AMERICAN INDUSTRIES.—No. 26.

THE MANUFACTURE OF PIANOS AND ORGANS.

The history of the development of the pianoforte reaches back more than a century and a half, and possesses considerable interest on account of the adoption of the instrument in almost every household. The most ordinary of modern pianos, compared with those used by Haydn, Gluck, and other composers and artists of the eighteenth century, are immensely better in tone, in size, in elegance, and in all other respects.

The piano, like everything else, had a beginning, and the history of the class of instruments from which it has been developed dates from the remote time when stretched strings were first employed in producing musical sounds. One of the early instruments of this kind was the ancient lyre, from which the harp, the psaltery, and the dulcimer were gradually developed. The clavicitherium, or keyed cithra, was the first marked approach to the piano. It consisted of an oblong box holding a series of stretched strings, which were struck by a plectra of quill attached to the inner ends of the keys. This instrument, it is believed, was first made in the twelfth century.

From the first days of the clavicitherium until the invention of the action, in 1711, the instrument was made in many forms, and took on as many different names. The invention of the action, by which hammers are made to strike the wires and fall back out of the way so as to permit the string to vibrate, has been ascribed to several persons, and there is great doubt as to who was the real inventor.

The first pianos manufactured in the United States were made in Boston in 1822, since which time the instrument has been greatly improved and brought to its present state of perfection.

The parlor or cabinet organ, which is the outgrowth of the melodeon, has been perfected within the last few years, and is now made in a great variety of forms, with different stop arrangements, and at prices so low that but few families need forego the pleasure of music in the household.

For many years a few old established houses controlled the business of piano making and selling; but latterly competition has increased, and new modes of doing business have been inaugurated, some of which have been very advantageous to the buyer and user. The largest manufacturer in this country doing business directly with retail purchasersis Mr. Daniel F. Beatty, whose factory we illustrate on the title page. The idea of dealing directly with the users of the instruments is a recent one, which not only benefits the buyer, but the manufacturer also, as it enables the manufacturer to sell a better instrument for less money than he could if agents were employed.

The central view at the top of the page represents Mr. Beatty's new factory, situated on Railroad Avenue, corner Beatty Street, in the city of Washington, New Jersey. The small building in the foreground is the office belonging to the factory. The larger building is the new factory. The building seen some little distance behind the new factory is the Beatty Building, a spacious structure, containing in addition to the hall proper, the office devoted to the extensive business connected with the piano and organ factory. The large building in the distance at the right is Beatty's Factory, No. 3. Samples of the products of these factories are shown in either of the upper corners. We have chosen a few only of the departments of this concern, as space will not permit us to enter into all of the details of piano and organ manufacture.

While the case of an organ is little more than an elegant piece of cabinet furniture, the case of a piano must not only be as elegant and well finished as skilled labor can make it, but it must be very strongly made of the very best of materials to insure its durability. The iron frame, which is to withstand the stress of the wires aggregating many tons, is fitted to the case; the sounding board is also supported by the case. In the assembling room the wires are placed on the pins, the action is fitted, the soft and loud pedal mechanism is put in, and the instrument is turned over to the workman who adjusts the action, then to the tuner, who puts the strings under their normal strain. The strings stretch somewhat; this, taken together with the slight but unavoidable yielding of the frame, soon throws the instrument out of tune, so that it requires tuning again and again. Finally, when it is capable of standing in tune, it is given to the final inspector, who gives it the last touches, which make it a complete instrument.

The organ is so entirely different from the piano in every respect that it requires workmen of altogether different qualifications. The actions—consisting of the keys, the nicely fitted valves, and the delicate springs which hold the valves to the seats—are made in the department shown in one of the lower engravings. It is with the utmost care that each piece is fitted in its appropriate place, and the workman, when he leaves one part to go to another, knows that what he has finished is well and perfectly done. Without this care on the part of the workman there would be no end to difficulties, and the work would never be completed.

The small central figure in the lower part of the engraving represents the room in which the reeds of the organs are tuned and voiced. The workman in this department must not only be a careful and experienced mechanic, but he must have a correct musical ear and a faculty of distinguishing between the shades of quality in a tone. Upon this workman depends all that is pleasing in an organ, as he has it in his power to make the tone soft, sweet, and mellow, or harsh and unpleasant.

Everything in this factory is conducted on a perfect system. None but the best of workmen are employed, none but the best of materials are used, and the most modern machinery and appliances are adopted to facilitate the work and to render it not only cheaper but better.

