemy. Unfortunately this advantage is offset by grave drawbacks; for, in the first place, each of the Whitehead torpedoes costs about ten thousand francs, without counting the expense of obtaining the right to use the patent, and, in the second place, its action is very uncertain, since currents very readily change its direction. However this may be, the inventor has realized a considerable sum by the sale of his secret to the different maritime powers, most of whom have adopted his system.

All our ports are provided with flotillas and torpedo boats, and with schools in which the officers and men charged with this service are trained by frequent exercises. It was near L'Orient, at Port Louis, that we were permitted to be witnesses of these maneuvers, and where we saw the torpedo boats that were lying in ambush behind Rohellan Isle glide between the rocks, all of which appeared familiar to them, and start out seaward at the first signal. It was here, too, that we were witnesses of the sham attack against a pleasure yacht, shown in one of our engravings. A torpedo boat, driven at full speed, stopped at one meter from the said yacht with a precision that denoted an oft-repeated study.

[Illustration: MODE OF FIRING TORPEDOES.]

Before we close, we must mention some very recent experiments that have been made with a torpedo analogous to Whitehead's, that is to say, one that runs alone by means of helices actuated by compressed air, but having the great advantage that it can be steered at a distance from the very place whence it has been launched. This extraordinary result is obtained by the use of a rudder actuated by an electric current which is transmitted by a small metallic cable wound up in the interior of the torpedo, and paying out behind as the torpedo moves forward on its mission. The operator, stationed at the starting point, is obliged to follow the torpedo's course with his eyes in order to direct it during its submarine voyage. For this reason the torpedo carries a vertical mast, that projects above the surface, and at the top of which is placed a lantern, whose light is thrown astern but is invisible from the front, that is, from the direction of the enemy. A trial of this ingenious invention was made a few weeks ago on the Bosphorus, with complete success, as it appears. From the shore where the torpedo was put into the water, the weapon was steered with sufficient accuracy to cause it to pass, at a distance of two kilometers, between two vessels placed in observation at a distance apart of ten meters. After this, it was made to turn about so as to come back to its starting point. What makes this result the more remarkable is that the waters of the Bosphorus are disturbed by powerful currents that run in different directions, according to the place.--_L'Illustration_.

*   *   *   *   *

PICTET'S HIGH SPEED BOAT.

It is now nearly a year ago since we announced to our readers the researches that had been undertaken by the learned physicist, Raoul Pictet, in order to demonstrate theoretically and practically the forms that are required for a fast-sailing vessel, and since we pointed out how great an interest is connected with the question, while at the same time promising to revert to the subject at some opportune moment. We shall now keep our promise by making known a work that Mr. Pictet has just published in the _Archives Physiques et Naturelles_, of Geneva, in which he gives the first results of his labors, and which we shall analyze rapidly, neglecting in doing so the somewhat dry mathematical part of the article.

For a given tonnage and identical tractive stresses, the greater or less sharpness of the fore and aft part of the keel allows boats to attain different speeds, the sharper lines corresponding to the highest speeds, but, in practice, considerably diminishing the weight of freight capable of being carried by the boat.

[Illustration: FIG. 1. PICTET'S HIGH SPEED BOAT.

A. Lateral View. B. Plan. C. Section of the boiler room. D. Section of the cabin.]

Mr. Pictet proposed the problem to himself in a different manner, and as follows:

Determine by analysis, and verify experimentally, what form of keel will allow of the quickest and most economical carriage of a given weight of merchandise on water.

We know that for a given transverse or midship section, the tractive stress necessary for the progression of the ship is proportional to the _square_ of the velocity; and the motive power, as a consequence, to the _cube_ of such velocity.

[Illustration: Fig. 2.--Diagram of tractive stresses at different speeds.]

The _friction_ of water against the polished surfaces of the vessel's sides has not as yet been directly measured, but some indirect experiments permit us to consider the resistances due thereto as small. The entire power expended for the progress of the vessel is, then, utilized solely in displacing certain masses of water and in giving them a certain amount of acceleration. The masses of water set in motion depend upon the surface submerged, and their acceleration depends upon the speed of the vessel. Mr. Pictet has studied a form of vessel in which the greatest part possible of the masses of water set in motion shall be given a vertical acceleration, and the smallest part possible a horizontal one; and this is the reason why: All those masses of water which shall receive a vertical acceleration from the keel will tend to move downward and produce a vertical reaction in an upward direction applied to the very surface that gives rise to the motion. Such reaction will have the effect of changing the level of the floating body; of lifting it while relieving it of a weight exactly equal to the value of the vertical thrust; and of diminishing the midship section, and, consequently, the motive power.

[Illustration: Fig. 3.--Diagram of variations in tractive stresses and tonnage taken as a function of the speed.]

All those masses of water which receive a horizontal acceleration from the keel run counter, on the contrary, to the propulsive stress, and it becomes of interest, therefore, to bring them to a minimum. The vertical stress is limited by the weight of the boat, and, theoretically, with an infinite degree of speed, the boat would graze the water without being able to enter it.

The annexed diagram (Fig. 1) shows the form that calculation has led Mr. Pictet to. The sides of the boat are two planes parallel with its axis, and perfectly vertical. The keel (properly so called) is formed by the joining of the two vertical planes. The surface thus formed is a parabola whose apex is in front, the maximum ordinate behind, and the concavity directed toward the bottom of the water. The stern is a vertical plane intersecting at right angles the two lateral faces and the parabolic curve, which thus terminates in a sharp edge. The prow of the boat is connected with the apex of the parabola by a curve whose concavity is directed upward.

[Illustration: Fig. 4.--Diagram of the variations in the power as a function of the speed.]

When we trace the curve of the tractive stresses in a boat thus constructed, by putting the speeds in abscisses and the tractive stresses in ordinates, we obtain a curve (Fig. 2) which shows that the same tractive stress applied to a boat may give it three different speeds, M, M', and M'', only two of which, M and M'', are stable.

Experimental verifications of this study have been partially realized (thanks to the financial aid of a number of persons who are interested in the question) through the construction of a boat (Fig. 1) by the Geneva Society for the Construction of Physical Instruments. The vessel is 20.25 m. in length at the water line, has an everywhere equal width of 3.9 m., and a length of 16 m. from the stern to the apex of the parabola of the keel. The bottom of the boat is nearly absolutely flat. The keel, which is 30 centimeters in width, contains the shaft of the screw. The boiler, which is designed for running at twelve atmospheres, furnishes steam to a two cylinder engine, which may be run at will, either the two cylinders separately, or as a _compound_ engine. The bronze screw is 1.3 m. in diameter, and has a pitch of 2.5 m. The vessel has two rudders, one in front for slight speeds, and the other at the stern. At rest, the total displacement is 52,300 kilogrammes.

This weight far exceeds what was first expected, by reason of the superthickness given the iron plates of the vertical sides, of the supplementary cross bracing, and of the superposition of the netting necessary to resist the flexion of the whole. On another hand, the tractive stress of the screw, which should reach about 4,000 kilogrammes, has never been able to exceed 1,800, because of the numerous imperfections in the engine. It became necessary, therefore, to steady the vessel by having her towed by the _Winkelried_, which was chartered for such a purpose, to the General Navigation Company. It became possible to thus carry on observations on speeds up to 27 kilometers per hour.

Fig. 3 shows how the tractive stress varies with each speed in a theoretic case (dotted curve) in which the stress is proportional to the square of the speed, in Madame Rothschild's boat, the _Gitana_ (curve E), and in the Pictet high speed vessel (curve B).

The _Gitana_ was tried with speeds varying between 0 and 4 kilometers. The corresponding tractive stresses have been reduced to the same transverse section as in the Pictet model in order to render the observations comparable. At slight speeds, and up to 19.5 kilometers per hour, the _Gitana_, which is the sharper, runs easier and requires a slighter tractive stress. At such a speed there is an equality; but, beyond this, the Pictet boat presents the greater advantages, and, at a speed of 27 kilometers, requires a stress about half less than does the _Gitana_. Such results explain themselves when we reflect that at these great speeds the _Gitana_ sinks to such a degree that the afterside planks are at the level of the water, while the Pictet model rises simultaneously fore and aft, thus considerably diminishing the submerged section.

With low or moderate speeds there is a perceptible equality between the theoretic curve and the curve of the fast boat; but, starting from 16 kilometers, the stress diminishes. The greater does the speed become, the more considerable is the diminution in stress; and, starting from a certain speed, the rise of the boat is such as to diminish its absolute tractive stress--a fact of prime importance established by theory and confirmed by experiment.

The curves in Fig. 4 show the power in horses necessary to effect progression at different speeds. The curve, A, has reference to an ordinary boat that preserves its water lines constant, and the curve, B, to a swift boat of the same tonnage. Up to 16 kilometers, the swift vessel presents no advantage; but beyond that speed, the advantage becomes marked, and, at a speed of 27 kilometers, the power to be expended is no more than half that which corresponds to the same speed for an ordinary boat.

The water escapes in a thin and even sheet as soon as the tractive stress exceeds 2,000 kilogrammes; and the intensity and size of the eddies from the boat sensibly diminish in measure as the speed increases.

The interesting experiments made by Mr. Pictet seem, then to clearly establish the fact that the forms deduced by calculation are favorable to high speeds, and will permit of realizing, in the future, important saving in the power expended, and, consequently, in the fuel (much less of which will need to be carried), in order to perform a given passage within a given length of time. Thus is explained the great interest that attaches to Mr. Pictet's labors, and the desire that we have to soon be able to make known the results obtained with such great speeds, not when the boat is towed, but when its propulsion is effected through its own helix actuated by its own engine, which, up to the present, unfortunately, has through its defects been powerless to furnish the necessary amount of power for the purpose.--_La Nature_.

*   *   *   *   *

INITIAL STABILITY INDICATOR FOR SHIPS.

For a vessel with a given displacement, the metacenter and center of gravity being known, it is easy to lay off in the form of a diagram its stability or power of righting for any given angle of heel. Such a diagram is shown in Fig. 3, in which the abscissæ are the angles of the heel, and the ordinates the various lengths of the levers, at the end of which the whole weight of the vessel is acting to right itself.
The curve may be constructed in the following manner: Having found by calculation the position of the transverse metacenter, M, for a given displacement--Figs. 1 and 2--the metacentric height, G M, is then determined either by calculations, or more correctly by experiment, by varying the position of weights of known magnitude, or by the stability indicator itself. Suppose, now, the vessel to be listed over to various angles of heel--say 20 deg., 40 deg., 60 deg., and 80 deg.--the water lines will then be A C, D E, F K, and H J respectively, and the centers of buoyancy, which must be found by calculation, will be B1, B2, B3, and B4. If lines are drawn from these points at right angles to the water levels at the respective heels, the righting power of the vessel in each position is found by taking the perpendicular distances between these lines and the center of gravity, G. This method of construction is shown to an enlarged scale in Fig. 2, where G is the center of gravity, B1 Z1, B2 Z2, B3 Z3, and B4 Z4 the lines from centers of buoyancy to water levels; and G N, G O, and G P the distances showing the righting power at the angles of 20 deg., 40 deg., and 60 deg. respectively, and which to any convenient scale are set off as the ordinates in the stability curve shown in Fig 3.

[Illustration: STABILITY INDICATOR FOR SHIPS. Fig. 1.]

Having obtained the curve, A, in this manner for a given metacentric height, we will suppose that on the next voyage, with the same displacement, it is found that, owing to some difference in stowage, the center of gravity is 6 in. higher than before. The ordinates of the curve will then be G„ N„ and G„ O„--Fig.2--and the stability curve will be as at C--Fig. 3--showing that at about 47 deg. all righting power ceases. Similarly, if the center of gravity is lowered 6 in. on the same displacement, the curve, B, will be found, and in this manner comparative diagrams can be constructed giving at a glance the stability of a vessel for any given draught of water and metacentric height.

[Illustration: STABILITY INDICATOR FOR SHIPS. Fig. 2.]

[Illustration: STABILITY INDICATOR FOR SHIPS. Fig. 3.]

The object of Mr. Alexander Taylor’s indicator is to measure and show by simple inspection the metacentric height under every condition of loading, and therefore to make known the stability of the vessel. It consists of a small reservoir, A, Fig. 4, placed at one side of the ship, in the cabin, or other convenient locality, communicating by a tube with the glass gauge, B, secured at the opposite side, the whole being half filled with glycerine, which is the fluid recommended by Mr. Wm. Denny, though water or any other liquid will answer the purpose. At one side of the gauge is the circular scale, C, capable of being revolved round its vertical axis, as well as adjusted up and down, so as to bring the zero pointer exactly to the top of the fluid when the vessel is without list. Round the top of the scale, at D, are engraved four different draughts, and under these are the metacentric heights. Test tanks of known capacity are placed at each side of the vessel, but in no way connected with the reservoir or gauge. The metacentric height is found as follows: The ship being freed from bilge water, the roller scale is turned round to bring to the front the mark corresponding with the mean draught of the vessel at the time, and the zero pointer is placed opposite the surface of the liquid in the gauge. One of the test tanks being filled with a known weight of water, the vessel is caused to list, and in consequence the liquid in the tube takes a new position corresponding with the degree of heel, the disturbance being greater according as the vessel has been more or less overbalanced. The scale having previously been properly graduated, the metacentric height for the draught and state of loading can be at once read off in inches, while as a check the water can be transferred from the one test tank to the other, and the metacentric height read off as before, but on the opposite side of the zero pointer. At the same time the angle of heel is shown on a second graduated scale, E. Having obtained the metacentric height, reference to a diagram will at once show the whole range of stability; and this being ascertained at each loading, the stowage of the cargo can be so adjusted as to avoid excessive stiffness in the one hand and dangerous tenderness on the other. It will thus be seen that Mr. Taylor’s invention promises to be of great practical value both in the hands of the ship-builder and ship-owner, who have now an instrument placed before them, by the proper use of which all danger from unskillful loading can be entirely avoided.--_The Engineer_.

[Illustration: STABILITY INDICATOR FOR SHIPS. Fig. 4.]

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SCRIVANOW’S CHLORIDE OF SILVER PILE.

Considerable attention has been attracted lately at Paris among those who are interested in electrical novelties to a chloride of silver pile invented by Mr. Scrivanow. The experiments to which it has been submitted are, in some respects, sufficiently extraordinary to cause us to make them known to our readers, along with the inventor’s description of the apparatus.

Mr. Scrivanow’s intention appears to be to apply this pile to the lighting of apartments, and even to the running of small motors, and, for the purpose of actuating sewing machines, he has already constructed a small model whose external dimensions are 160 x 100 x 90 millimeters.

"My invention," says the inventor, "is intended as an electric pile capable of regeneration. The annexed Fig. 1 shows a vertical arrangement of the apparatus, and Fig. 2 a horizontal one. In the latter, two elements are represented superposed.

"My pile consists of a prism of retort carbon (a) covered on every side with pure chloride of silver (b). The carbon thus prepared is immersed in a solution of hydrate of potassium (KHO) or of hydrate of sodium (NaHO), marking 1.30 to 1.45 by the BaumØ areometer, the solvent being water.

"In the vicinity of the carbon is arranged the plate to be attacked--a plate of zinc (c) of good quality. The surface of the electrodes, and their distance apart, depends upon the effects that it is desired to obtain, and is determined in accordance with the well known principles of electro-kinetics.

"The chemical reactions that take place in this couple are multiple. In contact with a sufficiently concentrated solution of hydrate of potassium or sodium, the chloride of silver, especially if it has been recently prepared, passes partially into the state of brown or black oxide, so that the carbon becomes covered, after remaining sufficiently long in the exciting liquid, with a mixture of chloride and oxide of silver. When the circuit is closed, the chloride becomes reduced to a spongy metallic state and adheres to the surface of the carbon. At the same time the zinc passes, in the alkaline solution, into a state of chloride and of soluble combination of zinc oxide and of alkali.

"To avoid all loss of silver I cover the carbon with asbestos paper, or with cloth of the same material, d. My piles are arranged in ebonite vessels, A, which are flat, as in Fig. 1, or round, as in Fig. 2.

"In Fig 1 there is seen, at e, gutta-percha separating the zinc from the carbon at the base.

"Under such conditions, we obtain a powerful couple that possesses an electro-motive power of 1.5 to 1.8 volts, according to the concentration of the exciting liquid. The internal resistance is extremely feeble. I have obtained with piles arranged like those shown in the figures nearly 0.06 ohm, the measurements having been taken from a newly charged pile.

"When the element is used up, and, notably, when all the chloride of silver is reduced, it is only necessary to plunge the carbon with its asbestos covering (after washing it in water) into a chloridizing bath, in order to bring back the metallic silver that invests the carbon to a state of chloride, and thus restore the pile to its primitive energy. After this the carbon is washed and put back into the exciting liquid.

"These reductions of the chloride of silver during the operation of the pile can be reproduced _ad infinitum_, since they are accompanied by no loss of metal. The alkaline liquid is sufficient in quantity for two successive charges of the couple.

"The chloridizing bath consists of 100 parts of acetic acid, 5 to 6 parts, by weight, of hydrochloric acid, and about 30 parts of water.

