THE

PHILOSOPHY OF SOUND.

THE ECHO OF LURLEY

ON THE RHINE

THE

PHILOSOPHY OF SOUND

AND

MUSICAL COMPOSITION.

by

W. M. Higgins, F. C. A.

AUTHOR OF THE "EARTH" AND OTHER

POPULAR WORKS

LONDON:

PUBLISHED BY [illegible] S. ORR & Co. [illegible]

MDCCCXXXVIII

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PHILOSOPHY OF SOUND,

AND

HISTORY OF MUSIC.

BY

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LONDON:
WM. S. ORR AND CO., AMEN CORNER,
PATERNOSTER ROW.

MDCCCXXXVIII.

LONDON:
BRADBURY AND EVANS, PRINTERS,
WHITEFRIARS.

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INTRODUCTORY CHAPTER.

Although the art of playing on musical instruments has become so general, in this country, that the education of a female is esteemed imperfect if she be not a tolerable performer, the science of music seldom becomes an object of study. There are many persons who, from constant practice, are able to make the meanest and least perfect instruments "discourse most eloquent music," and yet cannot account for the production of a single sound, much less for the spirit-stirring harmony. When we consider the great interest which has been felt by all classes of society, during the last few years, in philosophical researches, we cannot attribute this ignorance of the philosophy of sound and the principles of music to any distaste for such inquiries. An effort has been made to inculcate the necessity of studying the styles of the more celebrated composers, and a better taste has been thus already created. An equal amount of importance will soon, we think, be attributed to the science; a know-

ledge of music should be based upon its philosophical principles; and in those instances where the teacher has failed to adopt this system, the want of a sufficient guide would probably be urged as the only reason for a course which every one would deprecate. So far as our knowledge extends, there is not a single work in the language which pretends to teach the doctrine of sound in connexion with the principles of music, in a manner calculated to assist the student. If this book should not be so extensive or perfect as many persons may wish, it will, we hope, do much to remove those difficulties which have so long prevented the study of the subjects it attempts to explain.

The time that is judiciously expended in acquiring the art of playing upon musical instruments, and in studying the principles of harmony, is by no means ill spent. There are many persons who affect to despise both the art and the science, and speak of them as pursuits only suited to inferior minds. It sometimes happens, that from an inordinate regard for the personal gratification derived from music, the mind is left uncultivated, and the ear is the only organ of communication; and that becomes so limited in its use as to convey those impressions calculated to please with far more facility than those which instruct.

There have been in this and in other countries many justly celebrated musical performers who have had scarcely any claim upon the attentions of polite, not to say educated, society, except for their skill in giving sound to a wild imagination. It is said of one of the greatest literary characters of this country, that he was once importuned by a young nobleman to listen to his performance on the flute. The

youth played well, and expected praise; but received a rebuke for the waste of much time that ought to have been devoted to the improvement of his own mind, and in the service of his country. This has sometimes been used as an argument against the study of music as an art; but it was not the intention of the moralist to object to the study in all cases as a useless expenditure of time, but a misappropriation of skill in one instance. We do not hesitate to say, that we can perceive no difference between the fame of a man who is nothing more than a skilful musician and one who is an expeditious conjuror; and we should prefer that of an ingenious blacksmith to either. But when we consider the proud honour of the musical composer, ranked in all ages with the poet, we discover that music is more than an art; it demands the aid of the imagination as well as the fingers.

How vast and unbounded are the pleasures derived from music! All the passions are under its control. Now it wakens the latent courage in the breast of the soldier; and now administers to the pensive sorrow of the weeping mother; at one moment it inspires the soul with sublime and hallowed awe, and at the next gives life to unbounded mirth. It is suited to stimulate the feeling of devotion, and to increase the boisterous pleasures of a village harvest-home. We listen with equal delight, but with different sensibilities, to the rich and overpowering strains of the organ, and the soft luxuriant tone of the flute. In all its variety of intensity, time, and style, it pleases; for it is harmony still, and leads the mind a willing captive to its power.

Music is also suited to please all the varieties of the human mind. The illiterate and the learned, the thoughtless and the giddy, the phlegmatic and the sanguine, all confess themselves to be its votaries. It is a source of the purest mental enjoyment, and may be obtained by all. A cultivated taste in this instance, as in all others, increases both our pleasures and our pain. The strains which gratify what is called the vulgar ear, are sources of painful disgust to him who has acquired a practical acquaintance with the noblest efforts of genius. But it is the best evidence of the universal character of music, that it is suited to all classes, and never ceases to please. These remarks will probably call to the reader's remembrance Shakspeare's celebrated lines.

> Nought is so stockish, hard, and full of rage,
> But music for the time doth change his nature:
> The man that hath no music in himself,
> Nor is not moved with concord of sweet sounds,
> Is fit for treasons, stratagems, and spoils,
> The motions of his spirit are as dull as night,
> And his affections dark as Erebus:
> Let no such man be trusted.

The power of music over the feelings of mankind is universally acknowledged. Wearied with the oppression of the noonday sun, and exhausted with labour, the husbandman sits beneath the shade of his native oak, and sings the songs he heard in infancy; amid the rugged heights of the Alps, the peasant girl chants the spirit-stirring songs of her ancestors; the man of business, the man of letters, and the statesman, wearied with exertion of mind and burden of care, seek relief round the family hearth, and forget awhile ambi-

tion and fears, under the influence of music; and the broken-hearted wanderer sings the songs he heard at home—

> Whilst recollections sad but sweet,
> Arise and disappear.

If such be the enjoyments derived from music, it must be a subject in every respect worthy our regard; but although appreciated by all, it is known to few; and its practice, in the higher branches, is confined to a very small number. That man's powers of mind deserve our highest regard, who can place sounds in such an order, and so unite harmonies, as to excite at will the souls of his hearers. And yet how inefficient is man at best, for how few of those who can rouse into action the varied powers of mind, can control their own! What poor expedients have been tried to bring into action that excitement, the result of which so much delights the hearer! It is a painful thing to watch the imbecility of genius. Haydn, the solemn and majestic Haydn, never felt the inspiration if he did not wear the ring presented to him by Frederick the Second. Cherubini was generally roused by the mirth of his friends; and if this should fail, by drawing caricatures on a pack of cards. Gluck wrote his "Iphigenias" and "Orpheus" in a meadow with a bottle of champagne by his side. Zingarelli read the classics previous to dictation. Sacchini sought the society of his cats; and Sarti shut himself in a large room dimly lighted by one solitary lamp hanging from the ceiling.

Musical composition may be divided into two classes, scientific and imaginative. In making this distinction, it is not intended to assert, that any composition can be entirely either one or the other. Many imitations are almost strictly

scientific, but they cannot perhaps have been penned without the aid of imagination, though evidently of so low an order as to be unworthy of the name. It is perhaps difficult in many instances to say, whether a composition belongs to one class or the other, the science and the imagination are so well balanced, and are both so far below praise. The music of Moscheles and Pixis is strictly scientific, almost mathematical. Beethoven, Handel, Mozart, Haydn, and Weber, were imaginative writers, yet possessed of so much scientific knowledge, that had they evinced less genius they must have taken rank with the inferior class.

The high estimation we have formed of what is required from a professor of music, and what ought to be sought after by a student, may, perhaps, lead us to place before our readers, in the estimation of some, too high a standard of excellence. There is, however, an advantage in this, for although it is quite possible for him who aims low, to shoot his arrow beneath the mark ; the chances are, that he who aims higher will be nearer the prize. The highest honours should be the objects of ambition, and if they should not be obtained, the energy which prompted and directed the effort will find a satisfactory reward.

CHAPTER I.

THE PRODUCTION OF SOUND.

The word sound may be used to signify either that sensation which, under certain circumstances, is experienced by organised creatures, or the means by which such sensation is caused. Thus, we speak of the velocity with which sound travels, and the distance at which it may be heard, evidently having reference to that particular physical condition affecting the organ of hearing. At other times the word is used in another sense; thus we say it is a pleasant sound, meaning to express the sensation produced. It is scarcely possible to avoid, in such a work as this, the use of the term in both its applications; but there can be no doubt at any time in the mind of a reader as to the meaning to be attached to it, for that may always be determined from the connexion in which it is used. It will, however, be better, where it can be done without sacrificing the perspicuity of style, so necessary in works intended to teach the elements of philosophy, to distinguish, by the use of a phrase, the difference between sound and the sensation produced by it, as we have done in the title of this chapter.

Without entering into any metaphysical inquiries as to the nature of a sensation, and admitting it to be an impression produced upon the mind through the agency of one or more

of the organs of sense, we shall at once proceed to illustrate the manner in which a sensation of sound may be produced. For this effect three things are required; a sounding body, a conducting medium, and an organ of hearing; and of these we shall speak separately.

I.—SOUNDING BODIES.

If we examine any substance at a time when it is said to be sounding, we shall find it to be in a state of vibration. The vibrations of a sounding-string may be seen; and in those instances where the vibrations of a body cannot be seen, they may be felt. A bell or a glass vessel, when struck, is put into a state of vibration, and if during the period that this continues it be touched with the finger, the vibration will be felt, and the sound will be deadened or stifled.

If a wire or cord be stretched between two fixed points, as in the harp or violin, and be then pulled with the finger or touched with a bow, it will be drawn from its position, and for a certain number of times will vibrate backwards and forwards. During the time of vibration some one sound will be given out, and it may be made continuous by keeping up the motion. The pitch of the sound will be regulated by the number of vibrations, as will be proved in a subsequent chapter. All that is necessary for us to state at present is, that, every condition remaining unchanged, the same sound will always be produced. A bell will give out the same tone so long as its temperature remains without any considerable alteration. A stretched cord also will give the same note for any length of time, if the weights upon it be continued,

and if its uniformity of structure does not suffer from stretching. In the case of vibrating strings, the same length and tension are not the only conditions required for the production of the same note, for the size and density have a considerable influence. So in bars, rods, plates, and other vibrating solids, the density of the material of which they are formed must be estimated. A perfect uniformity of structure is not less necessary, as must be known from the broken and discordant sound produced by a cracked glass or bell.

II.—THE CONDUCTING MEDIUM.

We come now to a consideration of the conducting medium. That there must be some medium of communication between the sounding body and organ of hearing, is evident, from the fact, that we have no sensation of sound by the vibration of a plate or bell in a vacuum, though the sound is quite audible when struck in the atmosphere.

CONDUCTING POWER OF AIR AND THE GASES.

Air is the common conductor of sound, but not the only one ; for it has been proved by experiment that liquids and solids perform the same office, as well as many gases, in various degrees. The conducting power of the atmosphere changes with its density, and the same is, in all probability, true in relation to the other gases. Travellers have stated that on high mountains sounds are much less intense than at those elevations above the sea where human habitations are commonly fixed. This may, however, be proved without entering upon the perilous task of crossing the elevated passes

of the Himalaya or other mountains ; for if any body, which can be kept in a state of vibration, be placed under the receiver of a pump, and the air be gradually exhausted, the intensity of the sound will be proportionately diminished, and at last cease to affect the ear.