Mr Beatty's offices are extensive and well appointed It requires twenty or more assistants to attend to the details of this immense business The advertising bureau alone keeps a goodly number of persons constantly employed

The business, started but a few years ago by its proprietor without a dollar, has grown beyond all precedent, amounting at present to several millions of dollars a year.

Mr Beatty was lately elevated to the Mayoralty of Washington entirely without his own seeking. His fellow-citizens chose him. He conducted no campaign, and was not even present on election day, business having called him to New York on that day, and the news of his triumph was telegraphed to his headquarters at the Fifth Avenue Hotel. He bears his honors modestly, and his neighbors testify to his being the same genial, open-handed, free-hearted man as ever, not forgetting to relieve the unfortunate, to give freely to his church, nor deeming it beneath him to preside at Children's Day services in his own church.

The Beatty piano and organ are everywhere known Mayor Beatty's success has been rapid and complete, and he claims to possess to-day the largest manufactory of pianos and organs which sells directly to the people.

Winter Precautions for Hydrants, Valves, Etc.

On the 1st of November Mr. Edward Atkinson, President of the Boston Manufacturers' Mutual Fire Insurance Company, issued the following to the mills insured in that company:

Many of the yard hydrants and those connected with standpipes are of the variety known as Y or branch hydrants, and are not provided with means of draining off the water when the hydrant is closed.

When the fire pumps are used for inspection, or for the drill of the fire organization, water remains in the upper portion of such hydrants as were closed before the pipes were drained; and also forces its way into the upper portion of every hydrant that does not remain perfectly tight under the heavy pressure. The hydrants are generally tight enough to retain this entrapped water, and the hydrant caps prevent its evaporation.

Our inspectors have discovered many instances of broken hydrants, several of broken pipes, and two of rotary pumps injured by the freezing of entrapped water, during the last year; while, undoubtedly, a larger number of similar cases were discovered by those in immediate charge and promptly repaired.

The hazard of a single broken hydrant does not lie so much in the possible deprivation of its use, as it does in the fact that when water is forced into the pipes there is a great risk of the hydrant breaking; and in most mill yards such an accident would tap all the pipes and prevent the efficient operation of the fire apparatus.

The possibility of such accidents can be obviated by opening all the hydrants when draining the pipes for the winter months and closing them afterwards.

It is therefore suggested that each agent shall, either on receipt of this circular or at such other time as he sees fit to prepare for freezing weather, cause all the hydrants of the description named to be opened, the pipes drained, and the hydrants then closed.

Rotary pumps should be emptied, if not submerged, by turning them backwards.

In this connection, we also urge that all left-handed valves and water gates be distinctly labeled, as many cases have been observed where the valves have been broken by an attempt to turn them the wrong way, even in the presence of our inspectors when causing them to be examined; some great disasters have occurred from the mismanagement of such valves both in premises insured by us and also outside of our line of risks.

The want of similarity in the direction of opening and closing valves is a great misfortune that cannot now be remedied in all cases. In several instances mills have been wet down when the fire apparatus has been under test, because the persons in control were ignorant of the right method of opening and closing their own valves.

It therefore behooves the principal manager of every mill to see that every left-handed valve or gate is distinctly labeled and marked with an arrow painted in white to indicate the direction in which it should be opened; or what would be better, where there are only a few left-hand valves in a yard containing many others, to remove them entirely.

Benzoate of Soda.

Professor Klebs, of Prague, announces that the benzoate of soda is the best antiseptic in all infectious diseases. It acts, as the experiments of the author show, very powerfully. It is claimed that a daily dose of from 30 to 50 grammes to a full-grown man will render the poison of diphtheria inoperative. The benzoate is prepared by dissolving crystallized benzoic acid in water, neutralizing at a slight heat with a solution of caustic soda, drying, and then allowing the solution to crystallize over sulphuric acid under a bell glass. Large doses do not appear to be absolutely necessary. Good results may be obtained by the daily administration of about 12 grammes.

AGRICULTURAL INVENTIONS

An improvement in plows has been patented by Mr Charles T. Crook & Logan J Huffman, of Fort Mill, S. C This plow has a bifurcated foot for a plowshare that will allow of the raising and lowering of the share at will, and is so adjusted as to prevent the clogging of both foot and plowshare from grass, litter, etc

An improvement in sulky plows has been patented by Mr Aden K Munson, of Marysville, Kan The object of this invention is to provide for vertical movement of the plow beam independent of the sulky, so that the plow will run at a uniform depth, and also for leveling the plow sidewise on uneven ground, and to provide for shifting the supports of the plow beam bodily on the axle of the sulky for adjustment to the size of plow and the desired width of furrow

Mr Joseph P Prairie, of Raleigh, N. C , has patented an improved machine for chopping and cultivating cotton. It is so constructed that it may be used for chopping, for chopping and cultivating, or for cultivating alone, as may be desired.