[Illustration: FIG. 1.--SCRIVANOW'S CHLORIDE OF SILVER PILE.]

"Other acids may be employed equally as well. A bath composed of chlorochromate of potassium and nitric or sulphuric acid makes an excellent regenerator.

"To sum up, I claim as the distinctive characters of my pile:

"1. The use of the potassic or sodic alkaline liquid conjointly with chloride of silver, and the oxide of the same, that forms through the immersion of the carbon in a chloridizing bath.

"2. The use of retort or other carbon covered with the salt of silver above specified.

"3. The arrangement and construction of my pile as I have described."

In the experiments recently tried with Mr. Scrivanow's pile, a large sized battery was made use of, whose dimensions were 300 x 145 x 125 millimeters, and whose weight was from 5 to 6 kilogrammes. The results were: intensity, 1 ampere; electro-motive power, 25 volts, corresponding to an energy of 25 volt-amperes, or about 2.5 kilogrammeters per second. The pile was covered with a copper jacket whose upper parts supported two Swan lamps. Upon putting on the cover a contact was formed with the electrodes, and it was possible by means of a commutator key with three eccentrics to light or extinguish one of the lamps or both at once.
A single element would have sufficed to keep one Swan lamp of feeble resistance lighted for 20 hours. Accepting the data given above and the 20 hours' uninterrupted duration of the pile's operation the power furnished by this large model is equal to 2.5 x 20 x 3,600 = 180,000 kilogrammeters.

[Illustration: FIG. 1.--SCRIVANOW'S CHLORIDE OF SILVER PILE.]

In our opinion, Mr. Scrivanow's pile is not adapted for industrial use because of the expense of the silver and the frequent manipulations it requires, but it has the advantage, however, of possessing, along with its small size and little weight, a disposable energy of from 150,000 to 200,000 kilogrammeters utilizable at the will of the consumer and securing to him a certain number of applications, either for lighting or the production of power. It appears to us to be specially destined to become a rival to the bichromate of potash pile for actuating electric motors applied to the directing of balloons.--_Revue Industrielle_.

* * * * *

ON THE LUMINOSITY OF FLAME.

The light emitted from burning gases which burn with bright flame is known to be a secondary phenomenon. It is the solid, or even liquid, constituents separated out by the high temperature of combustion, and rendered incandescent, that emit the light rays. Gases, on the other hand, which produce no glowing solid or liquid particles during combustion burn throughout with a weakly luminous flame of bluish or other color, according to the kind of gas. Now, it is common to say, merely, in explanation of this luminosity, that the gas highly heated in combustion is self-incandescent. This explanation, however, has not been experimentally confirmed. Dr Werner Siemens was, therefore, led recently to investigate whether highly-heated pure gases really emit light.

The temperature employed in such experiments should, to be decisive, be higher than those produced by luminous combustion. The author had recourse to the regenerative furnace used by his brother, Friedrich, in Dresden, in manufacture of hard glass. This stands in a separate room which at night can be made perfectly dark. The furnace has, in the middle of its longer sides, two opposite apertures, allowing free vision through. It can be easily heated to the melting temperature of steel, which is between 1,500° and 2,000° C. Before the furnace apertures were placed a series of smoke blackened screens with central openings, which enabled one to look through without receiving, on the eye, rays from the furnace walls. If, now, all air exchange was prevented in the furnace, and all light excluded from the room, it was found that not the least light came to the eye from the highly-heated air in the furnace. For success of the experiment, it was necessary to avoid any combustion in the furnace, and to wait until the furnace-air was as free from dust as possible. Any flame in the furnace (even when it did not reach into the line of sight), and the least quantity of dust in it, illuminated the field of vision.

As a result of these experiments, Dr. Siemens considers that the view hitherto held, that highly-heated gases are self-luminous, is not correct. In the furnace were the products of the previous combustion and atmospheric air: consequently oxygen, nitrogen, carbonic acid, and aqueous vapor. If even one of these gases was self-luminous, the field of vision must have been always illuminated. The weak light given by the flame of burning gases that separate out no solid nor liquid constituents cannot, therefore, be explained as a phenomenon of glow of the gaseous products.

It appealed to the author probable, that heated gases did not, either, emit heat rays; and he set himself to test this idea, experimenting, in company with Herr Fröhlich, in Dresden. They first convinced themselves in this case that the light emission of pure heated gases sunk to zero, even when the field of vision was not always quite dark, and it was only possible to observe this a short time; but the repeatedly observed perfect darkness of the field of vision was demonstrative. On the other hand, experiments made with sensitive thermopiles, in order to settle the question of emission of heat-rays from highly-heated gases, failed.

Afterward, however, Dr. Siemens was convinced, by a quite simple experiment of a different kind, that his supposition was erroneous. An ordinary lamp, with circular wick, and short glass cylinder, was wholly screened with a board, and a thermopile was so placed that its axis lay somewhat higher than the edge of the board. As the room-walls had pretty much a uniform temperature, the deflection of the galvanometer was but slight, when the tube-axis of the thermopile was directed anywhere outside of the hot-air current rising from the flame. When, however, the axis was directed to this current, a deflection occurred, which was as great as that from the luminous flame itself. That the heat radiation from hot gases is but very small in comparison with that from equally hot solid bodies, was shown by the large deflection produced when a piece of fine wire was held in the hot-air current. On the other hand, however, it was far too considerable to admit of being attributed to dust particles suspended in the air current.

It must be conceded to be possible (the author says) that the light radiation of hot gases, as also the heat radiation, is only exceedingly weak, and therefore may escape observation. It is, therefore, much to be desired that the experiments should be repeated at still higher temperatures and with more exact instruments, in order to determine the limit of temperature at which heated gases undoubtedly become self-incandescent. The fact, however, that gases, at a temperature of more than 1,500° C, are not yet luminous, proves that the incandescence of the flame is not to be explained as a self-incandescence of the products of combustion. This is confirmed by the circumstance that, with rapid mixture of the burning gases, the flame becomes shorter because the combustion process goes on more quickly, and hotter because less cold air has access. Further, the flame also becomes shorter and hotter if the gases are strongly heated previous to combustion. As the rising products of combustion still retain for a time the temperature of the flame, the reverse must occur if the gases were self-luminous. The luminosity of the flame, however, ceases at a sharp line of demarkation, and evidently coincides with completion of the chemical action. The latter, itself, therefore, and not the heating of the combustion products, which is due to it, must be the cause of the luminosity. If we suppose that the gas-molecules are surrounded by an ether-envelope, then, in chemical combination of two or several such molecules, there must occur a changed position of the ether-envelopes. The motion of ether-particles thus caused may be represented by vibrations, which form the starting-point of light and heat-waves.

In quite a similar manner we may also, according to Dr. Siemens, represent the light-phenomenon occurring when an electric current is sent through gases, which always takes place when the maximum of polarization belonging to them is exceeded. As the passage of the current through the gas seems to be always connected with chemical action, the phenomenon of glow may be explained in the same way as in flame, by oscillating transposition of the ether envelopes, by which the passage of electricity is effected. In that case the light of flame may be called electric light by the same light as the light of the ozone tube or the Geissler tube, which is mainly to be distinguished from the former in that it contains a dielectric of an extremely small maximum of polarization. This correspondence in the causes of luminosity of flame, and of gases traversed by electric currents, is supported by the similarity of the flame-phenomena in strength and color of light.

[These researches were lately described by Dr. Werner Siemens to the Berlin Academy.]

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A QUICK WAY TO ASCERTAIN THE FOCUS OF A LENS.

It is well known that if the size of an object be ascertained, the distance of a lens from that object, and the size of the image depicted in a camera by that lens, a very simple calculation will give the focus of the lens. In compound lenses the matter is complicated by the relative foci of its constituents and their distance apart; but these items, in an ordinary photographic objective, would so slightly affect the result that for all practical purposes they may be ignored.

What we propose to do--what we have indeed done--is to make two of these terms constant in connection with a diagram, here given, so that a mere inspection may indicate, with its aid, the focus of a lens. All that is required in making use of it is to plant the camera perfectly upright, and place in front of it, at exactly fifteen feet from the center of the lens, a two foot rule, also perfectly upright and with its center the same height from the floor as the lens, and then, after focusing accurately with as large a diaphragm as will give sharpness, to note the size of the image and refer it to the diagram. The focus of the lens employed will be marked under the line corresponding to the size of the image of the rule on the ground glass.

As our object is to minimize time and trouble to the utmost, we may make a suggestion or two as to carrying out the measuring. It will be obvious that any object exactly two feet in length, rightly placed, will answer quite as well as a "two-foot," which we selected as being about as common a standard of length and as likely to be handy for use as any. The pattern in a wall paper, a mark in a brick wall, a studio background, or a couple of drawing pins pressed into a door, so long as two feet exactly are indicated, will answer equally well.

And, further, as to the actual mode of measuring the image on the ground glass (we may say that there is not the slightest need to take a negative), it will perhaps be found the readiest method to turn the glass the ground side outward, when two pencil marks may be made with complete accuracy to register the length of the image, which can then be compared with the diagram. Whatever plan is adopted, if the distance be measured exactly between lens and rule, the result will give the focus with exactitude sufficient for any practical purpose.--_Br. Jour. of Photo_.

[Illustration]

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THE HISTORY OF THE PIANOFORTE.

[Footnote: A paper recently read before the Society of Arts, London.]

By A. J. HIPKINS.

As this paper is composed from a technical point of view, some elucidation of facts, forming the basis of it, is desirable before we proceed to the chronological statement of the subject. These facts are the strings, and their strain or tension; the sound-board, which is the resonance factor; and the bridge, connecting it with the strings. The strings, sound-board, and bridge are indispensable, and common to all stringed instruments. The special fact appertaining to keyboard instruments is the mechanical action interposed between the player and the instrument itself. The strings, owing to the slender surface they present to the air, are, however powerfully excited, scarcely audible. To make them sufficiently audible, their pulsations have to be communicated to a wider elastic surface, the sound-board, which, by accumulated energy and broader contact with the air, re-enforces the strings' feeble sound. The properties of a string set in periodic vibration are the best known of the phenomena appertaining to acoustics. The molecules composing the string are disturbed in the string's vibrating length by the means used to excite the sound, and run off into sections, the comparative length and number of which depend partly upon the place in the string the excitement starts from; partly upon the force and the form of force that is employed; and partly upon the length, thickness, weight, strain, and elasticity of the string, with some small allowance for gravitation. The vibrating sections are of wave-like contour; the nodes or points of apparent rest being really knots of the greatest pressure from crossing streams of molecules. Where the pressure slackens, the sections rise into loops, the curves of which show the points of least pressure. Now, if the string be struck upon a loop, less energy is communicated to the string, and the carrying power of the sound proportionately fails. If the string be struck upon a node, greater energy ensues, and the carrying power proportionately gains. By this we recognize the importance of the place of contact, or striking-place of the hammer against the string; and the necessity, in order to obtain good fundamental tone, which shall carry, of the note being started from a node.

If the hammer is hard, and impelled with force, the string breaks into shorter sections, and the discordant upper partials of the string, thus brought into prominence, make the tone harsh. If the hammer is soft, and the force employed is moderated, the harmonious partials of the longer sections strike the ear, and the tone is full and round. By the frequency of vibration, that is to say, the number of times a string runs through its complete changes one way and the other, say, for measurement, in a second of time, we determine the pitch, or relative acuteness of the tone as distinguished by the ear.

We know, with less exactness, that the sound-board follows similar laws. The formation of nodes is helped by the barring of the sound-board, a ribbing crosswise to the grain of the wood, which promotes the elasticity, and has been called the "soul" of stringed musical instruments. The sound-board itself is made of most carefully chosen pine; in Europe of the _Abies excelsa_, the spruce fir, which, when well grown, and of light, even grain, is the best of all woods for resonance. The pulsations of the strings are communicated to the sound-board by the bridge, a thick rail of close-grained beech, curved so as to determine their vibrating lengths, and attached to the sound-board by dowels. The bridge is doubly pinned, so as to cut off the vibration at the edge of the bearing the strings exert upon the bridge. The shock of each separate pulsation, in its complex form, is received by the bridge, and communicated to such undamped strings as may, by their lengths, be sensitive to them; thus producing the ˘olian tone commonly known as sympathetic, an eminently attractive charm in the tone of a pianoforte.

We have here strings, bridge, and sound-board, or belly, as it is technically called, indispensable for the production of the tone, and indivisible in the general effect. The proportionate weight of stringing has to be met by a proportionate thickness and barring of the sound-board, and a proportionate thickness and elevation of the bridge.

The tension of the strings is met by a framing, which has become more rigid as the drawing power of the strings has been gradually increased. In the present concert grands of Messrs. Broadwood, that drawing power may be stated as starting from 150 lb. for each single string in the treble, and gradually increasing to about 300 lb. for each of the single strings in the bass. I will reserve for the historical description of my subject some notice of the different kinds of framing that have been introduced. It will suffice, at this stage, to say that it was at first of wood, and became, by degrees, of wood and iron; in the present day the iron very much preponderating. It will be at once evident that the object of the framing is to keep the ends of the strings apart. The near ends are wound round the wrest-pins, which are inserted in the wooden bed, called the wrest-plank, the strength and efficiency of which are most important for the tone and durability of the instrument. It is composed of layers of wainscot oak and beech, the direction of the grain being alternately longitudinal and lateral. Some makers cover the wrest-plank with a plate of brass; in Broadwood's grands, it is a plate of iron, into which, as well as the wood, the wrest-pins are screwed. The tuner's business is to regulate the tension, by turning the wrest-pins, in which he is chiefly guided by the beats which become audible from differing numbers of vibrations. The wrest-plank is bridged, and has its bearing like the soundboard; but the wrest-plank has no vibrations to transfer, and should, as far as possible, offer perfect insensibility to them.

I will close this introductory explanation with two remarks, made by the distinguished musician, mechanician, and inventor, Theobald Boehm, of Munich, whose inventions were not limited to the flute which bears his name, but include the initiation of an important change in the modern pianoforte, as made in America and Germany. Of priority of invention he says, in a letter to an English friend, "If it were desirable to analyze all the inventions which have been brought forward, we should find that in scarcely any instance were they the offspring of the brain of a single individual, but that all progress is gradual only; each worker follows in the track of his predecessor, and eventually, perhaps, advances a step beyond him." And concerning the relative value of inventions in musical instruments, it appears, from an essay of his which has been recently published, that he considers improvement in acoustical proportions the chief foundation of the higher or lower degree of perfection in all instruments, their mechanism being but of secondary value.

I will now proceed to recount briefly the history of the pianoforte from the earliest mention of that name, continuing it to our contemporary instruments, as far as they can be said to have entered into the historical domain. It has been my privilege to assist in proving that Bartolommeo Cristofori was, in the first years of the 18th century, the real inventor of the pianoforte, but with a wide knowledge and experience of how long it has taken to make any invention in keyed instruments practicable and successful, I cannot believe that Cristofori was the first to attempt to contrive one. I should rather accept his good and complete instrument as the sum of his own lifelong studies and experiments, added to those of generations before him, which have left no record for us as yet discovered.

The earliest mention of the name pianoforte (_piano e forte_), applied to a musical instrument, has been recently discovered by Count Valdrighi in documents preserved in the Estense Library, at Modena. It is dated A.D. 1598, and the reference is evidently to an instrument of the spinet or cembalo kind; but how the tone was produced there is no statement, no word to base an inference upon. The name has not been met with again between the Estense document and Scipione Maffei's well-known description, written in 1711, of Cristofori's "gravecembalo col piano e forte." My view of Cristofori's invention allows me to think that the Estense "piano e forte" may have been a hammer cembalo, a very imperfect one, of course. But I admit that the opposite view of forte and piano, contrived by registers of spinet-jacks, is equally tenable.

Bartolommeo Cristofori was a Paduan harpsichord maker, who was invited by Prince Ferdinand dei Medici to Florence, to take charge of the large collection of musical instruments the Prince possessed. At Florence he produced the invention of the pianoforte, in which he was assisted and encouraged by this high-minded, richly-cultivated, and very musical prince. Scipione Maffei tells us that in 1709 Cristofori had completed four of the new instruments, three of them being of the usual harpsichord form, and one of another form, which he leaves undescribed. It is interesting to suppose that Handel may have tried one or more of these four instruments during the stay he made at Florence in 1708. But it is not likely that he was at all impressed with the potentialities of the invention any more than John Sebastian Bach was in after years when he tried the pianofortes of Silbermann.

The sketch of Cristofori's action in Maffei's essay, from which I have had a working model accurately made, shows that in the first instruments the action was not complete, and it may not have been perfected when Prince Ferdinand died in 1713. But there are Cristofori grand pianos preserved at Florence, dated respectively 1720 and 1726, in which an improved construction of action is found, and of this I also exhibit a model. There is much difference between the two. In the second, Cristofori had obtained his escapement with an undivided key, reconciling his depth of touch, or keyfall, with that of the contemporary harpsichord, by driving the escapement lever through the key. He had contrived means for regulating the escapement distance, and had also invented the last essential of a good pianoforte action, the check. I will explain what is meant by escapement and check. When, by a key being put down, the hammer is impelled toward the strings, it is necessary for their sustained vibration that, after impact, the hammer should rebound or escape; or it would, as pianoforte makers say, "block," damping the strings at the moment they should sound.