"The height to which an atmosphere, or medium," says Sir John Herschel, "capable of conveying sound extends, far exceeds any attainable on mountains, by balloons, or even by the lightest clouds. The great meteor of 1783 produced a distinct rumbling sound, although its height above the earth's surface was full fifty miles at the time of its explosion. The sound produced by the explosion of the meteor of 1719, at an elevation of at least sixty-nine miles, was heard as 'the report of a very great cannon or broadside,' shook the doors and windows of houses, and threw a looking-glass out of its frame and broke it. These heights are deduced by calculation from observations too unequivocal, and agreeing too well with each other, to allow of doubt. Scarcely less violent was the sound caused by the bursting of the meteor of July 17th, 1771, near Paris ; the height of which at the moment of the explosion is assigned by Le Loy at 20,598 toises, or about twenty-five miles. The report of a meteor, in 1756, threw down several chimneys at Aix in Provence, and was taken for an earthquake. These instances, and others which might be adduced, are sufficient to show that sound can be excited in, and conveyed by, air of an almost inconceivable tenuity, provided the exciting cause be sufficiently powerful and extensive, neither of which qualities can be regarded as deficient in the case of fire-balls such as those of 1719 and 1783, the latter of which was half a mile in diameter, and moved at the

rate of twenty miles in a second. It may, however, be contended, and not without some probability, that at these enormous heights sound may owe its propagation to some other medium more rare and elastic than air, and extending beyond the limits of the atmosphere of air and vapour."

We have introduced this quotation from Sir John Herschel's paper on sound, in the Encyclopedia Metropolitana, not because it would have been difficult or troublesome to have collected the same and many other similar examples from the philosophical journals, but for the purpose of directing the attention of the reader to that able treatise, and to give ourselves an opportunity of acknowledging the assistance we have derived from it. Those who are anxious to extend their inquiries beyond the limits which we are compelled to draw in an elementary treatise, may consult it with the confidence that they have availed themselves of the best guide which the literature of England can offer. This tribute of honour we owe to the truly illustrious philosopher; and if we had been speaking of his Essay on Light, we should have said it is the best philosophical article in any language, remarkable for the elegance and purity of its style, the simplicity of its demonstrations, the eloquence of its deductions; it is, in fact, a perfect exposition of the state of the science at the time when it was written, and should be the model of all future teachers.

We come now to inquire into the conducting power of gases. It has been maintained, with what truth we shall see in the following pages, that the intensity of sounds varies with the density of the gases which transmit them. Dr. Priestley made some experiments on this subject, and informs us that a

bell put into vibration in hydrogen gas was scarcely more audible than in a vacuum; and that in carbonic acid and oxygen it was louder than in common atmospheric air. Perolle says, that a sound which was heard in atmospheric air at a distance of fifty-six feet, was not audible at a distance of more than forty-eight in carbonic acid gas, eleven in hydrogen, and sixty-three in oxygen and nitrous gas. From these statements it is evident that Priestley and Perolle did not obtain the same results.

In the Cambridge Philosophical Transactions (vol. i., p. 267), Mr. Leslie has given an account of some experiments he made on the conducting power of gases, and they are by far the most important yet brought before our attention. He proved in these observations the truth of Priestley's results in reference to hydrogen. Having exhausted the air from a receiver, he filled it with that gas, and the audibility of sound was scarcely increased. On another occasion, he took a portion of air from a receiver, and admitted hydrogen. In the mixed gases the intensity of sound was instantly diminished, the bell being scarcely heard. This is a result which could not have been anticipated from our knowledge of the conduction of sound in other instances, and the physical constitution of the atmosphere, which is, in fact, a mixed gas.

Upon these experiments Sir John Herschel makes the following remarks: "It is much to be regretted that the circumstances are not more fully stated; the pitch of the bell in air, in the mixed gases, and in hydrogen alone: the dimensions of the receiver; the distances at which the sounds ceased to be heard; and whether the same effect took place when bells of different pitch were struck, and when the bell was muffled

so as to produce no musical sound,—are all particulars of essential consequence, to enable us to form a judgment of what really took place in this interesting experiment."

The lamented death of Professor Leslie before he had an opportunity of repeating his experiments with attention to the circumstances suggested in the previous remarks, induced the author to commence the task with great care, and the results already obtained are such as to repay the labour they have cost. We shall not anticipate the details which will, at no very distant period, be communicated to some philosophical journal, as the observations are not at present complete.

In all experiments upon the conduction of sound, it is absolutely necessary that the substance, whose office it is to carry the sound, should be homogeneous. If it be at one place more dense than another, the sound may be retarded at one instant, and have an increased velocity at another. Thus in uniting media of different densities, sound is stifled. Take a tumbler and touch it on the edge with a spoon, and it gives out a clear distinct sound. Now it must be remembered that the tumbler is not empty, it is filled with air. To exclude the air fill it with water, and still a clear tone will be produced. Then place successively in the water a little carbonate of soda, and tartaric acid, and an effervescing liquid will be obtained. The water is, for a few minutes, intermixed with a large quantity of gas, and a medium of unequal density is formed. The particles of gas and of water are blended together, and a sound attempting to pass from one part of the mixture to another is impeded, and loses its clearness of tone. That this is the effect may be proved by touching the edge of the glass as before, and a dull heavy tone will be heard instead of that

clear, sonorous musical note given out when the vessel was full of air.

This experiment has been introduced to explain the reason why sounds are more distinctly heard during the night than by day. That the clearness and intensity of sounds are increased during the night is known to every one. It may be partly attributed to the repose of the animal creation, but this is not sufficient to account for the fact. In a retired country resort the only sounds that strike the ear in the busiest hours of day, are the lowing of oxen, the bleating of sheep, the merry songs of birds, the indifferent whistle of the ploughman, and sometimes the pleasing peel of bells. But with what a freshness does the last burst upon the ear when heard at evening when the sun has sunk to rest! Humboldt says that he was particularly struck with the greatly increased intensity of sound during the night, when he heard the noise of the great cataracts of the Oroonoko in the plain which surrounds the mission of Apures. It is, he says, three times greater at night than at day, although the noises arising from animals are more numerous and louder at that time. There must then be a reason for the greater intensity of sound at night, altogether independent of the influence of animal life. During the day the temperature of the atmosphere is not uniform. The stratum in immediate contact with the earth is heated both by radiation and conduction, and consequently has a higher temperature than the strata above it. The effect of heat upon all gases is known to be expansion, and therefore they must become bulk for bulk lighter. As soon then as the air in contact with the earth is heated it rises, and that which is above descends into its place, and this also suffers the same

change. Currents of different densities are constantly ascending and descending, so that during the day the sound is not so well conducted as at night, when the temperature of the atmosphere becomes more uniform. In dense fogs, and in snow-storms, sounds are badly conducted, for the same reason. The effect of carpets, woollens of all kinds, and furs, in deadening sound, arises from the same cause. The openness of texture allows the intermixture of air with the fibre, and this is quite sufficient to account for the singular effect. The alteration of conducting power produced by the admixture of gases of different kinds has not yet been determined; but from what has been already stated, we may perceive that in the constitution of the atmosphere, the power of conducting sound must have been ordained by the Creator.

CONDUCTING POWER OF LIQUIDS.

Many liquids have the property of conducting sound as well as gases and vapours. Water, which is always considered as the type of the class to which it belongs, evidently has a conducting power. Divers inform us that they are sensible of sounds when at great depths beneath the surface of water, and not only of those sounds which are created in that medium, but also of those produced in air. In the latter case they are less distinct, as might be supposed. Dr. Franklin made a familiar experiment, which may be easily repeated, to determine whether sound can be conducted by water. An assistant was stationed about half a mile from the Doctor, and made to strike two stones together under the surface; the sound was distinctly heard by the latter, when the head was

plunged into the same medium. Anderon's experiments on this subject are the most interesting with which we are acquainted. On one occasion he caused three persons to dive, and remain at a depth of about two feet below the surface; during which time he spoke to them as loud as he was able, and they heard him, but thought that he spoke very low. At another time he engaged a diver to descend with a bell in his hand, and the sound was distinctly heard in the water. These facts are sufficient to prove the conducting power of one liquid, and all others probably possess the same property.

CONDUCTING POWER OF SOLIDS.

Elastic solids are found to be better conductors of sound than liquids. It is well known the ticking of a watch may be distinctly heard at the end of a long piece of timber, opposite to that at which the watch is placed. If, however, instead of the watch, an assistant tap with the head of a pin, and so gently as not to be even heard by himself, it will be quite audible to the person who applies his ear at the opposite end. A still more interesting experiment, mentioned by Chladni, may be made in proof of the ready conducting power of elastic solids. Suspend a piece of metallic wire, about 600 feet long, in an horizontal position, and attach to one end a metal plate which when struck will give out a clear tone. If the opposite end of the wire be taken between the teeth, and an assistant then strike the plate, the sound will be immediately conducted by the wire, and more slowly by the air; the sound as conducted by the metal is immediately heard, while that transmitted by the air follows.

THE CONDITION OF SOUNDING AND CONDUCTING BODIES.

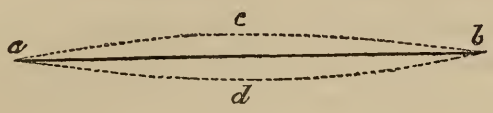
Although the conductors of sound are extremely various in their physical constitution, being either solids, liquids, or gases, they must possess some common properties to which the power of transmitting sound may be attributed. When a tense string is touched, or a bell is rung, a tremulous motion is produced through the mass of the substance. This is evidently occasioned by a limited displacement of particles. Let us take as simple a case as we can. Imagine a string to be a single row of indivisible particles, or, as they are sometimes called, molecules. The union between them is produced and maintained by that attractive power denominated the force of cohesion. Within a certain limit, the close connexion between these particles may be disturbed without being destroyed. Let us for example examine this fact in reference to any two of the chain of molecules. The cohesive force binds them together, but some external force stronger than the cohesive may turn them from the line of direction, and yet not so far as to prevent the cohesive force from bringing them back to their original position, when the external agency is removed. Two magnets suspended near to each other will soon arrange themselves by magnetic attraction—the north pole of the one being directed to the south pole of the other. Remove either of these poles from the right line in which it is placed, and the other will be also disturbed ; but as soon as the external force is taken away, the magnetic attraction acts without control, and after a few vibrations backwards and forwards, the poles come to precisely the same position they occupied before dis-

turbance. It is just so with the particles of a sounding body. The particles of all substances are not equally capable of disturbance, and for this reason they are not all equally good sounding bodies. The power of receiving an alteration of form, and of afterwards returning to the original condition, is called elasticity, and this property is essential to the production of sound. We may, however, be told that all elastic substances are not sonorous, and to meet this objection fully would occupy more space than ought to be given to such a subject in an elementary work. One or two remarks, however, will not be out of place.

The elasticity possessed by bodies may be of different kinds; thus, for instance, both dough and indian-rubber have the property, but the effect is very different in the two cases. We may suppose the particles of dough to be elastic, but the sphere of their elasticity is small; and when once drawn beyond it, they suffer permanent displacement. In indian-rubber, on the other hand, the sphere is very large, so that we may draw it out to a great distance without bringing the particles out of the influence of mutual attraction. So again, the ease with which the particles are displaced may vary; a force which would have a great effect upon indian-rubber would have little or none on a piece of metal. These and similar differences should be estimated when considering the reason why one substance is sonorous and another is not.