The Fruit of Shrubby Trefoil as a Substitute for Hops.

All who are acquainted with the tall shrub called "shrubby trefoil" (*Ptelea trifoliata*) know that its fruit is bitter, and in odor is almost exactly the same as the hop. In fact the fruit is sometimes used in this country as a substitute for the latter, and for this reason the plant is also known as the "hop tree." In consequence of the ravages of the phylloxera the French are now looking about for new beverages, and, as observed in the *Revue Horticole*, if the destruction of the vine continues there is no doubt that wine must be largely replaced by beer. M. Charles Baltet has discovered that the fruit of the "shrubby trefoil" makes equally as good beer as hops. At a recent agricultural exhibition at Châlons-sur-Marne, a M. Ponsard exhibited a sample of beer in which the fruits of this plant were substituted for hops, and its quality and flavor are reported as being equal to those of the best Strasbourg beer. As above stated, the fruit of the *Ptelea* is sometimes used in the United States as a substitute for hops, but whether it has ever been so used in the manufacture of beer, we are unable to say.

The World's Commercial Marine.

According to the *Répertoire Général*, Bureau Veritas, for 1879–80, the sailing tonnage of the civilized world has decreased from 14,218,072 to 14,103,605—a falling away which shows the decided tendency which now prevails to give steamers the preference over sailing vessels. The total sailing tonnage of Great Britain, which includes colonial tonnage, is 5,584,128, so that considerably more than one third of the tonnage which sails the sea is under the British flag. When we come to steamships, Great Britain takes a still prouder position. The total number of steamers which can be classed as sea-going is 5,897, of which Great Britain has 3,542; and the total net tonnage of steamships is 4,021,869, of which Great Britain has 2,555,575 tons, or about three fifths of the whole. Counting sailing vessels and steamers together, the civilized world has 18,125,474 tons afloat, of which 8,139,703, or not much less than half are under the British flag. Canada occupies the fourth position among nations. The leading nations are Great Britain, United States, Norway, Canada, Germany, Italy, and France.

Artificial Rotten Eggs.

Mr. J. Fletcher, F.C.S., recently described a new method of preparing sulphureted hydrogen. The plan is simply to fuse sulphur and solid paraffine in a small glass flask, leading the resulting gas by means of a perforated cork, India-rubber, and glass tube directly into the solution to be tested. The first gases are not sulphureted, but when the mixture has been thoroughly fused and mixed the sulphureted hydrogen passes over abundantly. The advantage of the process is that the moment the flame of the lamp is removed the evolution of gas ceases, and the little apparatus can be laid aside without fear of creating offensive smells. When used again, the gas passes at once when sufficiently heated. There are few precautions to be taken. The mixture is inclined to BUMP when strongly heated, but a few pieces of broken tobacco pipe shank prevent it. Care must be taken that when the lamp is removed and the gas ceases to pass, none of the solution is sucked back into the bulb; it is very easily prevented. A very strong heat should not be applied, as then distillations would commence and the product condense in the tube.

National Exhibitions.

The years 1880 and 1881 will both be marked by two national exhibitions—the one at Brussels, the other at St. Petersburg. The preparations for the Brussels Exhibition, which will be opened next May, are in a very forward state, and the building will be handed over by the contractors before the end of December. The total space at disposal is 66,000 square meters, one half of which will be devoted to the arts and industries of the past, the other half to modern industrial arts and sciences. All the Belgian industries will be fully represented, including those of agriculture and horticulture, and there will be an additional space of 16,000 square meters set aside for a show of live stock. The Exhibition will be fourteen times as large as the one of 1874 held in the Halles Centrales. The Russian Exhibition is also proceeding rapidly, as far as the building is concerned, and the ironwork is being made at the St. Petersburg foundry.

Changes in the Appearance of Jupiter.