A dulcimer player gains his elastic blow by the free movement of the wrist. To gain a similarly elastic blow mechanically in his first action, Cristofori cut a notch in the butt of his hammer from which the escapement lever, "linguetta mobile" as he called it--"hopper," as we call it--being centered at the base, moved forward, when the key was put down, to the extent of its radius, and after the delivery of the blow returned to its resting place by the pressure of a spring. The first action gave the blow with more direct force than the second, which had the notch upon what is called the underhammer, but was defective in the absence of any means to regulate the distance of the "go-off," or "escapement" from the string. In the second action, a small check before the hopper is intended to regulate it, but does so imperfectly. The pianoforte had to wait for fifty years for satisfactory regulation of the escapement.

In the first action, the hammer rests in a silken fork, dropping the whole distance of the rise of every blow. The check in the second action, the "paramartello," is next in importance to the escapement. It catches the back part of the hammer at different points of the radius, responding to the amount of force the player has used upon the key. So that in repeated blows, the rise of the hammer is modified, and the notch is nearer to the returning hopper in proportionate degree.

I have given the first place in description to Cristofori's actions, instead of to the "cembalo" or instrument to which they were applied, because piano and forte, from touch, became possible through them, and what else was accomplished by Cristofori was due, primarily, to the dynamic idea. He strengthened his harpsichord sound-board against a thicker stringing, renouncing the cherished sound-holes. Yet the sound-box notion clung to him, for he made openings in his sound-board rail for air to escape. He ran a string-block round the case, entirely independent of the sound-board, and his wrest-plank, which also became a separate structure, removed from the sound-board by the gap for the hammers, was now a stout oaken plank which, to gain an upward bearing for the strings, he inverted, driving his wrest-pins through in the manner of a harp, and turning them in like fashion to the harp. He had two strings to a note, but it did not occur to him to space them into pairs of unisons. He retained the equidistant harpsichord scale, and had, at first, under-dampers, later over-dampers, which fell between the unisons thus equally separated. Cristofori died in 1731. He had pupils, one of whom made, in 1730, the, "Rafael d'Urbino," the favorite instrument of the great singer Farinelli. The story of inventive Italian pianoforte making ends thus early, but to Italy the invention indisputably belongs.

The first to make pianofortes in Germany was the famous Freiberg organ-builder and clavichord maker, Gottfried Silbermann. He submitted two pianofortes to the judgment of John Sebastian Bach in 1726, which judgment was, however, unfavorable; the trebles being found too weak, and the touch too heavy. Silbermann, according to the account of Bach's pupil, Agricola, being much mortified, put them aside, resolving not to show them again unless he could improve them. We do not know what these instruments were, but it may be inferred that they were copies of Cristofori, or were made after the description of his invention by Maffei, which had already been translated from Italian into German, by Koenig, the court poet at Dresden, who was a personal friend of Silbermann. With the next anecdote, which narrates the purchase of all the pianofortes Silbermann had made, by Frederick the Great, we are upon surer ground. This well accredited occurrence took place in 1746. In the following year occurred Bach's celebrated visit to Potsdam, when he played upon one or more of these instruments. Burney saw and described one in 1772. I had this one, which was known to have remained in the new palace at Potsdam until the present time unaltered, examined, and, by a drawing of the action, found it was identical with Cristofori's. Not, however, being satisfied with one example, I resolved to go myself to

Potsdam; and, being furnished with permission from H.R.H. the Crown Princess of Prussia, I was enabled in September, 1881, to set the question at rest of how many grand pianofortes by Gottfried Silbermann there were still in existence at Potsdam, and what they were like. At Berlin there are none, but at Potsdam, in the music-rooms of Frederick the Great, which are in the town palace, the new palace, and Sans Souci--left, it is understood, from the time of Frederick’s death undisturbed--there are three of these Silbermann pianofortes. All three are with unimportant differences having nothing to do with structure, Cristofori instruments, wrest plank, sound-board, string-block, and action; the harpsichord scale of stringing being still retained. The work in them is undoubtedly good; the sound-boards have given in the trebles, as is usual with old instruments, from the strain; but I should say all three might be satisfactorily restored. Some other pianofortes seem to have been made in North Germany about this time, as our own poet Gray bought one in Hamburg in 1755, in the description of which we notice the desire to combine a hammer action with the harpsichord which so long exercised men’s minds.

The Seven Years’ War put an end to pianoforte making on the lines Silbermann had adopted in Saxony. A fresh start had to be made a few years later, and it took place contemporaneously in South Germany and England. The results have been so important that the grand pianofortes of the Augsburg Stein and the London Backers may be regarded, practically, as reinventions of the instrument. The decade 1770-80 marks the emancipation of the pianoforte from the harpsichord, of which before it had only been deemed a variety. Compositions appear written expressly for it, and a man of genius, Muzio Clementi, who subsequently became the head of the pianoforte business now conducted by Messrs. Collard, came forward to indicate the special character of the instrument, and found an independent technique for it.

A few years before, the familiar domestic square piano had been invented. I do not think clavichords could have been altered to square pianos, as they were wanting in sufficient depth of case; but that the suggestion was from the clavichord is certain, the same kind of case and key-board being used. German authorities attribute the invention to an organ builder, Friederici of Gera, and give the date about 1758 or 1760. I have advertised in public papers, and have had personal inquiry made for one of Friederici’s "Fort Biens," as he is said to have called his instrument. I have only succeeded in learning this much--that Friederici is considered to have been of later date than has been asserted in the text-books. Until more conclusive information can be obtained, I must be permitted to regard a London maker, but a German by birth, Johannes Zumpe, as the inventor of the instrument. It is certain that he introduced that model of square piano which speedily became the fashion, and was chosen for general adoption everywhere. Zumpe began to make his instruments about 1765. His little square, at first of nearly five octaves, with the "old man’s head" to raise the hammer, and "mopstick" damper, was in great vogue, with but little alteration, for forty years; and that in spite of the manifest improvements of John Broadwood’s wrest-plank and John Geib’s "grasshopper." After the beginning of this century, the square piano became much enlarged and improved by Collard and Broadwood, in London, and by Petzold, in Paris. It was overdone in the attempt to gain undue power for it, and, about twenty years ago, sank in the competition, with the later cottage pianoforte, which was always being improved.

To return to the grand pianoforte. The origin of the Viennese grand is rightly accredited to Stein, the organ builder, of Augsburg. I will call it the German grand, for I find it was as early made in Berlin as Vienna. According to Mozart's correspondence, Stein had made some grand pianos in 1777, with a special escapement, which did not "block" like the pianos he had played upon before. When I wrote the article "Pianoforte" in Dr. Grove's "Dictionary," no Stein instrument was forthcoming, but the result of the inquiries I had instituted at that time ultimately brought one forward, which has been secured by the curator of the Brussels Museum, M. Victor Mahillon. This instrument, with Stein's action and two unison scale, is dated 1780. Mozart's grand piano, preserved at Salzburg, made by Walther, is a nearly contemporary copy of Stein, and so also are the grands by Huhn, of Berlin, which I took notes of at Berlin and Potsdam; the latest of these is dated 1790.

An advance shown by these instruments of Stein and Stein's followers is in the spacing of the unisons; the Huhn grands having two strings to a note in the lower part of the scale, and three in the upper. The Cristofori Silbermann inverted wrest-plank has reverted to the usual form; the tuning pins and downward bearing being the same as in the harpsichord. There are no steel arches as yet between the wrest-plank and the belly-rail in these German instruments. As to Stein's escapement, his hopper was fixed behind the key; the axis of the hammer rising on a principle which I think is older than Stein, but have not been able to trace to its source, and the position of his hammer is reversed. Stein's light and facile movement with shallow key-fall, resembling Cristofori's in bearing little weight, was gratefully accepted by the German clavichord players, and, reacting, became one of the determining agents of the piano music and style of playing of the Vienna school. Thus arose a fluent execution of a rich figuration and brilliant passage playing, with but little inclination to sonorousness of effect, lasting from the time of Mozart's immediate followers to that of Henri Herz; a period of half a century. Knee-pedals, as we translate "geuouillŁres," were probably in vogue before Stein, and were levers pressed with the knees, to raise the dampers, and leave the pianoforte undamped, a register approved of by Carl Philip Emmanuel Bach, who regarded the undamped pianoforte as the more agreeable for improvising.. He appears, however, to have known but little of the capabilities of the instrument, which seemed to him coarse and inexpressive beside his favorite clavichord. Stein appears to have made use of the "una corda" shift. Probably by knee-pedals, subsequently by foot-pedals, the following effects were added to the Stein pianos.

The harpsichord "harp"-stop, which muted one string of each note by a piece of leather, became, by the interposition of a piece of cloth between the hammer and the strings, the piano, harp, or _celeste_. The more complete sourdine, which muted all the strings by contact of a long strip of leather, acted as the staccato, pizzicato, or pianissimo. The

Germans further displayed that ingenuity in fancy stops Mersenne had attributed to them in harpsichords more than a hundred and fifty years before, by a bassoon pedal, a card which by a rotatory half-cylinder just impinging upon the strings produced a reedy twang; also by pedals for triangle, cymbals, bells, and tambourine, the last drumming on the sound-board itself.

Several of these contrivances may be seen in a six-pedal grand pianoforte belonging to Her Majesty the Queen, at Windsor Castle, bearing the name as maker of Stein's daughter, Nannette, who was a friend of Beethoven. The diagram represents the wooden framing of such an instrument.

We gather from Burney's contributions to "Rees's Cyclopaedia," that after the arrival of John Christian Bach in London, A.D. 1759, a few grand pianofortes were attempted, by the second-rate harpsichord makers, but with no particular success. If the workshop tradition can be relied upon that several of Silbermann's workmen had come to London about that time, the so-called "twelve apostles," more than likely owing to the Seven Years' War, we should have here men acquainted with the Cristofori model, which Silbermann had taken up, and the early grand pianos referred to by Burney would be on that model. I should say the "new instrument" of Messrs. Broadwood's play-bill of 1767 was such a grand piano; but there is small chance of ever finding one now, and if an instrument were found, it would hardly retain the original action, as Messrs. Broadwood's books of the last century show the practice of refinishing instruments which had been made with the "old movement."

[Illustration: Fig. 1.]

Burney distinguishes Americus Backers by special mention. He is said to have been a Dutchman. Between 1772 and 1776, Backers produced the well-known English action, which has remained the most durable and one of the best up to the present day. It refers in direct leverage to Cristofori's first action. It is opposite to Stein's contemporary invention, which has the hopper fixed. In the English action, as in the Florentine, the hopper rises with the key. To the direct leverage of Cristofori's first action, Backers combined the check of the second, and then added an important invention of his own, a regulating screw and button for the escapement. Backers died in 1776. It is unfortunate we can refer to no pianoforte made by him. I should regard it as treasure trove if one were forthcoming in the same way that brought to light the authentic one of Stein's. As, however, Backers' intimate friends, and his assistants in carrying out the invention, were John Broadwood and Robert Stodart, we have, in their early instruments, the principle and all the leading features of the Backers grand. The increased weight of stringing was met by steel arches placed at intervals between the wrest-plank and the belly-rail, but the belly-rail was still free from the thrust of the wooden bracing, the direction of which was confined to the sides of the case, as it had been in the harpsichord.

Stodart appears to have preceded Broadwood in taking up the manufacture of the grand piano by four or five years. In 1777 he patented an alternate pianoforte and harpsichord, the drawing of which patent shows the Backers action. The pedals he employed were to shift the harpsichord register and to bring on the octave stop. The present pedals were introduced in English and grand pianos by 1785, and are attributed to John Broadwood, who appears to have given his attention at once to the improvement of Backers' instrument. Hitherto the grand piano had been made with an undivided belly-bridge, the same as the harpsichord had been; the bass strings in three unisons, to the lowest note, being of brass. Theory would require that the notes of different octaves should be multiples of each other and that the tension should be the same for each string. The lowest bass strings, which at that time were the note F, would thus require a vibrating length of about twelve feet. As only half this length could be afforded, the difference had to be made up in the weight of the strings and their tension, which led, in these early grands, to many inequalities. The three octaves toward the treble could, with care, be adjusted, the lengths being practically the ideal lengths. It was in the bass octaves (pianos were then of five octaves) the inequalities were more conspicuous. To make a more perfect scale and equalize the tension was the merit and achievement of John Broadwood, who joined to his own practical knowledge and sound intuitions the aid of professed men of science. The result was the divided bridge, the bass strings being carried over the shorter division, and the most beautiful grand pianoforte in its lines and curves that has ever been made was then manufactured. In 1791 he carried his scale up to C, five and a half octaves; in 1794 down to C, six octaves, always with care for the artistic, form. The pedals were attached to the front legs of the stand on which the instrument rested. The right foot-pedal acted first as the piano register, shifting the impact of each hammer to two unisons instead of three; a wooden stop in the right hand key-block permitted the action to be shifted yet further to the right, and reducing the blow to one string only, produced the pianissimo register or _una corda_ of indescribable attractiveness of sound. The cause of this was in the reflected vibration through the bridge to the untouched strings. The present school of pianoforte playing rejects this effect altogether, but Beethoven valued it, and indicated its use in some of his great works. Steibert called the _una corda_ the _celeste_, which is more appropriate to it than Adam's application of this name to the harp-stop, by which the latter has gone ever since.

Up to quite the end of the last century the dampers were continued to the highest note in the treble. They were like harpsichord dampers raised by wooden jacks, with a rail or stretcher to regulate their rise, which served also as a back touch to the keys. I have not discovered the exact year when, or by whom, the treble dampers were first omitted, thus leaving that part of the scale undamped. This bold act gave the instrument many sympathetic strings free to vibrate from the bridge when the rest of the instrument was played, each string, according to its length, being an aliquot division of a lower string. This gave the instrument a certain brightness or life throughout, an advantage which has secured its universal adoption. The expedients of an untouched octave string and of utilizing those lengths of wire that lie beyond the bridges have been brought into notice of late years, but the latter was early in the century essayed by W. F. Collard.

From difficulties of tuning, owing to friction and other causes, the real gain of these expedients is small, and when we compare them with the natural resources we have always at command in the normal scale of the instrument, is not worth the cost. The inventor of the damper register opened a floodgate to such aliquot re-enforcement as can be got in no other way. Each lower note struck of the undamped instrument, by excitement from the sound-board carried through the bridge, sets vibrating higher strings, which, by measurement, are primes to its partials; and each higher string struck calls out equivalent partials in the lower strings. Even partials above the primes will excite their equivalents up to the twelfth and double octave. What a glow of tone-color there is in all this harmonic re-enforcement, and who would now say that the pedals should never be used? By their proper use, the student’s ear is educated to a refined sense of distinction of consonance and dissonance, and the intention and beauty of Chopin’s pedal work becomes revealed.

The next decade, 1790-1800, brings us to French grand pianoforte-making, which was then taken up by Sebastian Erard. This ingenious mechanic and inventor traveled the long and dreary road along which nearly all who have tried to improve the pianoforte have had to journey. He appears, at first, to have adopted the existing model of the English instrument in resonance, tension, and action, and to have subsequently turned his attention to the action, most likely with the idea of combining the English power of gradation with the German lightness of touch. Erard claimed, in the specification to a patent for an action, dated 1808, "the power of giving repeated strokes, without missing or failure, by very small angular motions of the key itself."

Once fairly started, the notion of repetition became the dominant idea with pianoforte-makers, and to this day, although less insisted upon, engrosses time and attention that might be more usefully directed. Some great players, from their point of view of touch, have been downright opposed to repetition actions. I will name Kalkbrenner, Chopin, and, in our own day, Dr. Hans von Bülow. Yet the Erard’s repetition, in the form of Hertz’s reduction, is at present in greater favor in America and Germany, and is more extensively used, than at any previous period.

The good qualities of Erard’s action, completed in 1821, the germ of which will be found in the later Cristofori, are not, however, due to repetition capability, but to other causes, chiefly, I will say, to counterpoise. The radical defect of repetition is that the repeated note can never have the tone-value of the first; it depends upon the mechanical contrivance, rather than the finder of the player, which is directly indispensable to the production of satisfactory tone. When the sensibility of the player’s touch is lost in the mechanical action, the corresponding sensibility of the tone suffers; the resonance is not, somehow or other, sympathetically excited.

Erard rediscovered an upward bearing, which had been accomplished by Cristofori a hundred years before, in 1808. A down-bearing bridge to the wrest-plank, with hammers striking upward, are clearly not in relation;

the tendency of the hammer must be, if there is much force used, to lift the string from its bearing, to the detriment of the tone. Erard reversed the direction of the bearing of the front bridge, substituting for a long, pinned, wooden bridge, as many little brass bridges as there were notes. The strings passing through holes bored through the little bridges, called agraffes, or studs, turned upward toward the wrest-pin. By this the string was forced against its rest instead of off it. It is obvious that the merit of this invention would in time make its use general. A variety of it was the long brass bridge, specially used in the treble on account of the pleasant musical-box like tone its vibration encouraged. Of late years another upward bearing has found favor in America and on the Continent, the Capo d'Astro bar of M. Bord, which exerts a pressure upon the strings at the bearing point.