We must, however, now proceed, upon the fact that a sounding body is in a state of vibration, to illustrate the effect produced upon a fluid-conducting medium, or in other words, the condition of such a medium during the trans-

mission of sound. Every one is acquainted with the appearance produced by the fall of stone into water. Many circular waves are produced, flowing from the centre, and gradually dying away as the distance increases. Now the successive impulses of a vibrating body act in precisely the same manner on any medium in which the vibrations are produced. Let us take the case of a tense string stretched by weights at both ends; for although bells, plates, and solids of other forms, act in the same manner, they would not perhaps afford so simple an illustration. Imagine the string



Vibrating String.

a b, to be drawn out of the straight line to point *c*, and then left at liberty to vibrate to *d*, and from thence to *c* again, and immediately after to come to rest in the line *a b*. The effect of this would be a series of waves in the atmosphere around the string, which would move, to use a common expression, backwards and forwards for a short time, and then die away in the calm uniformity. But instead of this single vibration, we may suppose the string to pass many times from *c* to *d*, and gradually taking a less arc, come to rest by slow and almost imperceptible degrees. If these vibrations be performed in equal times, that is to say, if an equal portion of time be occupied in its successive arrivals on the sides *c* and *d*, a regular series of waves will be produced, and a continuous musical sound will be the result; but if on the other hand the impulses be irregular,

the waves will be so also, and either the sound will be stifled, or a noise must be the result.

The notion which people generally have of a wave is by no means correct, and it will be necessary that we should attach a right meaning to the term before we proceed. "A wave is not," says a celebrated writer, "a progressive, moving body, but an advancing form." This is directly opposed to the common notion. Language is rightly employed when we say that a wave is approaching; but it is erroneous to suppose that the medium on which it is formed has a progressive motion. If we stand on the sea-shore at a time when the surface of the water is agitated, it will appear as if one mass of the liquid was advancing after another, and that we should soon be overwhelmed with the flood. This, however, is but an optical deception. We may perhaps see at no great distance a boat, or a floating fragment of wood or sea-weed; at one moment it is on the top of the wave, and at the next hidden from sight in a valley, and makes no progress towards the shore. If the water were advancing, this would not be the case; it would occupy the summit or depression of a wave, as it might be accidentally placed at first, and move on with the mass, without any vertical motion, towards the shore.

A wave then is a form, and not a thing. It is true that the thing is in motion, but in a direction at right angles to the wave. In a string put into vibration by a bow, we may observe a system of waves, and they are moving in the direction of its length, but the string cannot do so, for it is fastened at both ends; its motion, in fact, is transverse to that of the waves.

If we have succeeded in giving an accurate and definite idea of what is meant by a wave or undulation, the reader who had previously entertained an erroneous opinion, will find many difficulties inseparably connected with his former supposition entirely removed. Should he have confined his attention to the propagation of sound in air, as he must have done, or would not have continued in error, many objections to the theory of undulations would be suggested to his mind. We can imagine an intelligent inquirer failing on this point, and being consequently involved in an ocean of difficulties. The impossibility of conceiving a mass of air in a state of undulation to be projected by every impulse of a sounding body, and to impinge upon the organ of hearing, would induce him at once to resist the theory as in the highest degree absurd. But at this moment he would be met by the recollection that all philosophers had given their assent to the accuracy of the theory of undulations. Thus urged in one direction by the conviction of his mind, and in the other by the authority of great names, he would probably be kept in a state of indecision, and perhaps of indifference. Put this individual in possession of the fact, that a wave is a moving form and not a moving thing, and his objections are instantly removed. He can then perceive that there is nothing difficult of belief in supposing the undulations of the atmosphere to be the means of conducting sound.

III. THE ORGAN OF HEARING.

Having explained the action of a sounding body, and the conducting medium, we will endeavour to describe the anatomical construction of the organ of hearing.

The human ear is a very beautiful and complete arrangement of canals and orifices for the transmission of sound. It is divided by anatomists into two parts, one of which is called the external and the other the internal ear. The former includes all the parts of the organ which are without the membrane commonly known as the tympanum or the drum of the ear, and the latter all those which are within. Mr. Tod in his excellent "Treatise on the Organ of Hearing," a work to which we are indebted for many of the facts to be mentioned in this part of our book, very properly objects to this division as arbitrary and defective, though he adopts it because generally employed in anatomical descriptions. The ear may be, he thinks, separated into three parts—an external, middle, and internal ; and this division is to be preferred, not only because it gives the student a better idea of its construction ; but also from the circumstance that it distinguishes between the several functions for which the ear is in fact constructed.

THE EXTERNAL EAR.

The external ear, or auricle, may be divided into two portions—a large superior, which is called the ala or pinna ; and a small inferior, called the lobus. The auricle is attached to the temporal bone, and is of an irregular oval form, curiously constructed.

The ala, or pinna, is formed of cartilage, and to the several eminences and cavities names have been given by anatomists, such as the helix, antihelix, tragus, antitragus, cavitas innominata, scapha, or fossa navicularis, and the concha ; all of which are represented in the following design.

" The helix (*a*) is the large folded margin, or curved border, which commences at the posterior superior part of the lobus, and from thence ascends and forms the margin or border which surrounds the upper part of the ala, and subsequently descends and terminates anteriorly, nearly opposite to its beginning, in a ridge which divides the cavity called the concha into two unequal chambers.

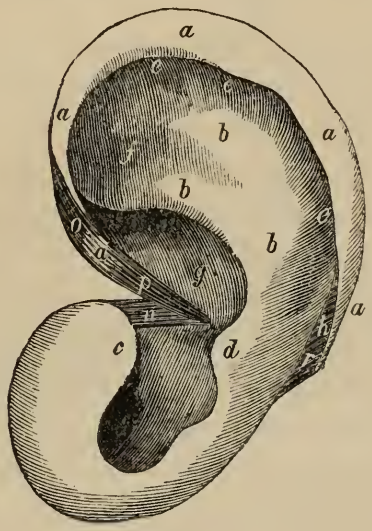


Fig. 2.

" The antihelix (*b*) is the large oblong eminence, which begins near the posterior extremity of the helix, and from thence extends obliquely forwards and upwards, and terminates by dividing into two parts, a superior and an inferior, of which the latter assists in forming the superior part of the brim of the concha.

" The tragus (*c*) is the small eminence situated below the anterior extremity of the helix. In advanced age it is generally covered with hairs.

" The antitragus (*d*) is the small eminence situated a little below the posterior extremity of the antihelix, and opposite to the tragus.

" The cavitas innominata (*e*) is the curved depression which is situated between the helix and antihelix.

" The scapha, or fossa navicularis (*f*), is the small depression between the divisions of the anterior extremity of the antihelix.

" The concha (*g*) is the large cavity which is bounded above by the antihelix, below by the lobus, before by the tragus, and behind by the antitragus. It is divided by the anterior extremity of the helix into a small superior and a large inferior chamber, of which the latter leads to the meatus auditorius externus.

" The lobus is situated at the inferior part of the ala. It is composed of a cellular substance, with a small quantity of fat, and forms the inferior soft part of the auricle.

" On the posterior surface of the auricle we observe a considerable eminence, called the dorsum of the concha."

For this anatomical description we are indebted to Mr. Tod, from whose work also the following account is in part collected. Connected with the concha there is a narrow tube, formed of bone and cartilage, called the meatus auditorius externus, A B of the accompanying figure. It is an oval canal, about three quarters of an inch in length, but differs considerably in diameter at different parts; it is smallest in the middle, and larger at the external than the internal extremity. " It leads," says the author already quoted, " obliquely forwards and inwards, from the inferior chamber of the concha; and in its course proceeds a little upwards, then downwards at its

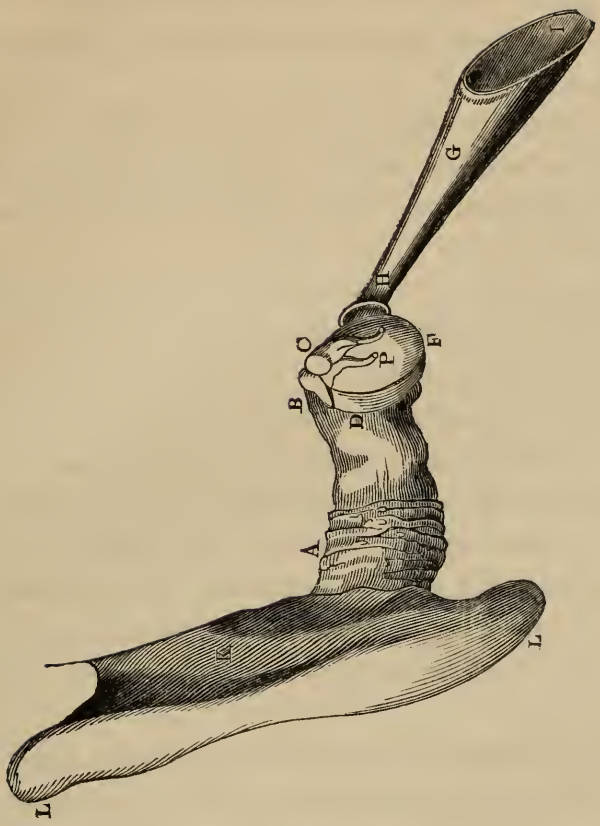


Fig. 3.

internal extremity, and terminates upon the surface of the membrana tympani, F. These curves, however, are very inconsiderable, for the internal extremity of the canal can be easily seen in a clear light, when the auricle is drawn a little backwards. This tube is defended from the injury that might arise from the access of dust and small insects, by fine hairs, and a viscous secretion called cerumen, or wax, produced by a number of small glands, known as the glandulæ ceruminosæ. Another effect resulting from this secretion is the dif-

fusion of a moisture over the tympanum, thereby softening down the sonorous impulses, and rendering the membrane itself more sensible."

The eustachian tube, H G I, is connected with this cavity, and opens into the mouth. Behind the tympanum is a complicated apparatus, B C P, which is shown in detail in figure 4.

The tympanum, F, or drum of the ear, is composed of two nearly circular membranes. In children it is of an oval form. This membrane separates the external and internal ear, and " forms a completely impervous septum ; and from its extremely delicate and sensible texture, tension, concave and convex obliquity, is rendered capable of being stimulated by a very small impulse of sound ; and of being moved, by the muscles of the cavitas tympani, with the utmost facility. It also prevents all extraneous matter, as well as sonorous pulses transmitted by the air, from irritating the cavitas tympani."

Having presented to the reader a condensed anatomical description of the external ear in man, many curious and interesting inquiries immediately suggest themselves to our mind. All animals do not possess an external ear, and the form varies considerably in the several species who are provided with this appendage. The external ear and tympanum is confined to vertebrated animals, and all these do not possess them. Reptiles, fishes, worms, and insects, have neither auricle or meatus ; and in birds the auricle is in the least possibly perfect state. Among this class of animals, however, there is a considerable variety in the degree of development. The carnivorous class have it much larger than the grami-

nivorous; and the birds which seek their prey by night, larger than those which procure it in the day. The last-mentioned fact certainly appears rather singular; for, as it has been already remarked, the sounds are transmitted with greater facility during the night than the day. This may not, however, be sufficient to recompense the animal for the want of light, and a more perfect organ of hearing may consequently have been provided.

The form and position of the external ear, and its capability of motion, vary considerably in different quadrupeds. The ears of rabbits and hares are large, and have a great readiness of motion. They are also so placed as to enable them to hear sounds which are produced behind them. The reason of this is evident; the animals are exposed to many dangers, and have no means of defence. Their chance of safety depends upon the swiftness of feet and the readiness of hearing. Rapacious animals, such as the lion, tiger, and cat, have their ears directed forward, and are not nearly so large in proportion to their bulk or strength as in the hare. The elephant also, a large animal of great physical power and capable of self-defence, has a comparatively small ear. It would appear, then, that the Creator has given such forms and sizes to the ears of animals as are best suited to their habits and characters. To those which have been denied weapons of defence, and are by nature timid, He has given such an acuteness of the senses, as enables them to avoid their enemies by flight or by cunning.