Writing with reference to the strange belt on Jupiter, in a communication dated September 28, Mr. J. A. Brashear, of Pittsburg, Pa., says:

"I first saw it at 2:45 A.M. on the 26th of June. A nine inch silvered glass Newtonian telescope was used in this observation. The belts on the equator were of a beautiful pinkish brown color. The broken belt noticed by your correspondent was so vivid and clear that it reminded me of a coke fire seen on a dark night. It made such an impression on my mind that I at once made a sketch of it, which has been of great value in subsequent observations. In referring to my note book I find I have eight drawings of the planet since the above date. Comparing the last drawing with previous ones, I am led to believe that the spot has slowly diminished in size, though not in general outline. Another and still more strange phenomenon has occurred, and to this I should like to call the special attention of observers. In my drawings I have located the white spots plainly visible between the equatorial belts, and by comparing the consecutive sketches I find that either the spots or the red belt has shifted in reference to one another about one-fourth the length of the red belt.

"Any one who has read Camille Flammarion's interesting article on Jupiter in the last number of your SUPPLEMENT, will see that this shifting of the spots is no new thing, but the question is, Which belt or spot has shifted? I am inclined to think, with my esteemed friend, Mr. F. W. Very, assistant to Prof. Langley at the Alleghany Observatory, that it may be some terrific action is going on in a local spot beneath the red belt which has dissipated or torn away the vaporous envelope of the planet over the place of local disturbance, and we possibly see the *actual surface of the planet* beneath or through the rift in the vaporous envelope. If this conjecture be true, then it is more than likely that the shifting has been in the white spots beneath the equatorial belts, as the local action which gives us the red belt would hardly be of a shifting character. I have used 6·5 inch, 9 inch, and 12 inch aperture silvered glass telescopes, and 4 inch and 13 inch achromatics, at different times of observation, and have had some exquisite views of this marvelous planet and its attendant panoramic phenomena."

A FUNGOID GROWTH—THE CAUSE OF WHOOPING COUGH.*

(*Tussio Convulsiva, Pertussis.*)

BY HENRY A. MOTT, JR., PH.D., E.M.

The idea has prevailed, and in fact is still prevalent now to a very great extent, that whooping cough must run its course, or that it has a definite limit; and if the cough is broken up it would be much worse for the child, for it would be laying the foundation for some fearful disease in the child's system. To this conclusion, I fully believe, can be attributed much of the mortality among children. The deaths from whooping cough, according to Condie, are 1 to 82 of the entire mortality in Boston, 1 to 46 in Charleston, 1 to 95 in Baltimore, 1 to 63 in Philadelphia, and 1 to 64 in New York.

When we consider such figures as these, surely any effort made to discover the cause of this terrible disease, and to point out the proper line of treatment, should be met with a hearty reception. Much diversity of opinion has existed in regard to the pathology of whooping cough. Fortunately, however, owing to the investigations of Dr. Letzerich, of Germany, in 1871, and the confirmation of his results by myself, our knowledge of this disease has been greatly enhanced. Condie says: "A majority of the most authoritative writers refer it to bronchial inflammation, which, by few, is considered to be of a specific character. By some, however, who have written very ably upon the disease, the bronchial affection is viewed as a mere concomitant, or effect of the whooping cough; and not in any degree essential to its existence. Most of the writers refer it either to disease of the pneumogastric or phrenic nerve, or to disease of the brain affecting the origin of the respiratory nerves; while others consider cerebral irritation to be secondary to the bronchial disease, and oftener absent.

"That the essential symptoms of whooping cough are the result of a spasmodic closure of the glottis there can be but little doubt, but whether this is owing to an irritation seated in the larynx or trachea, or in the brain, it is difficult to determine." In pathology so uncertain as this, how are the proper remedies to be selected? Are they to be addressed to the brain, the origin of the nerves, or to the larynx or trachea?

The question having only recently been answered, among the former remedies are found purgatives, astringents, emetics, expectorants, narcotics, vesicants, tonics, depletants, antispasmodics, caustics, revulsents, antiperiodics, ablutions, etc. As Dr. J. O. Hamilton, in his able article* on whooping cough, remarks: "How can we imagine such a hydra-headed disease, requiring such fearful instruments for its decapitation?" From the above it is certain that Dr. R. Dugleson, in his work on disease of children,† stated the truth when he said, "But little is known of the cause of whooping cough."

As stated before, in 1871 Dr. Ludwig Letzerich commenced a series of microscopical investigations as to the real cause of whooping cough, and his original investigations are to be found in full in Virchow's *Archiv*, vol. 49, p. 530.

* Read before the New York Academy of Sciences, November 24, 1879.