About the year 1820, great changes and improvements were made in the grand pianoforte both externally and in the instrument. The harpsichord boxed up front gave way to the cylinder front, invented by Henry Pape, a clever German pianoforte-maker who bad settled in Paris. Who put the pedals upon the familiar lyre I have not been able to learn. It would be in the Empire time, when a classical taste was predominant. But the greatest change was from a wooden resisting structure to one in which iron should play an important part. The invention belongs to this country, and is due to a tuner named William Allen, a young Scotchman, who was in Stodart's employ. With the assistance of the foreman, Thom, the invention was completed, and a patent was taken out, dated the 15th of January, 1820, in which Thom was a partner. The patent was, however, at once secured by the Stodarts, their employers. The object of the patent was a combination of metal tubes with metal plates, the metallic tubes extending from the plates which were attached to the string-block to the wrest-plank. The metal plates now held the hitch-pins, to which the farther ends of the strings were fixed, and the force of the tension was, in a great measure, thrown upon the tubes. The tubes were a mistake; they were of iron over the steel strings, and brass over the brass and spun strings, the idea being that of the compensation of tuning when affected by atmospheric change, also a mistake. However, the tubes were guaranteed by stout wooden bars crossing them at right angles. At once a great advance was made in the possibility of using heavier strings, and the great merit of the invention was everywhere recognized.

James Broadwood was one of the first to see the importance of the invention, if it were transformed into a stable principle. He had tried iron tension bars in past years, but without success. It was now due to his firm to introduce a fixed stringed plate, instead of plates intended to shift, and in a few years to combine this plate with four solid tension bars, for which combination he, in 1827, took out a patent, claiming as the motive for the patent the string-plate; the manner of fixing the hitch-pins upon it, the fourth tension bar, which crossed the instrument about the middle of the scale, and the fastening of that bar to the wooden brace below, now abutting against the belly-rail, the attachment being effected by a bolt passing through a hole cut in the sound-board.

This construction of grand pianoforte soon became generally adopted in England and France. Messrs. Erard, who appear to have had their own adaptation of tension bars, introduced the harmonic bar in 1838. This, a short bar of gun metal, was placed upon the wrest-plank immediately above the bearings of the treble, and consolidated the plank by screws tapped into it of alternate pressure and drawing power. In the original invention a third screw pressed upon the bridge. By this bar a very light, ringing treble tone was gained. This was followed by a long harmonic bar extending above the whole length of the wrest-plank, which it defends from any tendency to rise, by downward pressure obtained by screws. During 1840-50, as many as five and even six tension bars were used in grand pianofortes, to meet the ever increasing strain of thicker stringing. The bars were strutted against a metal edging to the wrest-plank, while the ends were prolonged forward until they abutted against its solid mass on the key-board side of the tuning-pins. The space required for fixing them cramped the scale, while the strings were divided into separate batches between them. It was also difficult to so adjust each bar that it should bear its proportionate share of the tension; an obvious cause of inequality.

Toward the end of this period a new direction was taken by Mr. Henry Fowler Broadwood, by the introduction of an iron-framed pianoforte, in which the bars should be reduced in number, and with the bars the steel arches, as they were still called, although they were no longer arches but struts.

In a grand pianoforte, made in 1847, Mr. Broadwood succeeded in producing an instrument of the largest size, practically depending upon iron alone. Two tension bars sufficed, neither of them breaking into the scale: the first, nearly straight, being almost parallel with the lowest bass string; the second, presenting the new feature of a diagonal bar crossed from the bass corner to the string-plate, with its thrust at an angle to the strings.

There were reasons which induced Mr. Broadwood to somewhat modify and improve this framing, but with the retention of its leading feature, the diagonal bar, which was found to be of supreme importance in bearing the tension where it is most concentrated. From 1852, his concert grands have had, in all, one bass bar, one diagonal bar, a middle bar with arch beneath, and the treble cheek bar. The middle bar is the only one directly crossing the scale, and breaking it. It is strengthened by feathered ribs, and is fastened by screws to the wooden brace below. The three bars and diagonal bar, which is also feathered, abut firmly on the string plate, which is fastened down to the wooden framing by screws. Since 1862, the wooden wrest-plank has been covered with a plate of iron, the iron screw-pin plate bent at a right angle in front. The wrest-pins are screwed into this plate, and again in the wood below. The agraffes, which take the upward bearings of the strings, are firmly screwed into this plate. The long harmonic bar of gun metal lies immediately above the agraffes, and crossing the wrest-plank in its entire width, serves to keep it, at the bearing line, in position. This construction is the farthest advance of the English pianoforte.

[Illustration: FIG. 2.--WILLIAM ALLEN.]

Almost simultaneously with it has arisen a new development in America, which, beginning with Conrad Meyer, about 1833, has been advanced by the Chickerings and Steinways to the well known American and German grand pianoforte of the present day. It was perfected in America about in 1859, and has been taken up since by the Germans almost universally, and with very little alteration. Two distinct principles have been developed and combined--the iron framing in a single casting, and the cross or overstringing. I will deal with the last first, because it originated in England and was the invention of Theobald Boehm, the famous improver of the flute. In Grove's "Dictionary," I have given an approximate date to his overstringing as 1835, but reference to Boehm's correspondence with Mr. Walter Broadwood shows me that 1831 was really the time, and that Boehm employed Gerock and Wolf, of 79 Cornhill, London, musical instrument makers, to carry out his experiment. Gerock being opposed to an oblique direction of the strings and hammers, Boehm found a more willing coadjutor in Wolf. As far as I can learn, a piccolo, a cabinet, and a square piano were thus made overstrung. Boehm's argument was that a diagonal was longer within a square than a vertical, which, as he said, every schoolboy knew. The first overstrung grand pianos seen in London were made by Lichtenthal, of St. Petersburg; not so much for tone as for symmetry of the case; two instruments so made were among the curiosities of the Great Exhibition of 1851. Some years before this, Henry Pape had made experiments in cross stringing, with the intention to economize space. His ideas were adopted and continued by the London maker, Tomkisson, who acquired Pape's rights for this country. The iron framing in a single casting is a distinctly American invention, but proceeding, like the overstringing, from a German by birth. The iron casting for a square piano of the American Alpheus Babcock, may have suggested Meyer's invention; it was, however, Conrad Meyer, who, in Philadelphia, and in 1833, first made a real iron frame square pianoforte. The gradual improvement upon Meyer's invention, during the next quarter of a century, are first due to the Chickerings and then the Steinways. The former overstrung an iron frame square, the latter overstrung an iron frame grand, the culmination of this special make since of general American and German adoption. It will be seen that, in the American make, the number of tension bars has not been reduced, but a diagonal support has, to a certain extent, been accepted and adopted. The sound-board bridges are much further apart than obtains with the English grand, or with the Anglo-French Erard. The advocates of the American principle point out the advantages of a more open scale, and more equal pressure on the sound-board. They likewise claim, as a gain, a greater tension. I have no quite accurate information as to what the sum of the tension may be of an American grand piano. One of Broadwood's, twenty years ago, had a strain of sixteen and one-half tons; the strain has somewhat increased since then. The remarkable improvement in wiredrawing which has been made in Birmingham, Vienna, and Nuremberg, of late years, has rendered these high tensions of far easier attainment than they would have been earlier in the century.

[Illustration: FIG. 3.--BROADWOOD.]

For me the great drawback to one unbroken casting is in the vibratory ring inseparable from any metal system that has no resting places to break the uniform reverberation proceeding from metal. We have already seen how readily the strings take up vibrations which are only pure when, as secondary vibrations, they arise by reversion from the sound-board. If vibration arises from imperfectly elastic wood, we hear a dull wooden thud; if it comes from metal, partials of the strings are re-enforced that should be left undeveloped, which give a false ring to the tone, and an after ring that blurs _legato_ playing, and nullifies the _staccato_. I do not pose as the obstinate advocate of parallel stringing, although I believe that, so far, it is the most logical and the best; the best, because the left hand division of the instrument is free from a preponderance of dissonant high partials, and we hear the light and shade, as well as the cantabile of that part, better than by any overstrung scale that I have yet met with. I will not, I say, offer a final judgment, because there may come a possible improvement of the overstrung or double diagonal scale, if that scale is persisted in, and inventive power is brought to bear upon it, as valuable as that which has carried the idea thus far.

[Illustration: FIG. 4.--BROADWOOD.]

I have not had time to refer other than incidentally to the square pianoforte, which has become obsolete. I must, however, give a separate historical sketch of the upright pianoforte, which has risen into great favor and importance, and in its development--I may say its invention--belongs to this present 19th century. The form has always recommended the upright on the score of convenience, but it was long before it occurred to any one to make an upright key board instrument reasonably. Upright harpsichords were made nearly four hundred years ago. A very interesting 17th century one was sold lately in the great Hamilton sale--sold, I grieve to say, to be demolished for its paintings. But all vertical harpsichords were horizontal ones, put on end on a frame; and the book-case upright grand pianos, which, from the eighties, were made right into the present century, were horizontal grands similarly elevated. The real inventor of the upright piano, in its modern and useful form, was that remarkable Englishman, John Isaac Hawkins, the inventor of ever-pointed pencils; a civil engineer, poet, preacher, and phrenologist. While living at Border Town, New Jersey, U. S. A., Hawkins invented the cottage piano--portable grand, he called it--and his father, Isaac Hawkins, to whom, in Grove's "Dictionary," I have attributed the invention, took out, in the year 1800[1], the English patent for it. I can fortunately show you one of these original pianinos, which belongs to Messrs. Broadwood. It is a wreck, but you will discern that the strings descend nearly to the floor, while the key-board, a folding one, is raised to a convenient height between the floor and the upper extremities of the strings. Hawkins had an iron frame and tension rods, within which the belly was entirely suspended; a system of tuning by mechanical screws; an upper metal bridge; equal length of string throughout; metal supports to the action, in which a later help to the repetition was anticipated--the whole instrument being independent of the case. Hawkins tried also a lately revived notion of coiled strings in the bass, doing away with tension. Lastly, he sought for a _sostinente_, which has been tried for from generation to generation, always to fail, but which, even if it does succeed, will produce another kind of instrument, not a pianoforte, which owes so much of its charm to its unsatiating, evanescent tone.

[Transcribers note 1: 3rd digit illegible, best guess from context.]

[Illustration: Fig. 5.--MEYER.]

Once introduced into Hawkins' native country, England, the rise of the upright piano became rapid. In 1807, at latest, the now obsolete high cabinet piano was fairly launched. In 1811, Wornum produced a diagonal. In 1813, a vertical cottage piano. Previously, essays had been made to place a square piano upright on its side, for which Southwell, an Irish maker, took out a patent in 1798; and I can fortunately show you one of these instruments, kindly lent for this paper by Mr. Walter Gilbey. I have also been favored with photographs by Mr. Simpson, of Dundee, of a precisely similar upright square. I show his drawing of the action--the Southwell sticker action. W. F. Collard patented another similar experiment in 1811. At first the sticker action with a leather hinge to the hammer-butt was the favorite, and lasted long in England. The French, however, were quick to recognize the greater merit of Wornum's principle of the crank action, which, and strangely enough through France, has become very generally adopted in England, as well as Germany and elsewhere. I regret I am unable to show a model of the original crank action, but Mr. Wornum has favored me with an early engraving of his father's invention. It was originally intended for the high cabinet piano, and a patent was taken out for it in 1826. But many difficulties arose, and it was not until 1829 that the first cabinet was so finished. Wornum then applied it in the same year to the small upright--the piccolo, as he called it--the principle of which was, through Pleyel and Pape, adopted for the piano manufacture in Paris. Within the last few years we have seen the general introduction of Bord's little pianino, called in England, ungrammatically enough, pianette, in the action of which that maker cleverly introduced the spiral spring. And, also, of those large German overstrung and double overstrung upright pianos, which, originally derived from America, have so far met with favor and sale in this country as to induce some English makers, at least in the principle, to copy them.

[Illustration: Fig. 6.--STEINWAY.]

I will conclude this historical sketch by remarking, and as a remarkable historical fact, that the English firms which in the last century introduced the pianoforte, to whose honorable exertions we owe a debt of gratitude, with the exception of Stodart, still exist, and are in the front rank of the world's competition. I will name Broadwood (whose flag I serve under), Collard (in the last years of the last century known as Longman and Clementi), Erard (the London branch), Kirkman, and, I believe, Wornum. On the Continent there is the Paris Erard house; and, at Vienna, Streicher, a firm which descends directly from Stein of Augsburg, the inventor of the German pianoforte, the favorite of Mozart, and of Beethoven in his virtuoso period, for he used Stein's grands at

Bonn. Distinguished names have risen in the present century, some of whom have been referred to. To those already mentioned, I should like to add the names of Hopkinson and Brinsmead in England; Bechstein and Bluthner in Germany; all well-known makers.

* * * * *

THE POISONOUS PROPERTIES OF NITRATE OF SILVER, AND A RECENT CASE OF POISONING WITH THE SAME.

[Footnote: Read before the Medico Legal Society, April 5, 1883.]

By HENRY A. MOTT, JR., Ph.D., etc.

Of the various salts of silver, the nitrate, both crystallized and in sticks (lunar caustic, _Lapis infernalis_), is the only one interesting to the toxicologist.

This salt is an article of commerce, and is used technically and medicinally.

Its extensive employment for marking linen, in the preparation of various hair dyes (Eau de Perse, d'Egypte, de Chiene, d'Afrique), in the photographer's laboratory, etc., affords ample opportunity to use the same for poisoning purposes.

Nitrate of silver possesses an acrid metallic taste and acts as a violent poison.

When injected into a vein of an animal, even in small quantities, the symptoms produced are dyspnoea,[1] choking, spasms of the limbs and then of the trunk, signs of vertigo, consisting of inability to stand erect or walk steadily, and, finally retching and vomiting, and death by asphyxia. These symptoms, which have usually been attributed to the coagulating action of the salt upon the blood, have been shown not to depend upon that change, which, indeed, does not occur, but upon a direct paralyzing operation upon the cerebro-spinal centers and upon the heart; but the latter action is subordinate and secondary, and the former is fatal through asphyxia.

[Footnote 1: Nat. Dispensatory. Alf. Stille & John M. Maisch, Phila., 1879, p. 232.]

One-third of a grain injected into the jugular vein killed a dog in four and one-half hours, with violent tetanic spasms.[1]

[Footnote 1: Medical Jurisprudence. Thomas S. Traill, 1857, p 117.]

Devergie states that acute poisoning with nitrate of silver, administered in the shape of pills, is more frequent than one would suppose. Yet Dr. Powell[1] states that it should always be given in pills, as the system bears a dose three times as large as when given in solution. The usual dose is from one-quarter of a grain to one grain three times a day when administered as a medicine. In cases of epilepsy Dr. Powell recommends one grain at first, to be gradually increased to six. Clocquet[2] has given as much as fifteen grains in a day, and Ricord has given sixteen grains of argentum chloratum ammoniacale.

[Footnote 1: U.S. Dispensatory, 18th ed., p. 1049. Wood & Bache.]

[Footnote 2: Handbuch der Giftlehre, von A. W. M. Von Hasselt. 1862, p. 316.]

Cases of poisoning have resulted from sticks of lunar caustic getting into the stomach in the process of touching the throat (Boerhave)[1]; in one case, according to Albers, a stick of lunar caustic got into the trachea.

[Footnote 1: Virchow's Archiv, Bd. xvii., s. 135. 1859.]

Von Hasselt therefore urges the utmost caution in using lunar caustic; the sticks and holder should always be carefully examined before use. An apprentice[1] to an apothecary attempted to commit suicide by taking nearly one ounce of a solution of nitrate of silver without fatal result. It must be remarked, however, that the strength of the solution was not stated.

[Footnote 1: Handbuch der Giftlehre, von A. W. M. Von Hasselt. Zweiter Theil, 1862. p. 316.]

In 1861, a woman, fifty-one years old, died in three days from the effects of taking a six-ounce mixture containing fifty grains of nitrate of silver given in divided doses.[1] She vomited a brownish yellow fluid before death. The stomach and intestines were found inflamed. It is stated that silver was found in the substance of the stomach and liver.

[Footnote 1: Treatise on Poison. Taylor, 1875, p. 475.]

It is evident that the poisonous dose, when taken internally, is not so very small, but still it would not be safe to administer much over the amounts prescribed by Ricord, for in the case of the dog mentioned one third of a grain injected into the jugular vein produced death in four and one-half hours.

The circumstance that more can be taken internally is explained by the rapid decomposition to which this silver salt is liable in the body by the proteine substance and chlorine combinations in the stomach, the hydrochloric acid in the gastric juice, and salt from food.

The first reaction produced by taking nitrate of silver internally is a combination of this salt with the proteinaceous tissues with which it comes in contact, as also a precipitation of chloride of silver.