Some writers have maintained, that the external ear of animals is intended as an ornament, and not as a useful or necessary part of the organ of hearing. This opinion has

been supported by the statement that the hearing of the horse or dog is not injured by cropping. No proof, however, can be given of this. That the sense of hearing continues after a portion of the external ear has been removed there is no doubt, but that it is unimpaired we have no evidence. The remarks which have already been made on the external ear will be sufficient to prove, that this opinion is not founded in fact; and although the human ear is incapable of motion like that of other animals, yet it is provided with muscles which, acting upon its several parts, dilate and contract the opening of the meatus, and have some action on the tympanum. That the auricle is of secondary importance in hearing is evident from a variety of circumstances, and not least from its exposure; for we find that in all cases the delicate portions of an organ most important as a medium in producing sensation, are protected. Still it has a purpose in the collection of sounds even in man, who is not able to give it motion. Were it not for the power which some animals have of giving motion to the external ear, "many of the inferior animals would be left without some of their most valuable endowments. The dog, for example, when he loses the scent, but not the sound of his master, would never be able to find him out without this admirable provision. When so situated, we observe that he immediately raises his head, shuts his mouth, erects his auriculæ, and has their concave surfaces directed generally forwards. Then he may be considered as listening with the greatest attention, and in the very best position for that purpose; for by raising his head he becomes enabled to receive the anticipated effect with great facility; by shutting his mouth the anterior auris muscle of each auricle

becomes enabled to dilate the orifice of its corresponding meatus externus to the utmost extent; and by erecting his auriculæ, with their concavities directed forwards, he becomes enabled to collect all the properties of sounds, including of course those which relate to its locality. The same remarks are, with very little exception, applicable to the hare, rabbit, fox, cat, and indeed to every animal which makes extensive use of its auricle*."

The use of the meatus is evident. It is a tube conducting to the tympanum, and must be of importance in regulating the intensity and softening the quality of sounds. The physiology of the membrana tympani will be more appropriately considered after we have explained the anatomical construction of the internal ear.

THE INTERNAL EAR.

Anatomists are accustomed to divide the internal ear into two parts, the tympanum and the labyrinth.

Immediately behind the thin elastic membrane, of which we have already spoken as dividing the external and internal ear, there is an irregular oblong cavity about half an inch in width, called the tympanum. This cavity communicates with the mouth by a small duct, H I (fig. 3), called the eustachian tube. It is bounded externally by the membrana tympani, and internally by an osseous septum separating it from the labyrinth. It was once supposed that deafness would result from the stoppage of the eustachian tube; but from the experiments

* Tod's Anatomy of the Ear, p. 41.

of Dr. Wollaston, which we shall presently have occasion to mention, it is only to sounds of a certain pitch.

The bones of the tympanum form a curious and complicated apparatus. They are usually said to be four in number, and have received names agreeing, it is supposed, with their peculiar forms. S C (fig. 4) is called the malleus, or hammer,

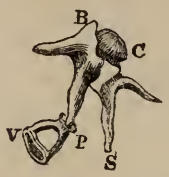


Fig. 4.

which is so placed that its smaller end comes into contact with B P, the incus, or anvil, and V is the stapes, or stirrup, the last two being connected with a small round bone, P, called by anatomists the os orbiculare. There are however, according to the writers on whom we may best depend, but three bones in the human subject, for the os orbiculare is but a process of the incus, though in the horse and other animals it may be distinctly seen as a separate bone. These bones form a chain, and are supposed to communicate the vibrations excited upon the membrane of the tympanum. This, however, is probably not the only use of the curious chain of bones ; for when the tympanum is destroyed, and the whole apparatus consequently hangs loose, hearing is not destroyed.

The septum tympani separates the tympanum and the labyrinth, which is an extraordinary system of canals formed in the bony cavity of the skull.

The labyrinth is divided by anatomists into three parts—the vestibulum, cochlea, and semicircular canals; "and to these may be added an appendix called the aquæductus fallopii." These are represented in fig. 5: *a* is the vesti-

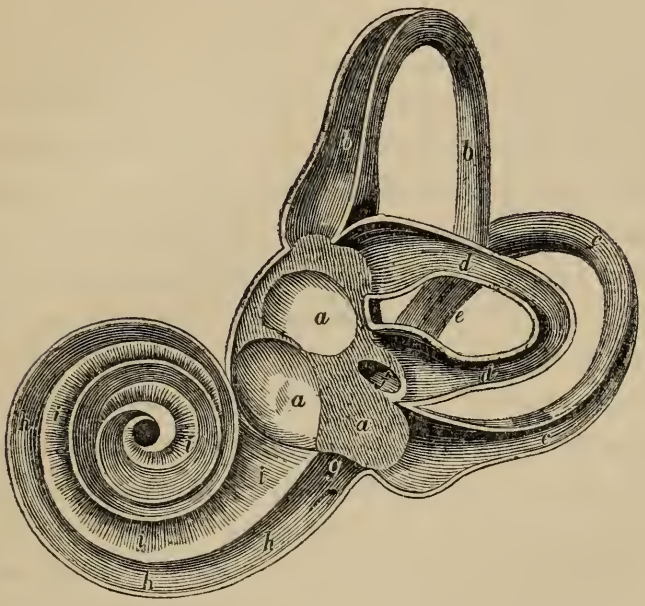


Fig. 5.

bulum, which is of an irregular curvilinear triangular figure, in appearance resembling the body of a common padlock, and about the size of a decorticated grain of barley;" *b b* represents the superior semicircular canals; *c c* the posterior semicircular canals; *d d* the inferior semicircular canals; *e* is the common canal, and *f* its orifice; *g* is the situation of the fenestra rotunda; *h* is the scala tympani; *i* the scala vestibuli; *m* the cupola. The whole cavity of the labyrinth is filled with a fluid into which the branches of the auditory

nerve are brought. This fluid is evidently as important to the organ of hearing as the fluids of the eye are to the production of sight; for if by any means the membrane which encloses the labyrinth should be pierced, and the liquid be allowed to escape, deafness is the necessary result.

The membrana tympani, which, as we have already stated, may be considered as the division between the external and internal ear, has, it cannot be doubted, an important office in the organ of which it forms a part. It is intimately connected with the malleus, and through that bone with all the other parts of the internal apparatus. The form, character, position, and texture, of this membrane have led anatomists and philosophers to suppose, that it receives the vibrations excited by a sounding body, and conveys them to the malleus, and the other smaller bones with which it is connected. It is also a remarkable fact, that the membrane is situated a little oblique in reference to the meatus, but less so in man than in those animals to whom an acuteness of hearing is of importance. The object of this is evidently, that as large a surface as possible should be presented to the action of the vibrating substance, and the extent of surface is proportioned to the wants of the animal. None of the organs are so fully developed in man, that animals cannot be found possessing a more perfect organization. The reason of this is evident: animals are governed by their senses, and according to their acuteness is the fitness of the animal to the circumstances in which he is placed. The physical strength and power of flight possessed by the eagle, would be useless expenditures of divine skill if the bird were not also furnished with a quick and penetrating eye. The defenceless hare, pursued by man and animals, would

be in a state inferior to most other creatures, if it had not a quickness of hearing warning it of approaching danger. But man, the master of all, possesses an improveable reason, by which he is regulated more than by his senses. Yet it is worthy remark, that his senses also are not only capable of, but require exercise, and their acuteness increases in proportion to their use. The child is at first quite unable to judge of distances, and, according to the opinions of some writers, perceives everything inverted ; but the eye that is thus deceived may be destined to watch and reveal the most occult processes of nature. The ear may be alive to none but the most simple sounds, but may afterwards be tuned to the appreciation of the most scientific and intricate music.

There may also be another reason for the oblique position of the membrana tympani ; preventing it "from being injured by the actions which any violent impulses might have produced, and enabling it to respond to the various sounds with great facility."

Allusion has been already made to the office of the small bones called the ossicula auditus ; but as we do not feel at liberty to express an opinion of our own upon questions which require for their determination an extensive acquaintance with anatomy, we may be permitted one other quotation, referring the reader to the work from which it is taken. These bones "are the most delicate and the most perfect osseous structures in the body, and the least susceptible of disease. From their intimate connexion with the membrana tympani and fenestra ovalis, and with each other ; from their zigzag position and their numerous muscles ; from the nature of their articulations ; and from their being under the influence of a

single nerve—the chorda tympani; we cannot doubt that they are capable of being moved in a variety of directions; that their motions are regular, and that these are productive of effects essential to the development of many phenomena appertaining to hearing. When, therefore, an action is produced in the membrana tympani, a certain effect must follow; the whole of the muscular structures of the tympanum must be immediately called into action, and the ossicula auditus drawn into certain positions, each of which must produce a particular effect on the membrane of the fenestra ovalis. Every one of these actions and effects must harmonize with each other, and of course partake of the nature of that action which is produced in the membrana tympani. It is not by the action of any single part or texture of the apparatus tympani, that the effect required by nature for particular ends can be produced, but by the uniform co-operation of all the textures which enter into the composition of this apparatus. Every part must, whilst it possesses its own percipient principle, perform in its turn, its own particular functions, before the required effect can be produced in the membrane of the fenestra ovalis. That these conclusions are just, is obvious, from the situation of the apparatus of the tympanum; from the absence of this apparatus being invariably attended with congenital deafness, and from the absence of the power of hearing during sleep*."

The magnitude and figure of the cavity behind the tympanum are so various, that no one can doubt that they have relation to the acuteness of the organ of hearing. In the

* Tod's Organ of Hearing, p. 47.

dog, cat, hare, and other animals, the cavity is large ; but in what manner the increase of size produces an increased power of hearing, physiologists are unable to determine.

We must now close our account of what has been advanced by others concerning the organ of hearing, by one or two remarks upon the physiology of the labyrinth. The special object of the various parts of the internal ear is but little understood, and particularly of that part to which we now refer. Anatomists do not pretend to assign any particular use to the several parts ; and speaking of the labyrinth as a whole, they can only say that it is intended to assist in some way the sense of hearing. Nature is economical in all her arrangements ; and it is as impossible that there should be any thing superfluous in her works, as that there should be any thing inappropriate. We are ill acquainted with the offices of the several parts of the human ear, but that they are all necessary for the formation of a perfect organ is proved by experiment, and deduced from our knowledge of the universal operations of the God of nature.

CHAPTER II.

VELOCITY OF SOUND.

In the last chapter we attempted to explain the manner in which sound is conducted by fluid media, and the nature of those substances said to be sonorous. Our next object is to determine the velocity of sound.

The velocity with which sounds are propagated must depend upon the nature of the substances conveying them. It may be readily supposed, that the undulations are more rapid in some media than in others. A free and almost instantaneous transit may be given by one substance, and by another the passage may be slow; opposed by its physical constitution at every step. The difficulty of assuming the undulatory form, the extent of surface influenced, and the freedom of motion between the ultimate particles, must have an influence upon the conducting power. The deadening influence of media of unequal densities has been already alluded to. When the vibrations are made to traverse effervescing liquids, the sounds lose all their clearness of tone, and become heavy noises. So when the vibration enters one medium after another, traversing water for instance after its passage through air, the intensity of sound is lost. In speaking, therefore, of the velocity of sound through the media we may select as examples, it must be remembered that they are supposed to be homogeneous.