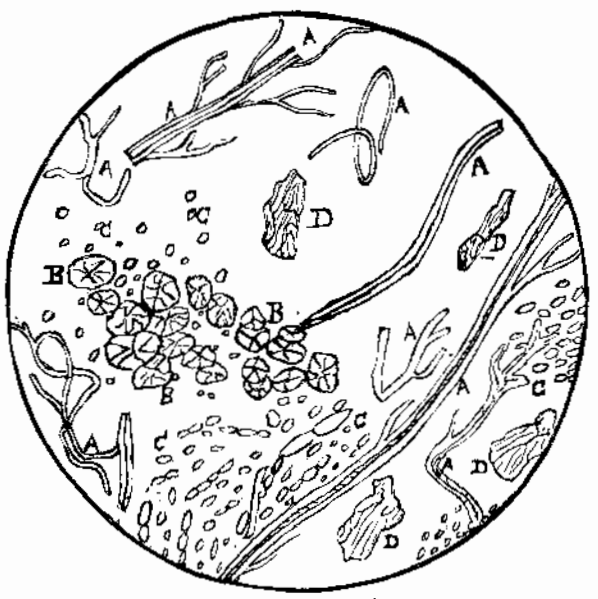
† Illinois State Med. Soc. Rep., p. 48, 1875.

‡ Page 299.

Letzerich showed, for the first time, that if the expectorated mucus whooped up during the short duration of the first catarrhal-like stage of the disease, be examined under the microscope, there will be seen, besides the portion of phlegm, etc., etc., small elliptically-shaped brownish-red fungus spores, some of which have partially germinated and brought into existence mycelium. This discovery gave a clew at once to the cause of pertussis, and opened a new channel for its treatment.

As the editor of the *Quarterly Journal of Microscopy* stated that this observation of Letzerich had not as yet been confirmed by any other investigator, and having an opportunity offered to study the disease in my own children, I concluded to do so, and after a careful microscopical investigation of the phlegm whooped up at various stages in the development of the disease, I can now state that in the main my investigations confirm those of Letzerich.

The following is an illustration of the fungus spores and the mycelium. Of course no one slide gave the field here presented, but it is the result of the examination of a very



large number. A represents the mycelium; B, cells thrown off from the epithelium; and C the fungus spores, which exist in great numbers; D represents a film of epithelium from the under surface of the epiglottis. Letzerich represents the fungus spores when developed as brownish-red. These I did not detect.

The ripe spores of whooping cough differ from those of diphtheria in not being circular, and in not showing any finger-like protuberances. The growth of the mycelium in the masses of phlegm goes on very rapidly, and the threads acquire considerable length, especially when the disease is at its height. The expectorated mucus is also very thick at this stage, and on drying becomes of a glassy appearance, although quite tenacious. In these latter stages the mycelium are very plentiful, and there is an energetic formation of spores. If the fresh spores are treated with iodine and concentrated sulphuric acid, the mycelium are colored beautifully blue, and the unripe spores, which are white, now appear brown. To show how this theory was received by Dr. Hamilton, who made such a careful investigation of all theories, I will quote what he says: "The only theory that seems to me tenable, and I think the success of certain remedies bear it out, is that whooping cough is the direct result of a fungous growth; that the spores are thrown off by the individual coughing, and are received by another in the saliva of the mouth, which retains them until they have time to attach themselves to the underside of the tongue, where the mucous membrane is the thinnest and softest of any part of the mouth, and at the same time are not so liable to be dislodged by drink or food. In this situation they remain until they are able to germinate and spread along the sides of the tongue and backward until they reach the larynx and pharynx, when the full whoop is established. Elevations or lumps can very plainly be seen under the tongue before the patient begins the whooping, but the catarrhal symptoms at this time are quite prominent; discharges from the nose, suffused eyes, headache, some fever, and general lassitude. The time of incubation is from nine to fifteen days, though varying in the different subjects. These elevations on either side of the frænum linguæ are small, and might escape observation unless carefully sought for, as it is quite difficult to induce the young subject to turn the point of the tongue up long enough to make proper observations."

Letzerich made numerous experiments on rabbits with the spores from whooping cough. The spores were cultivated on pieces of bread soaked in milk, and then introduced into the trachea of young rabbits for future development. This was affected by tracheotomy, but the animals rapidly recovered from the effects of the operation, and in a short time became affected with a cough—the same as whooping cough. The rabbits were killed, and their air passages and lungs were found to contain enormous quantities of fungus; the expectorated mucus was also the same as in man.