According to Mitscherlich, the combination with the proteine or albuminous substance is not a permanent one, but suffers a decomposition by various acids, as dilute acetic and lactic acid.

The absorption of the silver into the system is slow, as the albuminoid and chlorine combinations formed in the intestinal canal cannot be immediately dissolved again.

In the tissues the absorbed silver salt is decomposed by the tissues, and the oxide and metallic silver separate.

Partly for this reason and partly on account of the formation of the solid albuminates, etc., the elimination of the silver from the body takes place very slowly. Some of the silver, however, passed out in the fæces, and, according to Lauderer, Orfila, and Panizza, some can be detected in the urine.

Bogolowsky[1] has also shown that in rabbits poisoned with preparations of silver, the (often albuminous) urine and the contents of the (very full) gall bladder contained silver.

[Footnote 1: Arch. f. Path. Anatomie, xlvi., p. 409. Gaz. Med de Paris, 1868, No. 39. Also Journ. de l'Anatomie et de la Physiologie, 1873, p. 398.]

Mayencon and Bergeret have also shown that in men and rabbits the silver salt administered is quickly distributed in the body, and is but slowly excreted by the urine and fæces.

Chronic poisoning shows itself in a peculiar coloring of the skin (Argyria Fuchs), especially in the face, beginning first on the sclerotic. The skin does not always take the same color; it becomes in most cases grayish blue, slaty sometimes, though, a greenish brown or olive color.

Von Hasselt thinks that probably chloride of silver is deposited in the rete malpighii, which is blackened by the action of light, or that sulphide of silver is formed by direct union of the silver with the sulphur of the epidermis. That the action of light is not absolutely necessary, Patterson states, follows from the often simultaneous appearance of this coloring upon the mucous membrane, especially that of the mouth and upon the gums; and Dr. Frommann Hermann[1] and others have shown that a similar coloring is also found in the internal parts.

[Footnote 1: Leh der Experiment. Tox. Dr. Hermann, Berlin, 1874, p. 211.]

Versmann found 14.1 grms. of dried liver to contain 0.009 grm. chloride of silver, or 0.047 per cent. of metallic silver. In the kidneys he found 0.007 grm. chloride of silver, or 0.061 per cent. of metallic silver; this was in a case of chronic poisoning, the percentage will be seen to be very small. Orfila Jun. found silver in the liver five months after the poisoning.

Lionville[1] found a deposit of silver in the kidneys, suprarenal gland, and plexus choroideus of a woman who had gone through a cure with lunar caustic five years before death.

[Footnote 1: Gaz. Med., 1868. No. 39.]

Sydney Jones[1] states that in the case of an old epileptic who had been accustomed to take nitrate of silver as a remedy, the choroid plexuses were remarkably dark, and from their surface could be scraped a brownish black, soot-like material, and a similar substance was found lying quite free in the cavity of the fourth ventricle, apparently detached from the choroid plexus.

[Footnote 1: Trans. Path. Soc., xi. vol.]

Attempts at poisoning for suicidal purposes with nitrate of silver are in most cases prevented from the fact that this salt has such a disagreeable metallic taste as to be repulsive; cases therefore of poisoning are only liable to occur by accident or by the willful administration of the poison by another person.

Such a case occurred quite recently, to a very valuable mare belonging to August Belmont.

I received on Dec. 6, 1882, a sealed box from Dr. Wm. J. Provost, containing the stomach, heart, kidney, portion of liver, spleen, and portion of rectum of this mare for analysis.

Dr. Provost reported to me that the animal died quite suddenly, and that there was complete paralysis of the hind quarters, including rectum and bladder.

The total weight of the stomach and contents was 18 lb., the stomach itself weighing 3 lb. and 8 oz.

Portions were taken from each organ, weighed, and put in alcohol for analysis.

The contents of the stomach were thoroughly mixed together and measured, and a weighed portion preserved for analysis.

The stomach, when cut open, was perfectly white on its inner surface, and presented a highly corroded appearance.

The contents of the stomach were first submitted to qualitative analysis, and the presence of a considerable quantity of nitrate of silver was detected.

The other organs were next examined, and the presence of silver was readily detected, with the exception of the heart!

The liver had a very dark brown color. A quantitative analysis of the contents of the stomach gave 59.8 grains of nitrate of silver. In the liver 30.5 grains of silver, calculated as nitrate, were found (average weight, 11 lb.). From the analysis made there was reason to believe that at least one-half an ounce of nitrate of silver was given to the animal. Some naturally passed out in the fæces and urine.

I was able to prepare several globules of metallic silver, as also all the well known chemical combinations, such as sulphide, chloride, oxide, iodide, bromide, bichromate of silver, etc.

From the result of my investigation I was led to the conclusion that the animal came to death by the willful administering of nitrate of silver, probably mixed with the food.

The paralysis of the hind quarters, mentioned by Dr. Provost, accords perfectly with the action of this poison, as it acts on the nerve centers, especially the cerebro-spinal centers, and produces spasms of the limbs, then of the trunk, and finally paralysis.

I might also state in this connection that, only two weeks previous to my receiving news of the poisoning of the mare, I examined for Mr. Belmont the contents of the stomach of a colt which died very mysteriously, and found large quantities of corrosive sublimate to be present.

Calomel is often given as a medicine, but not so with corrosive sublimate, which is usually employed in the arts as a poison.

It is to be regretted that up to the present moment, even with the best detectives, the perpetrator of this outrage has been at large. Surely the very limit of the law should be exercised against any man who would willfully poison an innocent animal for revenge upon an individual. Cases have been reported in England where one groom would poison the colts under the care of another groom, so that the owner would discharge their keeper and promote the other groom to his place.

A few good examples, in cases where punishment was liberally meted out, would probably check such unfeeling outrages.

*   *   *   *   *

TUBERCLE BACILLI IN SPUTA.

Prof. Baumgarten has just published in the _Ctbl. f. d. Med. Wiss_., 25, 1882, the following easy method to detect in the expectorated matter of phthisical persons the pathogenic tubercle bacilli:

Phthisical sputa are dried and made moist with very much diluted potash lye (1 to 2 drops of a 33 per cent. potash lye in a watch glass of distilled water). The tubercle bacilli are then easily recognized with a magnifying power of 400 to 500. By light pressure upon the cover glass the bacilli are easily pressed out of the masses of detritus and secretion. To prevent, however, the possibility of mistaking the tubercle bacilli for other septic bacteria, or vice versa, the following procedure is necessary: After the examination just mentioned, the cover glass is lifted up and the little fluid sticking to its under side allowed to dry, which is done within one or two minutes. Now the cover glass is drawn two or three times rapidly through a gas flame; one drop of a diluted (but not too light) common watery aniline solution (splendid for this purpose is the watery extract of a common aniline ink paper) is placed upon the glass. When now brought under the microscope, all the septic bacteria appear colored intensely blue, while the tubercle bacilli are absolutely colorless, and can be seen as clearly as in the pure potash lye. We may add, however, that Klebs considers his own method preferable.

As the whole procedure does not take longer than ten minutes, it is to be recommended in general practice. The consequences of Koch's important discovery become daily more apparent, and their application more practicable.

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[Concluded from SUPPLEMENT No. 384, page 6132.]

MALARIA.

By JAMES H. SALISBURY, A.M., M.D.

PRIZE ESSAY OF THE ALBANY MEDICAL COLLEGE ALUMNI ASSOCIATION, FEB., 1882.

VIII.

Observations in Washington, D. C., September 5, 1879, 8:35 A.M., Boston time, near Congressional Cemetery.

1. Seized with sneezing on my way to cemetery. Examined nasal excretions and found no Palmellæ

2. Pool near cemetery. Examined a spot one inch in diameter, raised in center, green, found Oedegonium abundant. Some desmids, Cosmarium binoculatum plenty. One or two red Gemiasmas, starch, Protuberans lamella, Pollen.

3. Specimen soft magma of the pool margin. Oedogonium abundant, spores, yeast plants, dirt.

4. Sand scraped. No organized forms but pollen, and mobile spores of some cryptogams.

5. Dew on grass. One stellate compound plant hair, one Gemiasma verdans, two pollen.

6. Grass flower dew. Some large white sporangia filled with spores.

7. Grass blade dew, not anything of account. One pale Gemiasma, three blue Gemiasmas, Cosmarium, Closterium. Diatoms, pollen, found in greenish earth and wet with the dew. Remarks: Observations made at the pool with clinical microscope, one-quarter inch objective. Day cloudy, foggy, hot.

8. Green earth in water way from pump near cemetery. Anabaina plentiful. Diatoms, OscillatoriaceæPolycoccus species. Pollen, Cosmarium, Leptothrix, Gemiasma, old sporangia, spores many. Fungi belonging to fruit. Puccinia. Anguillula fluviatilis.

9. Mr. Smith’s blood. Spores, enlarged white corpuscles. Two sporangia? Gemiasma dark brown, black. Mr. Smith is superintendent Congressional Cemetery. Lived here for seven years. Been a great sufferer with ague. Says the doctors told him that they could do no more for him than he could for himself. So he used Ayer’s ague cure with good effect for six months. Then he found the best effect from the use of the Holman liver ague pad in his own case and that of his children. From his account one would infer that, notwithstanding the excellence of the ague pad, when he is attacked, he uses blue mass, followed with purgatives, then 20 grains of quinine. Also has used arsenic, but it did not agree with him. Also used Capsicum with good results. Had enlarged spleen; not so now.

2d specimen of Mr. Smith’s blood. Stelline, no Gemiasma. 3d specimen, do. One Gemiasma. 4th specimen. None. 5th specimen. Skin scraped showed no plants. 6th specimen. Urine; amyloid bodies; spores; no sporangia.

United States Magazine store grounds. Observation 1. Margin of Eastern Branch River. Substance from decaying part of a water plant. OscillatoriaceæDiatoms. Anguillula. Chytridium. Dirt. No Gemiasma.

Observation 2. Moist soil. Near by, amid much rubbish, one or two so-called Gemiasmas; white, clear, peripheral margin.

Observation 3. Green deposit on decaying wood. Oscillatoriaceæ Protuberans lamella, Gemiasma alba. Much foreign matter.

Mr. Russell, Mrs. R., Miss R., residents of Magazine Grounds presented no ague plants in their blood. Sergeant McGrath, Mrs. M., Miss M., presented three or four sporangias in their blood. Dr. Hodgkins, some in urine. Dr. H.’s friend with chills, not positive as to ague. No plants found.

Observations in East Greenwich, R.I., Aug. 16, 1877.

1. At early morn I examined greenish earth, northwest of the town along the margin of a beautiful brook. Found the Protuberans lamella, the Gemiasma alba and rubra. Observation 2. Found the same. Observation 3. Found the same.

Observation 4. Salt marsh below the railroad bridge over the river.

The scrapings of the soil showed beautiful yellow and transparent Protuberans, beautiful green sporangias of the Gemiasma verdans.

Observation 5. Near the brook named was a good specimen of the Gemiasma plumba. While I could not find out from the lay people I asked that any ague was there, I now understand it is all through that locality.

Observation at Wellesley, Mass., Aug. 20, 1877.

No incrustation found. Examined the vegetation found on the margin of the Ridge Hills Farm pond. Among other things I found an Anguillula fluviatilis. Abundance of microspores, bacteria. Some of the Protococci. Gelatinous masses, allied to the protuberans, of a light yellow color scattered all over with well developed spores, larger than those found in the Protuberans. One or two oval sporanges with double outlines. This observation was repeated, but the specimens were not so rich. Another specimen from the same locality was shown to be made up of mosses by the venation of leaves.

Mine host with whom I lodged had a microscopical mount of the Protococcus nivalis in excellent state of preservation. The sporangia were very red and beautiful, but they showed no double cell wall.

In this locality ague is unknown; indeed, the place is one of unusual salubrity. It is interesting to note here to show how some of the algæ are diffused. I found here an artificial pond fed by a spring, and subject to overflow from another pond in spring and winter. A stream of living water as large as one’s arm (adult) feeds this artificial pond, still it was crowded with the Clathrocyotis æruginosa of some writers and the Polycoccus of Reinsch. How it got there has not yet been explained.

The migration of the ague eastward is a matter of great interest; it is to be hoped that the localities may be searched carefully for your plants, as I did in New Haven.

In this connection I desire to say something about the presence of the Gemiasmas in the Croton water. The record I have given of finding the Gemiasma verdans is not a solitary instance. I did not find the gemiasmas in the Cochituate, nor generally in the drinking waters of over thirty different municipalities or towns I have examined during several years past. I have no difficulty in accounting for the presence of the Gemiasmas in the Croton, as during the last summer I made studies of the Gemiasma at Washington Heights, near 165th St. and 10th Ave., N.Y.

Plate VIII. is a photograph of a drawing of some of the Gemiasmas projected by the sun on the wall and sketched by the artist on the wall, putting the details in from microscopical specimens, viewed in the ordinary way. This should make the subject of another observation.

I visited this locality several times during August and October, 1881. I found an abundance of the saline incrustation of which you have spoken, and at the time of my first visit there was a little pond hole just east of the point named that was in the act of drying up. Finally it dried completely up, and then the saline and green incrustations both were abundant enough. The only species, however, I found of the ague plants was the Gemiasma verdans. On two occasions of a visit with my pupils I demonstrated the presence of the plants in the nasal excretions from my nostrils. I had been sneezing somewhat.

There is one circumstance I would like to mention here: that was, that when, for convenience’ sake, my visits were made late in the day, I did not find the plants abundant, still could always get enough to demonstrate their presence; but when my visits were timed so as to come in the early morning, when the dew was on, there was no difficulty whatever in finding multitudes of beautiful and well developed plants.

To my mind this is a conclusive corroboration of your own statements in which you speak of the plants bursting, and being dissipated by the heat of the summer sun, and the disseminated spores accumulating in aggregations so as to form the white incrustation in connection with saline bodies which you have so often pointed out.

I also have repeated your experiments in relation to the collection of the mud, turf, sods, etc., and have known them to be carried many hundred miles off and identified. I have also found the little depressions caused by the tread of cattle affording a fine nidus for the plants. You have only to scrape the minutest point off with a needle or tooth pick to find an abundance by examination. I have not been able to explore many other sites, nor do I care, as I found all the materials I sought in the vicinity of New York.

To this I must make one exception; I visited the Palisades last summer and examined the localities about Tarrytown. This is an elevated location, but I found no Gemiasmas. This is not equivalent to saying there were none there. Indeed, I have only given you a mere outline of my work in this direction, as I have made it a practice to examine the soil wherever I went, but as most of my observations have been conducted on non-malarious soils, and I did not find the plants, I have not thought it worth while to record all my observations of a negative character.

I now come to an important part of the corroborative observations, to wit, the blood.

I have found it as you predicted a matter of considerable difficulty to find the mature forms of the Gemiasmas in the blood, but the spore forms of the vegetation I have no difficulty in finding. The spores have appeared to me to be larger than the spores of other vegetations that grow in the blood. They are not capable of complete identification unless they are cultivated to the full form. They are the so-called bacteria of the writers of the day. They can be compared with the spores of the vegetation found outside of the body in the swamps and bogs.

You said that the plants are only found as a general rule in the blood of old cases, or in the acute, well marked cases. The plants are so few, you said, that it was difficult to encounter them sometimes. So also of those who have had the ague badly and got well.

Observation at Naval Hospital, N.Y., Aug., 1877. Examined with great care the blood of Donovan, who had had intermittent fever badly. Negative result.

The same was the result of examining another case of typho-malarial (convalescent); though in this man's blood there were found some oval and sometimes round bodies like empty Gemiasmas, 1/1000 inch in diameter. But they had no well marked double outline. There were no forms found in the urine of this patient. In another case (Donovan,) who six months previous had had Panama fever, and had well nigh recovered, I found no spores or sporangia.

Observations made at Washington, D.C., Sept., 1879. At this time I examined with clinical microscope the blood of eight to ten persons living near the Congressional Cemetery and in the Arsenal grounds. I was successful in finding the plants in the blood of five or more persons who were or had been suffering from the intermittent fever.

In 1877, at the Naval Hospital, Chelsea, I accidentally came across three well marked and well defined Gemiasmas in the blood of a marine whom I was studying for another disease. I learned that he had had intermittent fever not long before.

Another positive case came to my notice in connection with micrographic work the past summer. The artist was a physician residing in one of the suburban cities of New York. I had demonstrated to him Gemiasma verdans, showed how to collect them from the soil in my boxes. And he had made outline drawings also, for the purposes of more perfectly completing his drawings. I gave him some of the Gemiasmas between a slide and cover, and also some of the earth containing the soil. He carried them home. It so happened that a brother physician came to his house while he was at work upon the drawings. My artist showed his friend the plants I had collected, then the plants he collected himself from the earth, and then he called his daughter, a young lady, and took a drop of blood from her finger. The first specimen contained several of the Gemiasmas. The demonstration, coming after the previous demonstrations, carried a conviction that it otherwise would not have had.

AGUE PLANTS IN THE URINE.

I have found them in the urine of persons suffering or having suffered from intermittent fever.