It is scarcely necessary to remark, that sound requires time for its transmission from one place to another. Some ancient philosophers illustrated the motion of light, by comparing it to the progress of a small stick pushed at one end, and moving at the same moment through its whole length. If sound had a direct motion in right lines, this would not be an inappropriate comparison, for the motion throughout is not instantaneous; although the lengths which we are accustomed to experiment on are so small, that the interval between the blow and the motion of the extreme point is insensible. But if the sun and the earth were the extremes of a bar, a motion communicated at one end, would not, it is said, be felt at the other in less than 1074 days.

Every one knows that the lightning is seen before the thunder is heard; and the report of a gun discharged at a distance, strikes the ear after the flash has ceased to affect the eye. These, and many other instances of the same kind which will be immediately suggested to the mind of the reader, prove that sound has a progressive motion. But it is not so easy to determine its velocity. The experiment is one requiring in all cases extreme accuracy, and the omission of one element of disturbance will affect with essential errors the results that are obtained.

Air being the medium by which sound is commonly conducted to the ear, our first experiments would naturally be directed to ascertain the velocity of transmission by the atmosphere. To solve this problem, we must enter upon a course of experiments, and the manner in which they are performed is of the highest importance. They must evidently be founded on the fact, that the progress of light is so rapid

that at short distances it may be said to be instantaneous. Now if we can accurately determine the instant at which we see the flash of a gun fired by a person standing at a known distance from us, and the instant when we hear the report, the velocity of sound, supposing that of light to be unit, will be at once determined. This plan has been pursued by all who have endeavoured to measure the velocity of sound ; but for want of sufficient care, and accurate instruments, the results obtained by the early experimenters were excessively erroneous.

The first thing will of course be to select some level plain, and, fixing upon two stations, to measure the distance between them with great accuracy. At one station the sound is to be produced, and at the other the observations are to be made. The discharge of some fire-arm is in all probability the best means of producing the sound ; for being attended with a flash, the exact instant of explosion can be more accurately ascertained than by any other means.

The difficulty most felt in performing experiments on the velocity of sound, was, in the measurement of that interval which elapsed between seeing the flash and hearing the sound. An error of a small fraction of a second would be sufficient to derange the result considerably. The most accurate experiments ever made were conducted at almost the same time in the years 1822 and 1823, by Moll and Vanbeck in Holland, and Arrago, Matthieu, and others, in France. The Dutch philosophers used a clock most accurately constructed with an index hand, so formed that it could be stopped at any moment without stopping the clock, and registering to the one hundredth part of a second. The French academicians

employed a watch, one hand of which revolved round the face in a second of time, and was furnished with a sort of dotting-pen containing printer's ink, so that by pressing upon a small lever a mark was left which could afterwards be read off with great accuracy. "By the use of these instruments, it was found practicable to ascertain the interval between the sight of the flash, and the arrival of the report of a gun, with such precision, as to destroy all material error in the result which might arise from this cause; an improvement of great importance, when we consider that an error of a single tenth of a second in the measurement of time is equivalent to 110 feet in that of distance." When this is considered, it will no longer be a matter of surprise, that the results obtained by the early experimenters were far away from the truth.

But there was one other cause of inaccuracy:—the direction and velocity of the wind was seldom estimated. It must be quite evident, that the progress of the sound would be retarded if moving in a direction opposite to that of the wind, and aided if moving in the same. To prevent any error from this source, the experiments should either be performed when the air is quite still, or the stations should be so placed that the sound may travel in a direction at right angles to the wind. This seems to have been altogether lost sight of by those who first attempted to determine the velocity of sound.

Modern inquirers have also thought it necessary to estimate with great precision the hygrometrical condition of the atmosphere, and its temperature. In taking the mean of a series of experiments, it is therefore customary to make

such corrections as shall give the velocity in dry air at the freezing temperature.

Previous to the experiments made in the year 1823, there was great uncertainty as to the velocity of sound in air. The results obtained by different persons varied from 1,100 to 1,175 feet in a second. The question has now been entirely set at rest, in consequence of the close approximation of three distinct series of experiments. Arrago estimates the velocity at 1086.1 feet in a second, Moll and Vanbeck at 1089.42, Dr. Olinthus Gregory at 1088.05. We may therefore take the mean of these results, and consider it as settled, that in dry air at the freezing temperature, sound moves with a velocity of 1,088 feet in a second.

We must now proceed to speak of the experiments which have been made with a view to determine the velocity of sound in water. By far the most accurate with which we are acquainted, were those conducted by M. Colladon in 1826, but some, not unworthy of notice, were also performed by M. Beudant, at Marseilles. The last-mentioned gentleman performed his experiments in the following manner :—Two boats were fixed at a known distance from each other ; an observer attended by a diver was stationed in each boat : when the diver at one station was in the water, a bell was rung at the other, and a signal was given by him as soon as he heard it. The mean result of a number of experiments made in this manner, gave sound a velocity of 4,921 feet in a second.

M. Colladon exhibited great ingenuity in the manner of performing his experiments ; and no situation could have

been more suited for his purpose than the Lake Geneva, where they were performed. Taking the mean of forty-four experiments, he comes to the conclusion, that at a temperature of about $46\frac{1}{2}$ degrees of Fahrenheit, sound moves in water with a velocity of 4,708 feet in a second. At present there is no means of testing the accuracy of this result by comparing it with others. There is a considerable difference between the estimate he has formed and that of M. Beudant, but the circumstances under which the experiments in the two cases were performed are so different, that both may be accurate. No course of observations on this subject can be of any value in which the direction and velocity of the current, if any, the purity of the water, its specific gravity and temperature, the height of the barometer, and many other such deranging agents, are not carefully registered.

From an estimate of the compressibility of different liquids, M. Colladon endeavours to calculate the velocity with which they conduct sound; for further information, however, the reader must refer to the original memoir, as we must proceed to make a few remarks on the velocity with which sound is conducted by elastic solids.

The only important experiments yet made on the transmission of sound by a solid, were conducted by M. Biot. When the cast-iron pipes were laid in Paris for the conveyance of water, this celebrated and talented philosopher took the opportunity of making several important experiments, and especially those the results of which are now to be stated. The pipes are together about 3,120 feet long, forming a continuous channel. Each length was $8\frac{1}{4}$ feet, and the several portions were united by flanches with lead collars. There

were two methods of determining the question open to the experimenters. The observations of Herhold and Rafn upon the transmission of sound by a metallic wire 600 feet long, have been already referred to; and also a curious fact noticed by them, that sound was heard twice, once as conducted by the wire, and afterwards as transmitted by the air. The same would of course happen in the experiments of Biot, and to ascertain the interval between hearing the sound by the pipe and by the air, would be to determine the velocity of transmission in iron, the distance and velocity in air being known. Another method of obtaining the same result would be, to ascertain the precise moment when the blow was struck at one end and heard at the other, and the interval would give the time required for transmission. Taking the mean of numerous experiments, it was ascertained that sound moves in cast iron at the temperature of nearly 52° Fahr., at the rate of 11,090 in a second.

Chladni has attempted to deduce the velocity of sound in various solids, taking that in air as unity. In glass, and iron, he says, it is equal to 17, in copper 12, in silver 9, in tin $7\frac{1}{2}$. Too much dependance must not be placed upon these results, for in the case of iron, experiment has proved them far from accurate.

The subject of which we have been speaking, is one of those which has no very evident application to what are called useful purposes. There are many persons who limit the advantages of philosophy, to its direct assistance in those arts most necessary for the comfort or support of man. The enthusiastic energy of the man who delights to examine the wonders of material existence, hidden from the careless or

casual observer, appears to them as the madness of genius or the folly of an aspirant. Mankind, however, are aided by a thousand indirect streams flowing from the fountain of natural knowledge. The brilliant arch which spans the heavens when the sun peers through the watery cloud that has refreshed the earth with showers, is as much a part of the present state of physical existence, as the rotation of the earth on its axis producing day and night, or its revolution round the sun producing the seasons. It would perhaps be difficult to discover any advantage which we as creatures derive from this splendid object; unless we consider it as an emblem of peace, a holy pledge to the promise that seed-time and harvest shall not fail; but it would be as easy to show, that the existence of those physical principles by which it is produced are of the highest importance. So the results of philosophic inquiry, if we may compare small things with great, having no evident influence upon the happiness of man, may embody principles from which may be drawn arts that in relation to society have an active vitality.

It is not perhaps easy to determine what ulterior advantage would be derived from ascertaining the relative power, possessed by different substances, of conducting sound. We have often thought, that this, and many similar subjects, may, at some future period, throw considerable light upon the constitution of bodies. The inquiries so zealously pursued in recent times to determine the conducting power of substances in relation to heat and electricity, are directing us to investigations which were once thought to be beyond the power of man. The reader will not imagine that any equally curious inquiries would necessarily be suggested by ascertain-

ing the power of different substances in the transmission of sound. But it is possible, that there may be found a connexion between this and other properties of matter, calculated to aid the most refined philosophical studies. Independent of this, the student will feel interested in the knowledge, for its own sake; and as the information already collected bears no proportion to that desired by all who are interested in scientific research, it offers an opportunity to every young experimenter of acquiring facility of examination, accuracy of observation, and ingenuity of invention, and at the same time of enlarging the boundary of science.

CHAPTER III.

GENERAL REMARKS ON SOUND.

THERE are many interesting particulars having reference to the transmission and progress of sound which will require notice, and cannot be conveniently introduced except in a separate chapter. This will be the most appropriate place for their introduction, as many of the truths to be subsequently explained, rest in fact upon some of these. The reader may, perhaps, at first imagine that there is no very intimate connexion between the subjects of this chapter ; but a slight consideration of their relations will prove, that they are not inappropriately introduced in the same place.

ALL SOUNDS HAVE THE SAME VELOCITY.

The whole science of music may, in one sense, be said to depend on the fact, that all sounds have the same velocity. If the velocity of sound changed with the pitch, nothing but discord would be heard by one who listened to music at a distance. On a still night, music may be heard far away, and especially if the performers and listeners be separated by water, and yet the harmony is preserved. The time required for conduction is altogether independent of the pitch. Imagine it to be otherwise ; suppose the high notes to move faster than the lower ones, and what a chaos of sound would

be produced by the performance of a large band. We may, however, stand at any distance, and can discover no want of harmony from this cause; there are no notes which are running before, and none that are lagging behind: they are all of the same relative duration, and separated by the same interval of time, at a distance where they can be only just heard, and on the spot where drawn from the instruments that gave them birth.

THE DISTANCE AT WHICH SOUNDS MAY BE HEARD.

Although all sounds have the same velocity, they have not always an equal intensity. The same sound may deafen with its loudness, or tire with its faintness; but whether it be the softest tone that is breathed from the flute, or the loudest that is forced from the organ, the velocity is always the same. The intensity of a sound varies, as we shall have occasion hereafter to explain, with the distance, and gradually dies away. Distances may often be determined by the effect of sound upon the organ of hearing. By habit we are accustomed to certain sounds, and by their intensity we judge of the distance at which they are produced. Thus, we say that one person is near and another is distant, by the different effects produced by their voice. But some men have the power of deception in this particular, and can so speak, that the hearers shall suppose the sound at one moment to be from another room, and at the next immediately behind them. We may also judge erroneously of distance, when we hear a sound with which we are unacquainted. An individual who should hear the sound of thunder for the first

time, would be unable to form any conception of its distance; and indeed there are few persons who, although accustomed to hear it, can gain any more particular idea of the distance than is comprised in the vague expression "very near" or "far away."