From Letzerich's valuable investigations he was able to show the difference between the action of fungus in diphtheria and that in whooping cough. He says: "Disease produced by the vegetation of fungi in the epithelium stratum of the respiratory organs are of two kinds. 1 *Diphtheria:* The vegetation of the fungus originates at the head of the windpipe and trachea, seizes and destroys the epithelium with startling rapidity. 2. *Whooping Cough:* The fungus germinates in the epithelium web; at first in the upper part, and then over the whole respiratory organs, without destroying the web, produces whooping cough and its manifest complications. If the growth of the fungus is confined to the epithelium of the epiglottis, of the larynx, and trachea, then it is simply whooping cough; but if the fungus enters into the delicate bronchial tubes and the cavities of the lungs, then the dreaded complications arise."

It is therefore best to meet the disease in its earliest stages and treat it properly; that is, with an object to kill the fungus and prevent its further development; and then we shall seldom have the complications of bronchitis, cholera infantum, or cerebral difficulties to contend with.

What, then, shall be the proper remedy? Quinine has been used for a long time with excellent results, but its use was not founded on the fact that it kills fungus plants. It was not so used until 1869, when Professor Binz made numerous experiments to show that it would check very markedly the alcoholic fermentation in various fluids; and that the antiseptic action was due to the poisonous influence of the drug upon the fungi, which are the cause of such fermentations. According to his experiments the largest infusoria are killed by a solution of quinine of the strength of 1 in 800 immediately, and upon the ordinary mould penicillium, upon vibrios and bacteria the drug acts with a similar fatality.* In the latter part of 1870 Prof. Binz, and later in the same year Breidenbach, published articles on the beneficial action of quinine in the convulsive stage of pertussis.

Their application of this drug indicated that they thought pertussis was due to the growth of fungi; but still this had never been demonstrated until Letzerich undertook the investigation. In 1871 Steffin confirmed in the main the accuracy of the observations of the savants mentioned above, and two years later Dr. B. F. Dawson reported eighteen cases in a valuable pamphlet, and advocated strongly the value of quinine in curing the whooping in this disease. Since then the use of quinine has been ably defended by Dr. Hamilton, of Jerseyville, Ill., and by Dr. Charles W. Earle, of Chicago. My experiments lead me to the same conclusion, as after administering quinine to my children, and in fact to numerous other children, they all speedily recovered, not whooping more than once a day after the second day it was given them, and discontinuing to whoop entirely by the end of the fifth to sixth day. The time could be made much shorter if children could be induced to take it in a powder directly on their tongue and let it dissolve slowly; but owing to its extremely bitter taste they object. So I found by dissolving the quinine in "gum"—that is to say, sugar and water—they soon became accustomed to the taste and craved for it, as as it afforded them relief.

The best time to administer it is just after a coughing spell and just before retiring at night. As regards the size of the dose, this should depend on the age and severity of the case. To a grown person, from three to five grains of powdered quinine can be put right on the tongue and allowed to dissolve itself. To a child from two to five grains may be dissolved in two ounces of gum (sugar and water), and one teaspoonful can be given as stated above. The gum helps to keep it in contact with the parts longer. Quinine administered in gelatine or sugar-coated pills is of no use whatever.

* Virchow's *Archiv*, 1869, p. 68. Wood's Therapeutics, Materia Med. and Toxicol., p. 62.

Sound Waves.

C. Decharme has extended the investigation of nodal systems, and drawn some interesting comparisons with the earlier researches of Chladni, who indicated three systems of nodal lines: the diametral, the concentric, and the compound. He substitutes a thin layer of water or some similar liquid for the sand which Chladni employed, and finds many interesting relations among the peripheral and eccentric networks, the number of sonorous vibrations, the breadths of the striæ, the areas of the internodal sectors, and the numbers of nodal divisions. By means of these equations it becomes easy to estimate the wave lengths of different sounds.

K. H. Schellbach and E. E. Boehn have experimented with waves of sound, in illustration of the wave theory of light. Connecting two Leyden jars with the conductors of a Holtz electrical machine, so as to produce sparks of 1 centimeter (0·39 inch) between the balls of the discharger, concentric rings were formed in coal dust sprinkled on a glass plate 4 centimeters (1·57 inch) from the balls. The longer the spark the more strongly marked were the rings. By reflecting the reports of the discharges, by means of parallel walls and mirrors of various kinds, the dust waves were made to assume such forms as are theoretically deducible from the reflection and refraction of light, thus visibly confirming the views of Huyghens and Young. That the results are not modified in any way by mere electrical action can be readily shown by substituting explosive gas or powder for the sparks. From ten to twenty sparks or explosions were generally sufficient to show the character of the waves and of their nodal intersections.—*Ann. d. Phys. und Chem.*