When I was at the Naval Hospital in Brooklyn one of the accomplished assistant surgeons, after I had showed him some plants in the urine, said he had often encountered them in the urine of ague cases, but did not know their significance. I might multiply evidence, but think it unnecessary. I am not certain that my testimony will convince any one save myself, but I know that I had rather have my present definite, positive belief based on this evidence, than to be floundering on doubts and uncertainties. There is no doubt that the profession believe that intermittents have a cause; but this belief has a vagueness which cannot be represented by drawings or photograph. Since I have photographed the Gemiasma, and studied their biology, I feel like holding on to your dicta until upset by something more than words.

In relation to the belief that no Algæ are parasitic, I would state on Feb. 9, 1878, I examined the spleen of a decapitated speckled turtle with Professor Reinsch. We found various sized red corpuscles in the blood in various stages of formation; also filaments of a green Alga traversing the spleen, which my associate, a specialist in Algology, pronounced one of the Oscillatoriaceæ These were demonstrated in your own observations made years ago. They show that Algæ are parasitic in the living spleen of healthy turtles.

This leads to the remark that all parasitic growths are not nocent. I understand you take the same position. Prof. Reinsch has published a work in Latin, "Contributiones ad Algologiam," Leipsic, 1874, in which he gives a large number of drawings and descriptions of Algæ many of them entophytic parasites on other animals or Algæ Many of these he said were innocent guests of their host, but many guest plants were death to their host. This is for the benefit of those who say that the Gemiasmas are innocent plants and do no harm. All plants, phanerogams or cryptogams, can be divided into nocent or innocent, etc., etc. I am willing to change my position on better evidence than yours being submitted, but till then call me an indorser of your work as to the cause and treatment of ague.

Respectfully, yours, ------

There are quite a number of others who have been over my ground, but the above must suffice here.

[Illustration: PLATE X.--EXPLANATION OF FIGURES.--1, Spore with thick laminated covering, constant colorless contents, and dark nucleus. B, Part of the wall of cell highly magnified, 0.022 millimeter in thickness. 2, Smaller spore with verruculous covering. 3, Spore with punctulated covering. 4, The same. 5, Minute spores with blue-greenish colored contents, 0.0021 millimeter in diameter. 6, Larger form of 5. 7, Transparent spherical spore, contents distinctly refracting the light, 0.022 millimeter in diameter. 8, Chroococcoid minute cells, with transparent, colorless covering, 0.0041 millimeter in diameter. 9, Biciliated zoospore. 10, Plant of the Gemiasma rubra, thallus on both ends attenuated, composed of seven cells of unequal size. 11, Another complete plant of rectangular shape composed of regularly attached cells. 12, Another complete, irregularly shaped and arranged plant. 13, Another plant, one end with incrassated and regularly arranged cells. 14, Another elliptical shaped plant, the covering on one end attenuated into a long appendix. 15, Three celled plant. 16, Five celled plant. 10-16 magnified 440/1.]

I wish to conclude this paper by alluding to some published investigations into the cause of ague, which are interesting, and which I welcome and am thankful for, because all I ask is investigations--not words without investigations.

The first the Bartlett following:

Dr. John Bartlett is a gentleman of Chicago, of good standing in the profession. In January, 1874, he published in the _Chicago Medical Journal_ a paper on a marsh plant from the Mississippi ague bottoms, supposed to be kindred to the Gemiasmas. In a consideration of its genetic relations to malarious disease, he states that at Keokuk, Iowa, in 1871, near the great ague bottoms of the Mississippi, with Dr. J. P. Safford, he procured a sod containing plants that were as large as rape seeds. He sent specimens of the plants to distinguished botanists, among them M. C. Cook, of London, England. Nothing came of these efforts.

2. In August, 1873, Dr. B. visited Riverside, near Chicago, to hunt up the ague plants. Found none, and also that the ague had existed there from 1871.

3. Lamonot, a town on the Illinois and Michigan Canal, was next visited. A noted ague district. No plants were found, and only two cases of ague, one of foreign origin. Dr. B. here speaks of these plants of Dr. Safford’s as causing ague and being different from the Gemiasmas. But he gives no evidence that Safford’s plants have been detected in the human habitat. In justice to myself I would like to see this evidence before giving him the place of precedence.

4. Dr. B., Sept. 1, 1873, requested Dr. Safford to search for his plants at East Keokuk. Very few plants and no ague were found where they both were rife in 1871.

5. Later, Sept. 15, 1873, ague was extremely prevalent at East Keokuk, Iowa, where two weeks before no plants were found; they existed more numerously than in 1871.

6. Dr. B. traced five cases of ague, in connection with Dr. Safford’s plants found in a cesspool of water in a cellar 100 feet distant. It is described as a plant to be studied with a power of 200 diameters, and consisting of a body and root. The root is a globe with a central cavity lined with a white layer, and outside of these a layer of green cells. Diameter of largest plant, one-quarter inch. Cavity of plant filled with molecular liquid. Root is above six inches in length, Dr. B. found the white incrustation; he secured the spores by exposing slides at night

over the malarious soil resembling the Gemiasmas. He speaks of finding ague plants in the blood, one-fifteen-hundredth of an inch in diameter, of ague patients. He found them also in his own blood associated with the symptoms of remittent fever, quinine always diminishing or removing the threatening symptoms. Professors Babcock and Munroe, of Chicago, call the plants either the Hydrogastrum of Rabenhorst, or the Botrydium of the Micrographic Dictionary, the crystalline acicular bodies being deemed parasitic. Dr. B. deserves great credit for his honest and careful work and for his valuable paper. Such efforts are ever worthy of respect.

There is no report of the full development found in the urine, sputa, and sweat. Again, Dr. B. or Dr. Safford did not communicate the disease to unprotected persons by exposure. While then I feel satisfied that the Gemiasmas produce ague, it is by no means proved that no other cryptogam may not produce malaria. I observed the plants Dr. B. described, but eliminated them from my account. I hope Dr. B. will pursue this subject farther, as the field is very large and the observers are few.

When my facts are upset, I then surrender.

"NOTES ON MARSH MIASM (LIMNOPHYSALIS HYALINA). BY ABR. FREDRIK EKLUND, M.D., STOCKHOLM, SWEDEN, PHYSICIAN OF THE FIRST CLASS IN THE SWEDISH ROYAL NAVY.

[Footnote: Translated from the _Archives de la Medecine Navale_, vol. xxx., no. 7, July, 1878, by A. Sibley Campbell, M.D., Augusta, Ga.]

Before giving a succinct account of the discovery of paludal miasma and of its natural history, I ought in the first place to state that I have not had the opportunity of reading or studying the great original treatise of Professor Salisbury. I am acquainted with it only through a resume published in the _American Journal of the Medical Sciences_ for the year 1866, new series, vol. li. p. 51. At the beginning of my investigations I was engaged in a microscopic examination of the water and mud of swampy shores and of the marshes, also with a comparison of their microphytes with those which might exist in the urine of patients affected with intermittent fevers. Nearly three months passed without my being able to find the least agreement, the least connection. Having lost nearly all hope of being able to attain the end which I had proposed, I took some of the slime from the marshes and from the masses of kelp and Confervæ from the sea shores, where intermittent fevers are endemic, and placed them in saucers under the ordinary glass desiccators exposed on a balcony, open for twenty-four hours, the most of the time under the action of the burning rays of the sun. With the evaporated water deposited within the desiccators, I proceeded to an examination, drop by drop. I at length found that which I had sought so long, but always in vain.

The parasite of intermittent fever, which I have termed Limnophysalis hyalina, and which has been observed before me by Drs. J. Lemaire and Gratiolet (_Comptes Rendus Hebdomadaires de l’Academie des Sciences_, Paris, 1867, pp. 317 and 318) and B. Cauvet (_Archives de Medecine Navale_, November, 1876), is a fungus which is developed directly from the mycelium, each individual of which possesses one or several filaments, which are simple or dichotomous, with double outlines, extremely fine, plainly marked, hyaline, and pointed. Under favorable conditions, that is, with moisture, heat, and the presence of vegetable matter in decomposition, the filaments of mycelium increase in length. From these long filaments springs the fungus. The sporangia, or more exactly the conidia, are composed of unilocular vesicles, perfectly colorless and transparent, which generally rise from one or both sides of the filaments of the mycelium, beginning as from little buds or eyes; very often several (two to three) sporangia occur placed one upon the other, at least on one side of the mycelium.

With a linear magnitude of 480, the sporangia have a transverse diameter of one to five millimeters, or a little more in the larger specimens. The filaments of mycelium, under the same magnitude, appear exceedingly thin and finer than a hair. The shape of the conidia, though presenting some varieties, is, notwithstanding, always perfectly characteristic. Sometimes they resemble in appearance the segments of a semicircle more or less great, sometimes the wings of butterflies, double or single. It is only exceptionally that their form is so irregular.

Again, when young, they are perfectly colorless and transparent; sometimes they are of a beautiful violet or blue color (mykianthinin mykocyanin). Upon this variety of the Limnophysalis hyalina depends the vomiting of blue matters observed by Dr. John Sullivan, at Havana, in patients affected with pernicious intermittent fever (algid and comatose form). In the perfectly mature sporangia, the sporidia have a dark brown color (mykophaein). From the sporidia, the Italian physicians, Lanzi and Perrigi, in the course of their attempts at its cultivation, have seen produced the Monilia penicinata friesii, which is, consequently, the second generation of the Limnophysalis hyalina, in which alternate generation takes place, admitting that their observations may be verified. The sporangia are never spherical, but always flat. When they are perfectly developed, they are distinctly separated from their filament of mycelium by a septum--that is to say, by limiting lines plainly marked. It is not rare, however, to see the individual sporangia perfectly isolated and disembarrassed of their filament of mycelium floating in the water. It seems to me very probable that these isolated sporangia are identical with the hyaline coagula so accurately described by Frerichs, who has observed them in the blood of patients dying of intermittent fevers. But if two sporangia are observed with their bases coherent without intermediary filaments of mycelium, it seems to me probable that the reproduction has taken place through the union, which happens in the following manner: Two filaments of mycelium become juxtaposed; after which the filaments of mycelium disappear in the sporangia newly formed, which by this same metamorphosis are deprived of the faculty of reproducing themselves through the filaments of myclium of which they are deprived. The smallest portion of a filament of mycelium evidently possesses the faculty of producing the new individuals.

It is unquestionable that the Limnophysalis hyalina enter into the blood either by the bronchial mucous membrane, by the surface of the pulmonary vesicles, or by the mucous membrane of the intestinal canal, most often, no doubt, by the last, with the ingested water; this introduction is aided by the force of suction and pressure, which facilitates their absorption. It develops in the glands of Lieberkuhn, and multiplies itself; after which the individuals, as soon as they are formed, are drawn out and carried away in the blood of the circulation.

The Limnophysalis hyalina is, in short, a solid body, of an extreme levity, and endowed with a most delicate organization. It is not a miasm, in the common signification of the term; it does not carry with it any poison; it is not vegetable matter in decomposition, but it flourishes by preference amid the last.

In regard to other circumstances relative to the presence of this fungus, there are, above all, two remarkable facts, namely, its property of adhering to surfaces as perfectly polished as that of a mirror, and its power of resistance against the reagents, if we except the caustic alkalies and the concentrated mineral acids. This power of resisting the ordinary reagents explains in a plausible manner why the fungus is not destroyed by the digestive process in the stomach, where, however, the acid reaction of the gastric juice probably arrests its development--is that of the schistomycetes in general--and keeps it in a state of temporary inactivity. This property of adhering to smooth surfaces explains perhaps the power of the Eucalyptus globulus in arresting the progress of paludal miasm (?). But it is evident that other trees, shrubs, and plants of resinous or balsamic foliage, as, for example, the Populus balsamifera, Cannabis sativa, Pinus silvestris, Pinus abies, Juniperus communis, have equally, with us, the same faculty; they are favorable also for the drying of the soil, and the more completely, as their roots are spreading, more extended, and more ramified.

In order to demonstrate the presence of the limnophysalis in the blood of patients affected with intermittent fever during the febrile stage, properly speaking, it appeared necessary for me to dilute the blood of patients with a solution of nitrate of potassa, having at 37.5℃. the same specific gravity as the serum of the blood. With capillary tubes of glass, a little dilated toward the middle, of the same shape and size as those which are used in collecting vaccine lymph, I took up a little of the solution of nitrate of potassa above indicated. After this I introduced the point of an ordinary inoculating needle under the skin, especially in the splenic region, where I ruptured some of the smallest blood-vessels of the subcutaneous cellular tissue. I collected some of the blood which flowed out or was forced out by pressure, in the capillary tubes just described, containing a solution of potassa; after which I melted the ends with the flame of a candle. With all the intermittent fever patients whose blood I have collected and diluted during the febrile stage, properly speaking, I have constantly succeeded in finding the Limnophysalis hyalina in the blood by microscopic examination.

It is only necessary for me to mention here that it is of the highest importance to be able to demonstrate the presence of fungus in the blood of the circulation and in the urine of patients in whom the diagnosis is doubtful. The presence of the Limnophysalis hyalina in the urine indicates that the patient is liable to a relapse, and that his intermittent fever is not cured, which is important in a prognostic and therapeutic point of view.

When the question is to prevent the propagation of intermittent fevers, it is evident that it should be remembered that the Limnophysalis hyalina enters into the blood by the mucous membrane of the organs of respiration, of digestion, and the surface of the pulmonary vesicles. We have also to consider the soil, and the water that is used for drinking.

In regard to the soil, several circumstances are very worthy of attention. It is desirable, not only to lower as much as possible the level of the subterranean water (grunawassen) by pipes of deep drainage, the cleansing, and if there is reason, the enlargement (J. Ory) of the capacity of the water collectors, besides covering and keeping in perfect repair the principal ditches in all the secondary valleys to render the lands wholesome, but also to completely drain the ground, diverting the rain water and cultivating the land, in the cultivation of which those trees, shrubs, and plants should be selected which thrive the most on marshy grounds and on the shores and paludal coasts of the sea, and which have their roots most speading and most ramified. Some of the ordinary grasses are also quite appropriate, but crops of the cereals, which are obtained after a suitable reformation of marshy lands, yield a much better return. After the soil in the neighborhood of the dwellings has been drained and cultivated with care, and in a more systematic manner than at present, the bottoms of the cellars should be purified as well as the foundations of the walls and of the houses.

The water intended for drinking, which contains the Limnophysalis hyalina, should be freed from the fungus by a vigorous filtration. But, as it is known, the filtering beds of the basins in the water conduits are soon covered with a thick coating of confervæand the Limnophysalis hyalina then extends from the deepest portions of the filtering beds into the filtered water subjacent. It is for this reason that it is absolutely necessary to renew so often the filtering beds of the water conduits, and, at all events, before they have become coated with a thick layer of confervæThe disappearance of intermittent fevers will testify to the utility of these measures. It is for a similar reason that wooden barrels are so injurious for equipages. When the wood has begun to decay by the contact of the impure water, the filaments of mycelium of the Limnophysalis hyalina penetrate into the decayed wood, which becomes a fertile soil for the intermittent fever fungi.

The employment for the preparation of mortar of water not filtered, or of foul, muddy sand which contains the Limnophysalis hyalina, explains how intermittent fevers may proceed from the walls of houses. This arises also from the pasting of wall-paper with flour paste prepared with water which contains an abundance of the fungi of intermittent fever.

The miasm in the latter case is therefore endoecic, or more exactly entoichic. With us the propagation of intermittent fever has been observed in persons occupying rooms scoured with unfiltered water containing the Limnophysalis hyalina in great quantity.

The following imperial ordinance was published on the 25th of March, 1877, by the chief of admiralty of the German marine. It has for its object the prevention and eradication of infectious diseases:

"In those places where infectious diseases, according to experience, are prevalent and unusually severe and frequent, it is necessary to abstain as much as possible from the employment of water taken from without the ship for cleansing said vessel, and also for washing out the hold when the water of the sea or of a river, in the judgment of the commander of a vessel, confirmed by the statement of the physician, is shown to be surcharged with organic matter liable to putrefaction. With this end in view, if you are unable to send elsewhere for suitable water, you must make use of good and fresh water, but with the greatest economy. In that event the purification of the hold must be accomplished by mechanical means or by disinfectants."

"As I have demonstrated by my investigations that in the distillation of paludal water, and that from the marshy shores of the sea, the Limnophysalis hyalina, which is impalpable, is carried away and may be detected again after the distillation, it must be insisted that the water intended to be used for drinking on shipboard shall be carefully filtered before and after its distillation."

The Klebs-Tommasi and Dr. Sternberg’s report, as summarized in the Supplement No. 14, National Board of Health Bulletin, Washington, D.C., July 18, I would cordially recommend to all students of this subject.

I welcome these observers into the field. Nothing but good can come from such careful and accurate observations into the cause of disease. For myself I am ready to say that it may be that the Roman gentlemen have bit on the cause of the Roman fever, which is of such a pernicious type. I do not see how I can judge, as I never investigated the Roman fever; still, while giving them all due credit, and treating them with respect, in order to put myself right I may say that I have long ago ceased to regard all the bacilli, micrococci, and bacteria, etc., as ultimate forms of animal or vegetable life. I look upon them as simply the embryos of mature forms, which are capable of propagating themselves in this embryonal state. I have observed these forms in many diseased conditions; many of them in one disease are nothing but the vinegar yeast developing, away from the air, in the blood where the full development of the plant is not apt to be found. In diphtheria I developed the bacteria to the full form--the Mucor malignans. So in the study of ague, for the vegetation which seems to me to be connected with ague, I look to the fully developed sporangias as the true plant.