We may also be deceived in estimating distance by the intensity of well-known sounds, in consequence of an unusual state of the conducting medium. An impure and misty state of the atmosphere deadens sound; an uniformly dense medium gives it a clearer tone, and apparently a greater intensity. The general principle has been alluded to in a previous chapter; and a few remarkable instances of the conduction of sound to great distances, may now be mentioned.

Lieutenant Foster, who attended Captain Parry in his third polar expedition, says, that he has conversed with a man across Port Bowen, which is a distance of about a mile and a quarter. This is an instance which supports the common opinion, that sounds are heard with great clearness when transmitted by a frosty atmosphere. A smooth surface of water is also said to be remarkably favourable to the conduction of sound; and some common instances of this must have occurred within the experience of all our readers. Derham states, that at Gibraltar, the human voice has been heard at a distance of ten miles. Dr. Hearn heard, in 1685, the guns fired at Stockholm, when two hundred miles distant; and it is authenticated, that the cannonade between the English and the Dutch, in 1672, was heard in Wales, more than two hundred miles from the place of action. These instances, however wonderful, cannot be compared with that recorded by Sir Stamford Raffles. The eruption of Tomboro,

in Sumbawa, was perhaps an instance of more violent volcanic action, than was ever before known to man. So loud were the detonations, and so favourable the state of the atmosphere, that the occasional paroxysms were heard more than nine hundred miles distant.

It is, we believe, generally known, that sounds are transmitted with great clearness over large bodies of ice and smooth water; and some few experiments have been made, to determine how far the human voice may be heard under favourable circumstance. Mr. King, who accompanied Captain Back as naturalist in the recent expedition, has informed us, that he often saw the natives conversing together at a distance of from half to three-fourths of a mile.

Derham, in his Physico-Theology, mentions a few instances of the transmission of sound to great distances. The sound of guns fired by his wish for the purpose of experiment at Florence, was heard by persons in Leghorn, a distance of fifty-five miles. At the time of the experiment, the air was calm; but as a hilly and wooded country intervenes between the two stations, sound might, in all probability, be heard at a much greater distance under more favourable circumstances. The Leghorn guns, he says, on the authority of other persons, are heard at Porto Ferraro, a distance of sixty-six miles. When the French bombarded Genoa, the sound was heard at a place near Leghorn, a distance of ninety miles; and in the Messina insurrection, the guns were heard at Augusta and Syracuse.

These instances of the transmission of sound to great distances, seem to have been noticed by Derham in consequence of a doubt once entertained, whether the situation

of a place in reference to latitude, had any effect upon the distance at which a sound may be heard. "These distances," he says, "being so considerable, give me reason to suspect, that sounds fly as far, or nearly as far, in the southern as in the northern parts of the world, notwithstanding we have a few instances of sound reaching farther distances. Also, there is this other reason of suspicion, that the mercury in the barometer riseth higher without than within the tropics, and the more northerly, still the higher, which may increase the strength of sounds." It is, however, we imagine, quite impossible to determine any law of transmission dependent on latitude. In a northern district, the air may be almost habitually so loaded with vapour as to stifle sound, and in a southern so clear that, even when rarified, it shall be easily conducted. The condition of the atmosphere therefore, altogether independent of place, is an important element.

The distance at which a sound may be heard will also depend upon another condition—the degree of divergence produced. The intensity of a sound is soon lost, under ordinary circumstances, by the spreading which it suffers. When a meteor bursts, or a gun is discharged, the sound diverges, and is not heard in any one direction more than another. This spreading of a sound must of necessity diminish its intensity, and in a proportion greater than the distance. The intensity of sound decreases, or so it would appear from calculation, as the square of the distance increases.

Now from these remarks it follows, that by preventing the divergence of the sound, we must increase the intensity at any given distance, and consequently cause it to be heard at

places which it could not otherwise reach. A common ear-trumpet acts upon this principle. It is a tube, with one opening so small as to be easily placed in the ear, and the other is, in comparison, very large. Its object is to make sounds proceeding from short distances audible to deaf persons, and is admirably suited for this purpose. The diverging sounds proceeding from the human voice are gathered together, if we may so speak, by the large opening; and the concentrated effect of the sounds, which are no longer at liberty to spread, is produced upon the ear.

Mr. Curtis, aurist to her Majesty, has recently greatly improved this instrument. The common trumpet is in very many cases found to have an effect by no mean proportional to the amount of hindrance that a person may have to the exercise of the organ of hearing. The instrument then becomes altogether useless. It is also inconvenient and exceedingly troublesome. These objections have, we think, been removed, and for the future Mr. Curtis's improvement will be preferred.

The speaking trumpet is not an instrument of modern invention, but has been from time to time altered and made more convenient. Alexander the Great is said to have had a tube, by the use of which a man might make himself heard at the distance of one hundred stadia. Kircher is in all probability the modern inventor; but this honour is, by some writers, given to Sir Samuel Morland. Kircher says, in his "Phonurg," that he invented the tromba twenty-four years before it was described by Morland, and published it in his "Misurgia." One of these he had in his chamber in the Roman College, and by its means could make himself heard

to the porter, and receive answers to any questions he proposed. He also informs us, that he took a trumpet fifteen palms in length to the Mons Eustachianus, where he assembled two thousand persons to prayers by its assistance, some of them coming from a distance of five Italian miles. There is but little doubt that Kircher was the inventor of the tromba; but whether Sir Samuel Morland was acquainted with the invention previous to the publication of his own description, may be fairly doubted.

We might give numerous other instances in which the intensity of sound is preserved by similar means. Speaking tubes are now commonly carried from one apartment to another in large buildings; and with their assistance, persons may communicate with each other at distances to which the human voice could not otherwise reach. A series of pipes might be so arranged through a number of apartments, as to carry orders from one office to another without any personal interview, and at the same time to confine the information to that one place where it is required. The lateral divergence of sound is such, that we may suppose the sides of the pipes to be acted upon by the air; and consequently if an opening be formed in a side, the sound will be heard there as well as at the end. We may then suppose, that in consequence of the condensation of the air during the propagation of sound, the wave has both a lateral and a forward motion. Of this we have many examples in familiar musical instruments.

There seems to be scarcely any limit to the distances at which sounds may be heard, when propagated through tubes. M. Biot states, that the faintest whisper uttered at one end of the Paris conduit-pipes, could be heard distinctly at the

other, a distance of 3,120 feet. We have no doubt that pipes might be so arranged, as to give an almost instantaneous communication between all the government offices, which would save much time, and be in many instances of the greatest importance.

Mr. Curtis, of Soho-square, has invented an acoustic chair, (fig. 6,) for the benefit of the incurable deaf; it has, however,

Fig. 6.

another purpose, for "by means of additional tubes," says the inventor, "the person seated in it may hear distinctly, while sitting perfectly at ease, whatever transpires in any apartment from which the pipes are carried to the chair; being an im-

proved application of the principles of the speaking pipes now in general use. The chair is of the size of a large library one, and has a high back, to which are affixed two barrels for sound, so constructed as not to appear unsightly ; and at the extremity of each barrel is a perforated plate, which collects sound into a paraboloid vase, from any part of the room. The instrument thus contrived gathers sound, and impresses it more sensibly, by giving to it a small quantity of air. The convex end of the vase serves to reflect the voice, and render it more distinct. Further, the air enclosed in the tube, being also excited by the voice, communicates its action to the ear, which thus receives a stronger impression from the articulated voice, or indeed from any other sound."

From these remarks it will appear, that the distance at which a sound may be heard, will depend on the state of the medium conducting it, and the surface over which it passes, and also on the divergence it suffers. Evidence has been given of the increased intensity produced by the transit of sounds through tubes which prevent the divergence, and consequently retard the decay. There is yet one other fact deserving our attention, before we proceed to another subject.

Although sounds are usually propagated in every direction by an elastic medium, diverging from what may be called the sonorous centre, there are instances in which this does not happen. One example will be sufficient in illustration. Dr. Young has explained an interesting experiment he made with a tuning-fork, and it has been also mentioned by Sir John Herschel. A tuning-fork (fig. 7) is a piece of steel in the form of a pair of sugar-tongs, to which is attached a handle of the same metal. When either of the branches is

struck against a resisting substance, both are put into a state of vibration, and sound is produced. A tuning-fork is generally so formed as to give a musical sound of a particular

Fig. 7.

pitch ; and when a musical instrument cannot be obtained, is sometimes used to direct the voice to the key in which a composition is to be sung. Now if this compound vibrating bar be held in a vertical direction, as shown in the diagram, about a foot from the ear, and be gradually turned on its axis, a considerable alteration in the intensity of the sound will be detected in one revolution. When the plane surfaces are turned towards the ear, the sounds will be distinct and clear ; but when the open sides are in the same position, the sound will be scarcely audible. Here then we have an instance in which the sound is not propagated by divergence in every direction, and many others might be adduced.

THE REFLECTION OF SOUND.

Having considered the circumstances under which the intensity of sound is destroyed, or suffers decay, we may proceed to illustrate the conditions under which sound is reflected. By the ordinary propagation in atmospheric air, the sound is at some point lost by divergence and consequent

decay; but the same effect may happen from other causes. A sound may be stifled by meeting with media of different densities; or its course may be interrupted by reflection. To the former we have already alluded, and must now direct our attention to the latter.

If heat and light are capable of reflection, it need not be a matter of surprise, that sound should suffer the same effect. The organs of touch, sight, and hearing, are all supposed to be acted upon in the same manner, and the agency to be similar. Heat and light are said to arise from vibratory motion, of what is not so evident as some persons would persuade us to believe; and all inquirers are agreed, that sound is ordinarily produced by the vibratory motions impressed upon atmospheric air. Whatever the agent may be whose undulations produce light and heat, the motion is capable of reflection; and if an agent so subtle can suffer such an impediment to motion, it is not singular that one, of whose existence we have almost tangible evidence, should be acted on in the same way. We might in fact have deduced, from our knowledge of the origin of sound, that reflection would be produced whenever it meets with a hard plane surface. The fact, however, does not rest upon any argument, for we have the evidence in that phenomenon called echo.

In tracing the effects of substances upon heat and light, it is found that by some they are absorbed, and by others transmitted or reflected, according to circumstances. A piece of polished metal resists altogether the progress of light, and throws back nearly all the rays that fall upon it; a piece of thick black cloth absorbs them, and a plate of glass transmits them. Neither of these effects perhaps can exist alone; in most

instances they have a simultaneous existence. Of the rays of light falling upon a thin plate of glass, some are reflected and some absorbed, but the greater number are refracted. When the thickness of the glass is increased, more rays will be absorbed and less refracted. Processes of a very similar nature are going on in reference to sound. By some substances it is absorbed, or more properly, stifled, by some transmitted, and by others reflected; and, as in light, all these effects may be occasioned by the same substance. The sound of a musical instrument in a room is reflected from all sides, and yet a part is evidently transmitted, as it may be heard by a person at a distance from the apartment; but as it is not heard so distinctly as it would be at the same distance in the room, a part is absorbed.

The similarity in regard to light and sound may be carried still further. In both cases there are some substances more favourable to reflection than others, and the principal law of reflection is the same in both instances, the angle of incidence being equal to the angle of reflection.

Echo, or repetition, is the effect of a reflection of sound, and yet this is a comparatively rare phenomenon, and wisely so. It may be attributed to the velocity with which sounds move; for even where a plain surface of sufficient extent is favourably situated for the production of echo, the distance is in ordinary circumstances so small, that the original sound and the echo are blended. If the motion had been slow, we should have been subject, especially in large buildings, to a repetition of every sound, an annoyance and interference to which even habit could scarcely have reconciled either a speaker or a hearer.