Again, I think that crucial experiments should be made on man for his diseases as far as it is possible. Rabbits, on which the experiments were made, for example, are of a different organization and food than man, and bear tests differently. While there are so many human beings subject to ague, it seems to me they should be the subjects on whom the crucial tests are to be made, as I did in my labors.

As far as I can see, Dr. Sternberg's inquiries tend to disprove the Roman experiments, and as he does not offer anything positive as a cause of ague, I can only express the hope that he will continue his investigations with zeal and earnestness, and that he will produce something positive and tangible in his labors in so interesting and important a field.

I would then that all would join hands in settling the cause of this disease; and while I do not expect that all will agree with me, still, I shall respect others' opinions, and so long as I keep close to my facts I shall hope my views, based on my facts, will not be treated with disrespect.

APPENDIX.

Gemiasma verdans and Gemiasma rubra collected Sept. 10, 1882, on Washington Heights, near High Bridge. The illustrations show the manner in which the mature plants discharge their contents.

Plate VIII. A, B, and C represent very large plants of the Gemiasma verdans. A represents a mature plant. B represents the same plant, discharging its spores and spermatia through a small opening in the cell walls. The discharge is quite rapid but not continuous, being spasmodic, as if caused by intermittent contractions in the cell walls. The discharge begins suddenly and with considerable force--a sort of explosion which projects a portion of the contents rapidly and to quite a little distance. This goes on for a few seconds, and then the cell is at rest for a few seconds, when the contractions and explosions begin again and go on as before. Under ordinary conditions it takes a plant from half an hour to an hour to deliver itself. It is about two-thirds emptied. C represents the mature plant, entirely emptied of its spore contents, there remaining inside only a few actively moving spermatia, which are slowly escaping. The spermatia differ from the spores and young plants in being smaller, and of possessing the power of moving and tumbling about rapidly, while the spores of young plants are larger and quiescent. D, E, F, and G represent mature plants belonging to the Gemiasma rubra. D represents a ripe plant, filled with spores, embryonic plants, and spermatia. E represents a ripe plant in the act of discharging its contents, it being about half emptied. F represents a ripe plant after its spore and embryonic plant contents are all discharged, leaving behind only a few actively moving spermatia, which are slowly escaping. G represents the emptied plant in a quiescent state.

Figs. A, B, C represent an unusually large variety of the Gemiasma verdans. This species is usually about the size of the rubra. This large variety was found on the upper part of New York Island, near High Bridge, in a natural depression where the water stands most of the year, except in July, August, and September, when it becomes an area of drying, cracked mud two hundred feet across. As the mud dries these plants develop in great profusion, giving an appearance to the surface as if covered thickly with brick dust.

These depressions and swaily places, holding water part of the year, and becoming dry during the malarial season, can be easily dried by means of covered drains, and grassed or sodded over, when they will cease to grow; this vegetation and ague in such localities will disappear.

The malarial vegetations begin to develop moderately in July, but do not spring forth abundantly enough to do much damage till about the middle of August, when they in ague localities spring into existence in vast multitudes, and continue to develop in great profusion till frost comes.

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ANALYSIS OF THE MALARIA PLANT (GEMIASMA RUBRA).

By Prof Paulus F. Reinsch.

Author Algæ of France, 1866; Latest Observations on Algology, 1867; Chemical Investigation of the Connections of the Lias and Jura Formations, 1859; Chemical Investigation of the Viscum Album, 1860; Contributions to Algology and Fungology, 1874-75, vol. i.; New Investigation of the Microscopic Structure of Pit Coal, 1881; Micrographic Photographs of the Structure and Composition of Pit Coal, 1888.

Dr. Cutter writes me September 28, 1882: "My dear Professor: By this mail I send you a specimen of the Gemiasma rubra of Salisbury, described in 1862, as found in bogs, mud holes, and marshes of ague districts, in the air suspended at night, in the sputa, blood, and urine, and on the skin of persons suffering with ague. It is regarded as one of the Palmellaceæ. This rubra is found in the more malignant and fatal types of the disease. I have found it in all the habitats described by Dr. Salisbury. Both he and myself would like you to examine and hear what you have to say about it."

The substance of clayish soil contains, besides fragments of shells of larger diatoms (Suriella synhedra), shells of Navicula minutissima, Pinnularia viridis. Spores belonging to various cryptogams.

1. Spherical transparent spores with laminated covering and dark nucleus--0.022 millimeter in diameter.

2. Spherical spores with thick covering of granulated surface.

3. Spherical spores with punctulated surface--0.007 millimeter in

diameter.

4. Very minute, transparent, bluish-greenish colored spores, with thin covering and finely granulated contents--0.006 millimeter in diameter.

5. Chroococcoid cells with two larger nuclei--0.0031 millimeter in diameter. Sometimes biciliated minute cells are found; without any doubt they are zoospores derived from any algoid or fungoid species.

I cannot say whether there exists any genetic connection between these various sorts of spores. It seems to me that probably numbers 1-4 represent resting states of the hyphomycetes.

No. 5 represents one and two celled states of chroococcus species belong to Chroococcus minutus.

The crust of the clayish earth is covered with a reddish brown covering of about half a millimeter in thickness. This covering proves to be composed, under the microscope, of cellular filaments and various shaped bodies of various composition. They are made up of cells with densely and coarsely granulated reddish colored contents--shape, size, and composition are very variable, as shown in the figures. _The cellular bodies make up the essential organic part of the clayish substance, and, without any doubt, if anything of the organic compounds of the substance is in genetical connection with the disease, these bodies would have this role_. The structure and coloration of cell contents exhibit the closest alliance to the characteristics of the division of Chroolepideæ and of this small division of Chlorophyllaceous Algæ nearest to Gongrosira--a genus whose five to six species are inhabitants of fresh water, mostly attached to various minute aquatic Algæ and mosses. Each cell of all the plants of this genus produces a large number of mobile cells--zoospores.

Fig. 9 represents very probably one zoospore developed from these plants as figured from 10 to 16.

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CARBON.

M. Berthelot, in the _Journal de Pharmacie et de Chimie_ for March, states that from peculiar physical relations he is led to suspect that the true element carbon is unknown, and that diamond and graphite are substances of a different order. Elementary carbon ought to be gaseous at the ordinary temperature, and the various kinds of carbon which occur in nature are in reality polymerized products of the true element carbon. Spectrum analysis is thought to confirm this view; and it is supposed the second spectrum seen in a Geissler tube belongs to gaseous carbon. This spectrum, which has been recognized along with that of hydrogen in the light of the tails of comets, indicates a carbide, probably acetylene.

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CANNED MEATS.

By P. CARLES.

When tinned iron serves for containing alimentary matters, it is essential that the tin employed should be free from lead. The latter metal is rapidly oxidized on the surface and is dissolved in this form in the neutral acids of vegetables, meat, etc. The most exact method of demonstrating the presence of lead consists in treating the alloy--so-called tin--with _aqua regia_ containing relatively little nitric acid. The whole dissolves; the excess of acid is driven off by evaporation at a boiling heat, and the residue, diluted with water, is saturated with hydrogen sulphide. The iron remains in solution, while the mixed lead and tin sulphides precipitated are allowed to digest for a long time in an alkaline sulphide. The tin sulphide only dissolves; it is filtered off and converted into stannic acid, while the lead sulphide is transformed into sulphate and weighed as such.

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NEW BLEACHING PROCESS, WITH REGENERATION OF THE BATHS USED.

By MR. BONNEVILLE.

To a cold solution containing 1 per cent. of bromine, 1 per cent. of caustic soda at 36° B. is added, then the material, to be bleached is first wet and then immersed in this bath until completely decolorized. It is passed into a newly-acidulated bath, rinsed, and dried. After the bromine bath has been used up, it is regenerated by adding 1 per cent. of sulphuric acid, which liberates the bromine. To the same bath caustic soda is added, which regenerates the hypobromite of soda. The hydrofluosilicic acid can be used, instead of the sulphuric acid, with greater advantage. A bath used up can also be regenerated by means of the electric current.

* * * * *

DETECTION OF MAGENTA, ARCHIL, AND CUDBEAR IN WINE.

These colors are not suitable for converting white wine into red, but they can be used for giving wines a faint red tint, for darkening pale red wines, and in making up a factitious bouquet essence, which is added to red wines. The most suitable methods for the detection of magenta are those given by Romei and Falieres-Ritter. If a wine colored with archil and one colored with cudbear are treated treated according to Romei's method, the former gives, with basic lead acetate, a blue, and the latter a fine violet precipitate. The filtrate, if shaken up with amylic alcohol, gives it in either case a red color. A knowledge of this fact is important, or it may be mistaken for magenta. The behavior of the amylic alcohol, thus colored red, with hydrochloric acid and ammonia is characteristic. If the red color is due to magenta, it is destroyed by both these reagents, while hydrocholoric acid does not decolorize the solutions of archil and cudbear, and ammonia turns their red color to a purple violet. If the wine is examined according to the Falieres-Ritter method in presence of magenta, ether, when shaken up with the wine, previously rendered ammoniacal, remains colorless, while if archil or cudbear is present the ether is colored red. Wartha has made a convenient modification in the Falieres-Ritter method by adding ammonia and ether to the concentrated wine while still warm. If the red color of the wool is due to archil or cudbear, it is extracted by hydrochloric acid, which is colored red. Ammonia turns the color to a purple violet. König mixed 50 c.c. wine with ammonia in slight excess, and places in the mixture about one-half grm. clean white woolen yarn. The whole is then boiled in a flask until all the alcohol and the excess of ammonia are driven off. The wool taken out of the liquid and purified by washing in water and wringing is moistened in a test-tube with pure potassa lye at 10 per cent. It is carefully heated till the wool is completely dissolved, and the solution, when cold, is mixed first with half its volume of pure alcohol, upon which is carefully poured the same volume of ether, and the whole is shaken. The stratum of ether decanted off is mixed in a test-tube with a drop of acetic acid. A red color appears if the slightest trace of magenta is present. The shaking must not be too violent, lest an emulsion should be formed. If the wine is colored with archil, on prolonged heating, after the addition of ammonia, it is decolorized. If it is then let cool and shaken a little, the red color returns. If the wool is taken out of the hot liquid after the red color has disappeared, and exposed to the air, it takes a red color. But if it is quickly taken out of the liquid and at once washed, there remains merely a trace of color in the wool. If these precautions are observed, magenta can be distinguished from archil with certainty according to König's method. As the coloring-matter of archil is not precipitated by baryta and magnesia, but changed to a purple, the baryta method, recommended by Pasteur, Balard, and Wurtz, and the magnesia test, are useless. Magenta may in course of time be removed by the precipitates formed in the wine. It is therefore necessary to test not merely the clear liquid, but the sediment, if any.--_Dr. B. Haas, in Budermann's Centralblatt.--Analyst_.

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PANAX VICTORIˇ.

Panax Victoriæ is a compact and charming plant, which sends up numbers of stems from the bottom in place of continually growing upward and thus becoming ungainly; it bears a profusion of elegantly curled, tasseled, and variegated foliage, very catching to the eye, and unlike any of its predecessors. The other, P. dumosum, is of similar habit, the foliage being crested and fringed after the manner of some of our rare crested ferns.--_The Gardeners' Chronicle_.

[Illustration: PANAX VICTORIˇ.]

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A NOTE ON SAP.

[Footnote: Read at an evening meeting of the Pharmaceutical Society, London, April 4, 1883.]

By Professor ATTFIELD, F.R.S.

Beneath a white birch tree growing in my garden I noticed, yesterday evening, a very wet place on the gravel path, the water of which was obviously being fed by the cut extremity of a branch of the birch about an inch in diameter and some ten feet from the ground. I afterward found that exactly fifteen days ago circumstances rendered necessary the removal of the portion of the branch which hung over the path, 4 or 5 feet being still left on the tree. The water or sap was dropping fast from the branch, at the rate of sixteen large drops per minute, each drop twice or thrice the size of a "minim," and neither catkins nor leaves had yet expanded. I decided that some interest would attach to a determination both of the rate of flow of the fluid and of its chemical composition, especially at such a stage of the tree's life.

A bottle was at once so suspended beneath the wound as to catch the whole of the exuding sap. It caught nearly 5 fluid ounces between eight and nine o'clock. During the succeeding eleven hours of the night 44 fluid ounces were collected, an average of 4 ounces per hour. From 8:15 to 9:15 this morning, very nearly 7 ounces were obtained. From 9:15 to 10:15, with bright sunshine, 8 ounces. From 10:15 until 8:15 this evening the hourly record kept by my son Harvey shows that the amount during that time has slowly diminished from 8 to a little below 7 ounces per hour. Apparently the flow is faster in sunshine than in shade, and by day than by night.

It would seem, therefore, that this slender tree, with a stem which at the ground is only 7 inches in diameter, having a height of 39 feet, and before it has any expanded leaves from whose united surfaces large amounts of water might evaporate, is able to draw from the ground about 4 liters, or seven-eighths of a gallon of fluid every twenty-four hours. That at all events was the amount flowing from this open tap in its water system. Even the topmost branches of the tree had not become, during the fifteen days, abnormally flaccid, so that, apparently, no drainage of fluid from the upper portion of the tree had been taking place. For a fortnight the tree apparently had been drawing, pumping, sucking--I know not what word to use--nearly a gallon of fluid daily from the soil in the neigborhood of its roots. This soil had only an ordinary degree of dampness. It was not wet, still less was there any actually fluid water to be seen. Indeed, usually all the adjacent soil is of a dry kind, for we are on the plateau of a hill 265 feet above the sea, and the level of the local water reservoir into which our wells dip is about 80 feet below the surface. My gardener tells me that the tree has been "bleeding" at about the same rate for fourteen of the fifteen days, the first day the branch becoming only somewhat damp. During the earlier part of that time we had frosts at night, and sunshine, but with extremely cold winds, during the days. At one time the exuding sap gave, I am told by two different observers, icicles a foot long. A much warmer, almost summer, temperature has prevailed during the past three days, and no wind. This morning the temperature of the sap as it escaped was constant at 52° F., while that of the surrounding air was varying considerably.

The collected sap was a clear, bright, water-like fluid. After a pint had stood aside for twelve hours, there was the merest trace of a sediment at the bottom of the vessel. The microscope showed this to consist of parenchymatous cells, with here and there a group of the wheel-like or radiating cells which botanists, I think, term sphere-crystals. The sap was slightly heavier than water, in the proportion of 1,005 to 1,000. It had a faintly sweet taste and a very slight aromatic odor.

Chemical analysis showed that this sap consisted of 99 parts of pure water with 1 part of dissolved solid matter. Eleven-twelfths of the latter were sugar.

That the birch readily yields its sap when the wood is wounded is well known. Philipps, quoted by Sowerby, says:

"Even afflictive birch,
Cursed by unlettered youth, distills,
A limpid current from her wounded bark,
Profuse of nursing sap."

And that birch sap contains sugar is known, the peasants of many countries, especially Russia, being well acquainted with the art of making birch wine by fermenting its saccharine juice.

But I find no hourly or daily record of the amount of sugar-bearing sap which can be drawn from the birch, or from any tree, before it has acquired its great digesting or rather developing and transpiring apparatus--its leaf system. And I do not know of any extended chemical analysis of sap either of the birch, or other tree.

Besides sugar, which is present in this sap to the extent of 616 grains--nearly an ounce and a half--per gallon, there are present a mere trace of mucilage; no starch; no tannin; 3‰ grains per gallon of ammoniacal salts yielding 10 per cent. of nitrogen; 3 grains of albuminoid matter yielding 10 per cent. of nitrogen; a distinct trace of nitrites; 7.4 grains of nitrates containing 17 per cent. of nitrogen; no chlorides, or the merest trace; no sulphates; no sodium salts; a little of potassium salts; much phosphate and organic salts of calcium; and some similar magnesian compounds. These calcareous and magnesian substances yield an ash when the sap is evaporated to dryness and the sugar and other organic matter burnt away, the amount of this residual matter being exactly 50 grains per gallon. The sap contained no peroxide of hydrogen. It was faintly if at all acid. It held in solution a ferment capable of converting starch into sugar. Exposed to the air it soon swarmed with bacteria, its sugar being changed to alcohol.

A teaspoonful or two of, say, apple juice, and a tablespoonful of sugar put into a gallon of such rather hard well-water as we have in our chalky district, would very fairly represent this specimen of the sap of the silver birch. Indeed, in the phraseology of a water-analyst, I may say that the sap itself has 25 degrees of total, permanent hardness.

How long the tree would continue to yield such a flow of sap I cannot say; probably until the store of sugar it manufactured last summer to feed its young buds this spring was exhausted. Even within twenty-four hours the sugar has slightly diminished in proportion in the fluid.