Echo is, however, a phenomenon sufficiently common, to render it almost unnecessary to give examples except of some peculiar cases. Instances are known in which the repetition is made several times successively. It may be easily imagined that two or more surfaces may be so placed, that a sound reflected by one shall be returned by another, and the echo be thus repeated until the sound shall entirely die away.

In Woodstock Park, near Oxford, there is an echo which repeats seventeen syllables by day and twenty by night. The reason why it repeats more syllables by night than by day, says an old writer, is because the air being colder at that time is more dense ; and therefore the return of the first vibrations being slower, gives time for the repetition of more syllables. This is certainly a most curious explanation, and one we can scarcely imagine to be sufficient to account for the phenomenon. It appears to us much more probable that it would be far better accounted for by the fact, that the density is more uniform at night than during the day, and consequently the intensity of the sound suffers a less rapid decay. But whatever may be the cause, there is no doubt of the fact, and many other similar instances of an increased number of repetitions during the night have been recorded by travellers and authors.

Single echos, or those in which a sound is repeated once, are by no means uncommon ; and those in which the repetitions are made many times, are too numerous to excite the surprise of any person when they are met with. At the sepulchre of Metella, the wife of Crassus, there is an echo that repeats seven times. Barthius states, on his own authority, that on the banks of the Naha, between Coblentz and Bingen,

there is an echo which repeats the words of a man seventeen times. Whereas in common echos, he says, the repetition is not heard till some time after hearing the word spoken, or the note sung; in this, the person who speaks or sings is scarcely heard at all, but the repetition most clearly, and always in surprising varieties; the echo seeming sometimes to approach nearer, and sometimes moving further off. Sometimes the voice is heard very distinctly, and sometimes scarcely at all. One hears only one voice, and another several; one hears the echo on the right and the other on the left. There is another singular echo on the banks of the Rhine, near Lusley; a representation of the place is given in the frontispiece.

Beneath the Menai suspension bridge, close to one of the main piers, there is a remarkably fine echo, upon which Sir John Herschel and Mr. Babbage made an experiment, leading them to the conclusion, that "in the reflection of sound, there is an evident approach to the law of equality between the angles of incidence and reflection, which obtains in that of light; and a tendency in the reflected sound to confine itself to the direction which a ray of light regularly reflected at the echoing surface would follow, and to spread into the surrounding air equally in all directions. This experiment, we doubt not, would lead to remarkable confirmations of the general analogy between sound and light, to which all optical and acoustical phenomena point."

There is one natural phenomenon produced by the reflection of sound, of which it is necessary to give a description in this place. Thunder is a sound resulting from the spontaneous discharge of atmospheric electricity. The analogies between the effect of common electricity and lightning are so strong, that

since the time of Franklin no one has ever doubted that the same agent is operating in both cases. We are accustomed to experiment on our laboratory tables with electricity distributed over a few square feet of tin-foil; in the atmosphere there are sometimes thousands of acres of electrified cloud. When the difference of quantity and also of intensity in the two cases is considered, there can be no surprise at the difference in amount, or violence of the effects produced by lightning over those resulting from common electricity. But although there is so evident an identity between many of the effects of ordinary and atmospheric electricity, there is one in which they have a great dissimilarity. When a Leyden jar or battery is discharged, a sharp, sudden noise is produced, which might perhaps be properly called a snap. When the atmospheric electricity is discharged, a deep rolling sound follows, best described by the expressive word thunder. The cause of this is readily explained. During a thunder-storm the atmosphere is generally loaded with dense clouds. Now supposing the sound to be produced from one point, and to be a single crash, as it diverges in every direction there will be repeated reflections, and the sound will be reverberated from some surfaces that are near, and others that are far distant, giving to the explosion that continuous, rolling sound, by which it is so peculiarly distinguished.

Sir John Herschel has proposed a very curious explanation of thunder, to which we cannot give consent. "Let us conceive," he says, "two flashes of lightning, each four miles long, both beginning at points equidistant from the auditor, but the one running out in a straight line directly away from him, the other describing an arc of a circle having him in its

centre. Since the velocity of electricity is incomparably greater than that of sound, the thunder may be regarded as originating at one and the same instant in every point of the course of either flash. But it will reach the ear under very different circumstances in the two cases. In that of the circular flash, the sound from every point will arrive at the same instant, and affect the ear as a simple explosion, with stunning loudness. In that of the rectilinear flash, on the other hand, the sound from the nearest point will arrive sooner than from those at a greater distance; and those from different points will arrive in succession, occupying altogether a time equal to that required by sound to run over four miles, or about twenty seconds."

In this theory it is supposed that the sound follows the flash, and, diverging in every direction, must of course reach an auditor on the surface of the earth. If this supposition be true, there can be no doubt of the accuracy of the theory. The sound however is, we imagine, produced at the point of discharge, and from that diverges, as when a bell is rung, or a cracker is exploded. The electricity, in its passage, whether in a direction away from the auditor, or in an arc of a circle around him, will condense the atmospheric air; and, unless that be supposed the origin of new sounds, we cannot conceive how Sir John Herschel's supposition can be substantiated. We may err altogether in our conception of his theory, but it appears to us that the sound cannot be produced at any other than the point of discharge, and from this diverges in every direction, suffering reflection from every point, causing that roll which is the peculiar character of the sound. The reflected sound can never arrive first, as some

persons have imagined; for if that could happen, it would be no longer true, that two sides of a triangle must necessarily be greater than the third. The greatest intensity may be at one or another place, according to circumstances; but this cannot, so far as we can understand the question, depend on the length or direction of the flash.

The application of the principles of reflection has been thought of great importance in the construction of buildings. All places intended for public speaking and the performance of music, should be constructed in that form, and with those provisions, known to give a ready passage to sound without the interference of reverberation. In small apartments the form is of but little importance, so far as regards the production of echo, for the incident and reflected sounds so rapidly follow each other, that there is no perceptible interval between them; in fact, they are brought to the ear as a single sound. In large buildings, on the other hand: "In churches, theatres, and concert-rooms," says the author to whom we have already frequently referred, "the echo is heard after the principal sound has ceased; and if the building is so constructed as to return several echos in very different times, the effect will be unpleasant. It is owing to this, that in cathedrals the service is usually read in a sustained, uniform tone, rather that of singing than speaking, the voice being thus blended in unison with its echo. A good reader will time his syllables, if possible, so as to make one fall in with the echo of the last, which will thus be merged in the louder sound, and produce less confusion in his delivery.

It is very difficult to direct the architect in the construction of a building best suited for sustaining sound. One effect

should certainly be sought, that of obtaining reflection; and one should be avoided, that of an echo from one sound blending with a note of a different pitch.

Everything that can stifle a sound should be avoided. Windows, deep recesses, carpets, and curtains, are in every respect injurious to the propagation of sound. They have the effect of preventing reflection, which should always be promoted, as a means of increasing intensity. Particular forms have been sometimes recommended as fit to reflect sounds; but if the laws governing the reflection of sound, are the same as those which influence the direction of light, they can be of little service. It would be easy to arrange reflecting surfaces of a particular form, in such a manner, that the speaker being in one focus and the hearer in the other, the sound would have great intensity; but under ordinary circumstances it is required to convey sound of great intensity over the whole of a building, and not to concentrate the effect upon any one point.

But while the architect aids the reflection of sound, he must be careful to prevent the possibility of an echo. This is especially necessary in concert-rooms, for as a number of notes may be struck in a short interval of time, it is possible that the echo of one may interfere with the original sound of another, and a constant discord would in this case afflict the ear of an auditor.

CHAPTER IV.

NOISES AND MUSICAL SOUNDS.

The readiness with which the ear detects the varieties of sound is very remarkable. There are numerous instances in which the sensation discriminates, without putting us into possession of any means by which to communicate to another person the differences so readily detected by us. A friend is known or identified by his voice, and yet it would be impossible so to describe it, except in very remarkable instances, as to give a third person the means of distinguishing it from others. The Indian hunters are said to hear, at great distances, sounds that have so small an intensity as to be altogether inaudible to inexperienced ears, and can frequently determine what is the animal by whose step the sounds are produced. We have been frequently struck with the great facility with which we, in common it is imagined with all who have for any length of time resided in the metropolis, can detect, during the night, the nature of the vehicle that is passing; and especially how suddenly one is roused, even from a state of slumber, by the peculiar and yet indescribable roll of a fire-engine.

The eye is justly said to be the most excursive organ, but its liability to deception bears a large proportion to the extent of external influence. By the organ of sight we are admitted to a communion with nature of a more intimate character

than could have been conceived by beings of greater intelligence than man without possession of the organ. The ear, however, is in many respects scarcely inferior either in its importance to us as creatures, or in its capabilities of instruction. Although we cannot derive from its unaided assistance so extensive a knowledge of external nature as from the eye, it offers to man, unimproved by a written language, the only means of receiving a knowledge of the opinions and reflections of his fellows. If it be possible to imagine a state of society in which the individuals are enjoying the blessings of civilization, and possessing all the advantages resulting from an acquaintance with the physical sciences, and the arts attending them, and yet destitute of a written language; it is quite certain that the organ of hearing would be the only medium of conveying the operations of one mind to another. Now even in the present day, and in this country, more advanced in the general education of the people than any other, we may realise the supposition. The majority of the people can read, and have facilities of obtaining books, and yet the number of readers compared with the gross population, is exceedingly small. Knowledge even here then, is chiefly communicated by the agency of the organ of hearing; it is the human voice which teaches best. The ease with which the ear detects sounds and distinguishes between them, is, therefore, of immense importance, altogether independent of its absolute necessity as a means of preserving us from innumerable dangers to which we should otherwise be exposed.

Although the varieties of sound are so numerous and so readily distinguished by the ear, they cannot be described, and we have terms for but few, and even those are generic.

Thus we speak of a snap, a crack, a bounce, a crash, an explosion, a rumbling. But we have no means of distinguishing between the varieties of these, except by using the name of the substance or thing by which it was produced. It is, therefore, customary to say, the crack of a whip, the explosion of a cannon; and in other instances we use a comparative expression, as when we say, like the roll of thunder.

There are, however, two general expressions under which all sounds may be placed—noises and musical sounds. A noise is produced by a series of irregular impulses, and its character is governed by their periods and duration. If they be short, and succeed each other rapidly, we may have an explosion, or crack; if longer and less rapid, a rumble. All the variety of noises may be traced to the length of interval between successive impulses and their duration. Yet the several genera, if we may so call them, are capable of division into species, and habit enables the ear to detect them. There is, for instance, the rumbling sound of distant thunder, and of a carriage; and although in some instances one may be mistaken for the other, in most cases they are readily distinguished.

When the impulses are regular, that is to say, when the same interval of time separates them, and they are all of the same duration, a musical sound is produced.