Whether or not this little note throws a single ray of light on the much debated question of the cause of the rise of sap in plants I must leave to botanists to decide. I cannot hope that it does, for Julius Sachs, than whom no one appears to have more carefully considered the subject, says, at page 677 of the recently published English translation of his textbook of botany, that "although the movements of water in plants have been copiously investigated and discussed for nearly two hundred years, it is nevertheless still impossible to give a satisfactory and deductive account of the mode of operation of these movements in detail." As a chemist and physicist myself, knowing something about capillary attraction, exosmose, endosmose, atmospheric pressure, and gravitation generally, and the movements caused by chemical attraction, I am afraid I must concur in the opinion that we do not yet know the real ultimate cause or causes of the rise of sap in plants.

Ashlands, Watford, Herts.

*   *   *   *   *

THE CROW.

[Footnote: Abstract of a recent discussion before the Connecticut State Board of Agriculture.]

Prof. W. A. Stearns, in a lecture upon the utility of birds in agriculture, stated that the few facts we do know regarding the matter have been obtained more through the direct experience of those who have stumbled on the facts they relate than those who have made any special study of the matter. One great difficulty has been that people looked too far and studied too deeply for facts which were right before them. For instance, people are well acquainted with the fact that hawks, becoming bold, pounce down upon and carry off chickens from the hen-yards and eat them. How many are acquainted with the fact that in hard winters, when pressed for food, crows do this likewise? But what does this signify? Simply that the crow regulates its food from necessity, not from choice.

Now, carry this fact into operation in the spring into the cornfield. Do you suppose that the crow, being hungry, and dropping into a field of corn wherein is abundance to satisfy his desires, stops, as many affirm, to pick out only those kernels which are affected with mildew, larva, or weevil? Does he instinctively know what corns, when three or four inches beneath the ground, are thus affected? Not a bit of it. To him, a strictly grain-feeding and not an insect-eating bird, the necessity takes the place of the choice. He is hungry; the means of satisfying his hunger are at hand. He naturally drops down in the first cornfield he sees, calls all his neighbors to the feast, and then roots up and swallows all the kernels until he can hold no more. There is no doubt the crow is a damage to the agriculturist. He preys upon the cornfield and eats the corn indiscriminately, whether there are any insects or not. That has been proved by dissection of stomach and crop.

If corn can be protected by tarring, so that the crows will not eat it, they will prove a benefit by leaving the corn and picking up grubs in the field. Where corn has been tarred, I have never known the crows to touch it.

Mr. Sedgwick remarked that, in addition to destroying the corn crop, the crow was also very destructive of the eggs of other birds. Last spring I watched a pair of crows flying through an orchard, and in several instances saw them fly into birds' nests, take out the eggs, and then go on around the field.

In answer to Mr. Hubbard, who claimed the crow would eat animal food in any form, and might not be rightly classified as a grain-eating bird, Prof. Stearns said the crow was thus classified by reason of the structure of its crop being similar to that of the finches, the blackbird, the sparrows, and other seed-eating birds.

[Illustration: THE AMERICAN CROW.]

Mr. Wetherell said: Crows are greedy devourers of the white worm, which sometimes destroys acres of grass. As a grub eater, the crow deserves much praise. The crow is the scavenger of the bird family, eating anything and everything, whether it is sweet or carrion. The only quarrel I have with the crow is because it destroys the eggs and young birds.

Mr. Lockwood described the experience of a neighbor who planted corn after tarring it. This seemed to prevent the ravages of the crows until the second hoeing, when the corn was up some eighteen inches, at which time the crows came in and pulled nearly an acre clean.

Crows, said Dr. Riggs, have no crop, like a great many carnivorous birds. The passage leading from the mouth goes directly to the gizzard, something like the duck. The duck has no crop, yet the passage leading from the mouth to the gizzard in the duck becomes considerably enlarged. In the crow there is no enlargement of this passage, and everything passes directly into the gizzard, where it is digested.

Dr. Riggs had raised corn and watched the operations of the crows. Going upon the field in less than a minute after the crows had left it, he found they had pulled the corn, hill after hill, marching from one hill to the other. Not until the corn had become softened and had come up would they molest it. In the fall they would come in droves on to a field of corn, where it is in stacks, pick out the corn from the husks, and put it into their gizzards. They raid robbins' nests and swallows' nests, devouring eggs and young birds. Yet crows are great scavengers. In the spring they get a great many insects and moths from the ground, and do good work in picking up those large white grubs with red heads that work such destruction in some of our mowing fields.

Mr. Pratt stated that he had used coal tar on his seed corn for five or six years, and had never a spear pulled by the crows. Dr. Riggs never had known a crow to touch corn after it got to the second tier of leaves. Mr. Lockwood said crows would sample a whole field of corn to find corn not tarred. Mr. Pratt recommended to pour boiling water on the corn before applying the tar. A large tablespoonful of tar will color a pail of water.

According to Dr. Riggs, the hot mixture with the corn must be stirred continually; if not, the life of the corn will be killed and germination prevented. It may be poured on very hot, if the stirring is kept up and too much tar is not used. If the water is hot it will dissolve the tar, and as it is poured on it will coat every kernel of corn. If the water is allowed to stand upon the corn any great length of time, the chit of the corn will be damaged. The liquid should be poured off and the corn allowed to cool immediately after a good stirring.

Mr. Gold had known of crows pulling corn after the second hoeing, when the scare-crows had been removed from the field. The corn thus pulled had reached pretty good size. This pulling must have been done from sheer malice on the part of the crows.

Mr. Ayer was inclined to befriend the crow. For five years he had planted from eight to twelve acres of corn each year and had not lost twenty hills by crows. He does not use tar, but does not allow himself to go out of a newly-planted cornfield without first stretching a string around it on high poles and also providing a wind-mill with a little rattle box on it to make a noise. With him this practice keeps the crows away.

Mr. Goodwin thought crows were scavengers of the forests and did good service in destroying the worms, grubs, and insects that preyed upon our trees. He had raised some forty crops of corn, and whenever he had thoroughly twined it at the time of planting, crows did not pull it up. In damp spots, during the wet time and after his twine was down, he had known crows to pull up corn that was seven or eight inches high.

Respecting crows as insect eaters, Prof. Stearns admitted that they did devour insects; he had seen them eat insects on pear trees. Tame crows at his home had been watched while eating insects, yet a crow will eat corn a great deal quicker than he will eat insects.--_Boston Cultivator_.

* * * * *

THE PRAYING MANTIS AND ITS ALLIES.

On examining the strange forms shown in the accompanying engraving, many persons would suppose they were looking at exotic insects. Although this is true for many species of this group, which are indigenous to warm countries, and reach at the most only the southern temperate zone, yet there are certain of these insects that are beginning to be found in France, to the south of the Loire, and that are always too rare, since, being exclusively feeders on living prey, they prove useful aids to us.

These insects belong among the orthoptera--an order including species whose transformations are less complete than in other groups, and whose larval and pupal forms are very active, and closely resemble the imago. Two pairs of large wings characterize the adult state, the first pair of which are somewhat thickened to protect the broad, net-veined hinder pair, which fold up like a fan upon the abdomen. The hind legs are large and adapted for leaping.

The raptorial group called _Mantidæ_, which forms the subject of this article, includes species that maybe easily recognized by their large size, their enormous, spinous fore legs, which are adapted for seizing other insects, and from their devotional attitude when watching their prey.

These insects exhibit in general the phenomenon of mimicry, or adaptation for protection, through their color and form, some being green, like the plants upon which they live, others yellowish or grayish, and others brownish like dead leaves.

In the best known species, _Mantis religiosa_, the head is triangular, the eyes large, the prothorax very long, and the body narrowed and lengthened; the anterior feet are armed with hooks and spines, and the shanks are capable of being doubled up on the under side of the thighs. When at rest it sits upon the four posterior legs, with the head and prothorax nearly erect, and the anterior feet folded backward. The female insect attains a length of 54 millimeters, and the male only 40.

The color is of a handsome green, sometimes yellow, or of a yellowish red. The insects are slow in their motions, waiting on the branches of trees and shrubs for some other insect to pass within their reach, when they seize and hold it with the anterior feet, and tear it to pieces. They are very voracious, and sometimes prey upon each other. Their eggs are deposited in two long rows, protected by a parchment-like envelope, and attached to the stalk of a plant. The nymph is as voracious as the perfect insect, from which it differs principally in the less developed wings.

The devotional attitude of these insects when watching for their prey--their fore legs being elevated and joined in a supplicating manner--has given them in English the popular names of "soothsayer," "prophet," and "praying mantis," in French, "prie-Dieu," in Portuguese, "louva-Deos," etc. According to Sparmann, the Nubians and Hottentots regard mantides as tutelary divinities, and worship them as such. A monkish legend tells us that Saint Francis Xavier, having perceived a mantis holding its legs toward heaven, ordered it to sing the praises of God, when immediately the insect struck up one of the most exemplary of canticles! Pison, in his "Natural History of the East Indies," makes use of the word _Vates_ (divine) to designate these insects, and speaks of that superstition, common to both Christians and heathens, that assigns to them the gifts of prophecy and divination. The habit that the mantis has of first stretching out one fore leg, and then the other, and of preserving such a position for some little time, has also led to the belief among the illiterate that it is in the act, in such cases, of pointing out the road to the passer by.

[Illustration: MANTIDES AND EMPUSĂ]

The old naturalist, Moufet, in his _Theatrum Insectorum_ (London, 1634), says of the praying mantis (_M. religiosa_) that it is reported so divine that if a child asks his way of it, it will show him the right road by stretching out its leg, and that it will rarely or never deceive him.

This group of insects is most abundant in the tropical regions of Africa, South America, and India, but some species are found in the warmer parts of North America, Europe, and Australia. The American species is the "race-horse" (_M. carolina_), and occurs in the Southern and Western States. Burmeister says that _M. argentina_, of Buenos Ayres, seizes and eats small birds.

The genera allied to _Mantis--Vates, Empusa, Harpax_, and _Schizocephala_--occur in the tropics. The genus _Eremophila_ inhabits the deserts of Northern Africa, where it resembles the sand in color.

The species shown in the engraving (which we borrow from _La Nature_) inhabit France.

*   *   *   *   *

MAY-FLIES.

There are usually found in the month of June, especially near water, certain insects that are called Ephemera, and which long ago acquired true celebrity, and furnished material for comparison to poets and philosophers. Indeed, in the adult state they live but one day, a fact that has given them their name. They appear for a few hours, fluttering about in the rays of a sun whose setting they are not to see, as they live during the space of a single twilight only. These insects have very short antennæan imperfect mouth incapable of taking food, and delicate, gauze like wings, the posterior ones of which are always small, or even rudimentary or wanting. Their legs are very delicate--the anterior ones very long--and their abdomen terminates in two or three long articulated filaments. One character, which is unique among insects, is peculiar to Ephemerids; the adults issuing from the pupal envelope undergo still another moult in divesting themselves of a thin pellicle that covers the body, wings, and other appendages. This is what is called the _subimago_, and precedes the imago or perfect state of the insect. The short life of adult May-flies is, with most of them, passed in a continual state of agitation. They are seen rising vertically in a straight line, their long fore-legs stretched out like antennæand serving to balance the posterior part of the body and the filaments of the abdomen during flight. On reaching a certain height they allow themselves to descend, stretching out while doing so their long wings and tail, which then serve as a parachute. Then a rapid working of these organs suddenly changes the direction of the motion, and they begin to ascend again. Coupling takes place during these aerial dances. Soon afterward the females approach the surface of the water and lay therein their eggs, spreading them out the while with the caudal filaments, or else depositing them all together in one mass that falls to the bottom.

These insects seek the light, and are attracted by an artificial one, describing concentric circles around it and finally falling into it and being burnt up. Their bodies on falling into the water constitute a food which is eagerly sought by fishes, and which is made use of by fishermen as a bait.

But the above is not the only state of Ephemerids, for their entire existence really lasts a year. Linnæus has thus summed up the total life of these little creatures: "The larvæ swim in water; and, in becoming winged insects, have only the shortest kind of joy, for they often celebrate in a single day their wedding, parturition, and funeral obsequies." The eggs, in fact, give birth to more or less elongated larvæ which are always provided with three filaments at the end of the abdomen, and which breathe the oxygen dissolved in the water by tracheo-branchiæ along the sides of the body. They are carnivorous, and live on small animal prey. The most recent authors who have studied them are Mr. Eaton, in England, and Mr. Vayssiere, of the Faculte des Sciences, at Marseilles.

A propos of the larvæ of Ephemera or May-flies, we must speak of one of the entomological rarities of France, the nature and zoological place of which it has taken more than a century to demonstrate. Geoffroy, the old historian of the insects of the vicinity of Paris, was the first to find in the waters of the Seine a small animal resembling one of the Daphnids. This animal has six short and slender thoracic legs, which terminate in a hook and are borne on the under side of the cephalic shield. This latter is provided above with two slender six-jointed antennæ, two very large faceted eyes at the side, and three ocelli forming a triangle. The large thoraceo-abdominal shield is hollowed out behind into two movable valves which cover the first five segments of the abdomen (Fig. 1). The last four segments, of decreasing breadth, are retractile beneath the carapax, as is also the broad plume that terminates them, and which is formed of three short, transparent, and elegantly ciliated bristles. These are the locomotive organs of the animal, whose total length, with the segments of the tail expanded, does not exceed seven to eight millimeters. The animal is found in running waters, at a depth of from half a meter to a meter and a half. It hides under stones of all sizes, and, as soon as it is touched, its first care is to fix itself by the breast to their rough surface, and then to swim off to a more quiet place. It fastens itself so firmly to the stone that it is necessary to pass a thin knife-blade under it in order to detach it.

[Illustration: FIG. 1.--LARVA OF MAY FLY. (Magnified 12 times.)]

Geoffroy, because of the two large eyes, and without paying attention to the ocelli, named this larva the "feather-tailed binocle." C. Dumeril, in 1876, found it again in pools that formed after rains, and named the creature (which is of a bluish color passing to red) the "pisciform binocle." Since then, this larva has been found in the Seine at Point-du-Jour, Bas-Meudon, and between Epone and Mantes. Latreille, in 1832, decided it to be a crustacean, and named it _Prosopistoma foliaceum_. In September, 1868, the animal was found at Toulouse by Dr. E. Joly in the nearly dry Garonne. Finally, in 1880, Mr. Vayssiere met with it in abundance in the Rhone, near Avignon.

The abnormal existence of a six-legged crustacean occupied the attention of naturalists considerably. In 1869, Messrs. N. and E. Joly demonstrated that the famous "feather-tailed binocle" was the larva of an insect. They found in its mouth the buccal pieces of the Neuroptera, and, under the carapax, five pairs of branchial tufts attached to the segments that are invisible outwardly. Inside the animal were found tracheæthe digestic tube of an insect, and malpighian canals. Finally, in June, 1880, Mr. VayssiŁre was enabled to establish the fact definitely that the insect belonged among the Ephemerids. Two of the larvae that he raised in water became, from yellowish, gradually brown. Then they crawled up a stone partially out of water, the carapax gradually split, and the adults readily issued therefrom--the head first, then the legs, and finally the abdomen. At the same time, the wings, which were in three folds in the direction of their length, spread out in their definite form (Fig. 2). The insects finally flew away to alight at a distance from the water. The wings of the insect, which are of an iron gray, are covered with a down of fine hairs. The posterior ones soon disappear.

[Illustration: FIG. 2.--MAY-FLY (adult magnified 14 times).]

Perhaps the subimago in this genus of Ephemerids, as in certain others, is the permanent aerial state of the female.--_La Nature_.

* * * * *

Connecticut is rapidly advancing in the cultivation of oysters. About 90,000 acres are now planted, and thirty steamers and many sailing vessels are engaged in the trade.

* * * * *

THE COLOR OF WATER.

It is well known that the water of different lakes and rivers differs in color. The Mediterranean Sea is indigo blue, the ocean sky blue, Lake Geneva is azure, while the Lake of the Four Forest Cantons and Lake Constance, in Switzerland, as well as the river Rhine, are chrome green, and Kloenthaler Lake is grass green.

Tyndall thought that the blue color of water had a similar cause as the blue color of the air, being blue by reflected light and red by transmitted light. W. Spring has recently communicated to the Belgian Academy the results of his investigations upon the color of water. He proved that perfectly pure water in a tube 10 meters long had a distinctly blue color, while it ought, according to Tyndall, to look red. Spring also showed that water in which carbonate of lime, silica, clay, and salts were suspended in a fine state of division offered a resistance to the passage of light that was not inconsiderable. Since the red and violet light of the spectrum are much more feeble than the yellow, the former will be completely absorbed, while the latter passes through, producing, with the blue of the water itself, different shades of green.

* * * * *

There is to be held in Paris this year, from the 1st to the 22d of July, an insect exhibition, organized by the Central Society of Agriculture and Insectology. It will include (1) useful insects; (2) their products, raw, and in the first transformations; (3) apparatus and instruments used in the preparation of these products; (4) injurious insects and the various processes for destroying them; (5) everything relating to insectology.

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