In estimating the character and peculiarities of musical sounds, there are three things to be considered—the intensity, the quality, and the pitch. The intensity of a sound, is its comparative loudness, and depends upon the violence of the impulses from which it proceeds. From any musical instrument a note may be obtained so loud as to be unpleasant to

a hearer, or so soft as to be scarcely audible. The only difference between the two sounds is in intensity. When the note obtained from two instruments is the same and of the same intensity, there may still be a difference between the tones. The organ and the flute, for instance, may be made to repeat precisely the same sounds and with the same intensity, yet an ear but little practised would instantly detect a dissimilarity of character—this is called quality. Sounds produced from the same instrument may be of different qualities. We can scarcely estimate how much a musical performance depends on the quality of the sounds. Two persons may play the same air, and with equal accuracy ; yet in one case we may be struck with the roughness of the tones, and in the other with their full and mellow harmony. In musical performances, the quality of sounds will depend partly upon the capabilities of the player, and partly on the instruments. Every one knows that some instruments are very preferable to others, and this is only because the sounds obtained from them are of a richer quality.

The pitch is altogether independent of both intensity and quality, which may be different in the same sound. When we strike two or three adjoining strings on the harp or the violin, we detect a difference in the sounds that cannot be attributed to either the greater loudness or sweetness of one than another—the sounds are in fact essentially different, they are not of the same pitch. When any two or more notes are of the same pitch, they are said to be in unison.

We have already explained that sound is produced by vibrations excited in some sonorous substances. By successive impulses on a conducting medium, the effect is transmitted to the

ear, and there excites the organ of sensation. A succession of impulses less frequent than sixteen in a second, is incapable of affecting the human ear. Sounds of different pitch, or in other words, different notes, are attributable to the rapidity of the vibrations. A certain number of vibrations in a second will always produce the same note, whatever may be the instrument used in obtaining the vibrations.

For the production of a certain musical note, the sounding body must be in a particular state—that state, in fact, suited to the production of a fixed number of vibrations in equal times. That a string should give out, when touched, a note of any pitch, it must have a fixed length, tension, and density; and if either of these be changed, the note is also instantly altered. All these elements are important, because the number of vibrations is regulated by them. Tuning an instrument, therefore, is nothing more than bringing the vibrating or sounding body into such a state, that a certain number of oscillations may be performed in a given time.

The human ear is not sensibly affected by all sounds. There are some notes so low that they are indistinct murmurs, and some so high that they cannot be heard at all; in the one case the vibrations are slow, and in the other rapid, but in both, the organ of hearing is alike incapable of transmitting the impression.

Dr. Wollaston made some curious observations which he communicated to the Royal Society in the year 1820, on the inaudibility of certain ears to particular sounds. This very accurate observer discovered, that persons who have, in the ordinary acceptation of the phrase, a perfect hearing, may at

the same time be completely insensible to those sounds which are at the extremities of the scale of musical notes. The loudness of the sound has, it is said, nothing to do with this effect ; it depends entirely upon the pitch. Deaf persons, as is well known, hear some sounds better than others, generally those which are sharp and clear. They hear women and children more distinctly than men. It may be remarked, says the Doctor, that the generality of persons accustomed to speak to those who are deaf, seem practically aware of this difference ; and, even without reflecting on the motives which guide them, acquire a habit of speaking to deaf persons in a shriller tone of voice, as a method by which they succeed in making them hear more effectually than by merely speaking louder.

It appears from the memoir, an abstract of which we are giving, that its author was first led to the subject by a desire to ascertain the origin of deafness in a friend. To do this, he sought to decrease the sensibility of his own ear, and found "that when the mouth and nose are shut, the tympanum may be so exhausted by a forcible attempt to take breath by expansion of the chest, that the pressure of the external air is strongly felt upon the membrana tympani; and that in this state of tension from external pressure, the ear becomes insensible to grave tones, without losing in any degree the perception of sharp sounds." By frequent attempts, he was able to keep the ear in a state of exhaustion without stopping the breath ; and could always restore an equality of pressure, and consequently remove the partial deafness, by the act of swallowing, which re-opens the tube. In this way he succeeded in making his

ear insensible to all sounds below F in the bass clef. So also he became unconscious of the sound produced by striking the table with the end of his finger, but heard the sound produced by the nail, a sharper sound, occasioned by a quicker vibration of parts around the point of contact.

It is however to the limits of hearing in persons who have the ordinary capability of hearing sounds, that we would especially direct the attention of the reader. In a healthy state of the organ, there does not seem to be any limit to the appreciation of low sounds. We are, as Dr. Wollaston states, sensible of vibratory motion, until it becomes a mere tremor, which may be felt, and even almost counted.

Sounds of a higher pitch, or, as they are frequently called, shrill sounds, affect the ear of individuals differently. Those which are distinctly audible to one person may not be heard by another, and yet the hearing of both shall be quite sensible to all the ordinary sounds. Dr. Wollaston states, that he first became acquainted with this fact, by observing that certain sharp sounds, the pitch of which he wished to determine, were not audible to some of his friends. Pursuing the train of thought and inquiry suggested by this fact, he discovered that there is a limit in every individual to the sense of hearing, and that the interval of a single note between two sounds may be the limit of audibility. The father of some ladies he knew, could not hear the chirping of the house-sparrow. This is the lowest limit to acute hearing that he met with, for even deafness to the chirping of the house-cricket, which is several notes higher, is not common. But the chirping of the gryllus campestris, a common inhabitant of the hedges during the summer, and an incessant songster

at evening, is not unfrequently the limit of hearing, and but seldom extends many notes above the pitch of that sound.

The suddenness of transition from perfect hearing to total want of perception, says our author, "occasions a degree of surprise, which renders an experiment on this subject, with a series of small pipes, among several persons, rather amusing. A pipe, one-fourth of an inch in length, produced a sound supposed to be about six octaves above the middle E, which was the limit of his own hearing; but some persons could not hear that, and others could hear higher. The whole range of human hearing, between the lowest notes of the organ and the highest of insects audible to man, is supposed to be about nine octaves; and although some individuals can hear sounds not audible to others, there is at last but little difference in the range of human hearing, although the existence of a limit cannot be disputed.

These facts suggest some very curious inquiries. There are many insects which, so far as we know, are dumb; and yet, is it not probable, from the existence of a limit to the capabilities of human hearing, that the greater number of these, perhaps all, are capable of emitting sounds so shrill as to be inaudible to man. Naturalists have frequently expressed surprise at the great readiness with which different members of the animal creation find their prey; but if guided by the organ of hearing, as they are in all probability, there is no longer any occasion for wonder. Every creature may be supposed to possess a capability in this particular, suited to its habits of life. And as the Creator has for wise purposes, in the present stage of organised existence, ordained, or permitted, that one scale of animated being should be the sup-

port of another, so he has provided each with an organ of hearing or sight, as most necessary, by which the peculiar sustenance required can be readily obtained.

HARMONY AND DISCORD.

There are few persons who are not sensible of harmony and discord. Any two notes struck together are not calculated to affect the mind with a pleasing sensation. All ears are not equally affected by harmony and discord; but it is seldom that we meet with a person who does not derive some degree of pleasure from the one and inconvenience from the other. Some are so sensible of harmony as to suffer evident pain from discordant notes. We knew a person who, when he had no knowledge of music, could detect a discordant note in a full orchestra; and we knew another, who was as much annoyed by the finest performance as by the beating of a tin kettle. In the majority of cases, however, there are certain combinations of sound peculiarly agreeable, and there are others equally unpleasant—the former are called concords, the latter discords.

It is found that whenever the vibrations producing any two notes, have a simple or low proportion, they are in concord. The lower the proportion the more perfect the concord. Thus when the vibrations are as 1 to 2, 1 to 3, 2 to 3, and so on, excellent concords are produced, When on the other hand the vibrations have no numerical proportion, discord is the result.

The simplest harmony is unison, that is when two notes are produced by the same number of vibrations. Next to this is

the octave, where the vibrations are as one to two. The harmony in this instance is almost as simple as a unison, for when any note and its octave are sounded together, it is almost impossible for those unacquainted with music, to distinguish between them. A woman's voice is an octave higher than a man's, and yet there are many persons who are not aware of the fact. "The octave, says an author to whom we have frequently referred, " approaches in its character to a unison ; and indeed two notes so related, when played together, can hardly be separated in idea ; and when singly, appear rather as the same note differently modified, than as independent sounds. The reason of this will be evident on inspecting the following figures, where the dots in the upper line represent

the periodically recurring impulses on the ear, produced by the vibrations of the acuter notes ; while those in the lower represent the same impulses as produced by those of the graver ; as the ear receives these all in the order they are placed, it will be the same thing as if they were produced by two sounds both of the graver pitch, but one of a different intensity and quality from the other ; the one having its impulses represented by : the sum of two separate impulses of the octave sounds, the other consisting of the alternate impulses of the acuter only."

When the vibrations are as 1 to 4, we have the octave of the octave, or the fifteenth, which is also a perfect concord, as are all the octaves, as 1 to 8 and 1 to 16.

A twelfth is where the vibrations are as 1 to 3. If the

octave of the note represented by 1 be used instead, we obtain a proportion of 2 to 3, which is called a fifth. A fourth is the proportion of 4 to 3.

If the vibrations on the other hand should be in high proportions, discords are produced. "Higher primes than 5 enter into no harmonic ratios. Such combinations, for instance, as 1 : 7; 5 : 7; or 6 : 7, are altogether discordant. The same may be said of the more complicated combinations of the lower primes, 1, 2, 3, 5. The ear will not endure them, and cannot rest upon them. When sounded, a sense of craving for a change is produced, and this is not satisfied but by changing one or both of the notes, so as to fall as easily as the case will permit into some one of the concords above enumerated. This is called the resolution of a discord; and such is the constitution of our minds in this respect, that a concord agreeable in itself, is rendered doubly so by being thus approached through a discord. For example, let us take the ratio of 5 to 9, which is called a flat seventh, a combination decidedly discordant. If we multiply the terms of this ratio by 5, we get 25 : 45. A small change in one of the notes will reduce this to 27 : 45, or 3 : 5, a major sixth—an agreeable concord. Now this will be done, if, retaining the lower note 5 or 25, we change the upper from 45 to $45\frac{2}{17}$, that is to say, to a note whose vibrations are to its own as 25 : 27.

Having premised these few facts concerning noises and musical sounds, we may proceed to examine the laws which govern vibrating bodies, and the construction of musical instruments.

CHAPTER V.

VIBRATING STRINGS AND CORDS.

So many musical instruments are constructed on those principles involved in the theory of vibrating strings, that we should feel ourselves justified in asserting there is no branch of the science of acoustics of greater importance than that we are about to investigate. But if we consider this subject merely as a philosophical question, the interest and importance attached to it are sufficient inducements to a careful investigation. As this book is especially designed for the general reader, no strictly mathematical or rigidly philosophical investigations can be admitted into its pages; yet we shall attempt, as far as may be practicable, to explain so much of the theory of vibrating strings as shall enable the reader to understand the origin of the varieties of sound produced, and the laws by which those sounds are regulated. When this has been done, we may describe the construction and trace the history of those instruments in which strings or cords are used. The laws to which we refer evidently have relation to all vibrating strings, in what instrument soever they may be employed: the varieties of tone produced by different instruments consist in an alteration of intensity and quality, which are partly regulated by the form of the instrument, and partly by the means adopted for producing

the excitement. In some instruments the string is made to vibrate by drawing a bundle of tense fibres, called a bow, over the stretched cords, as in the violin and violoncello ; in some by the fingers, as in the harp and guitar, and in others by a small hammer, as in the pianoforte. The manner in which the vibrations are produced in these several instruments will assist in accounting for the peculiarities of their tones, so far at least as regards their quality; but the circumstances under which the vibrations are made will also have some influence.

The monochord (fig. 8) is an instrument admirably adapted to illustrate the laws which govern the production of sound in vibrating strings. A, B, C, D, is a hollow wooden box, on

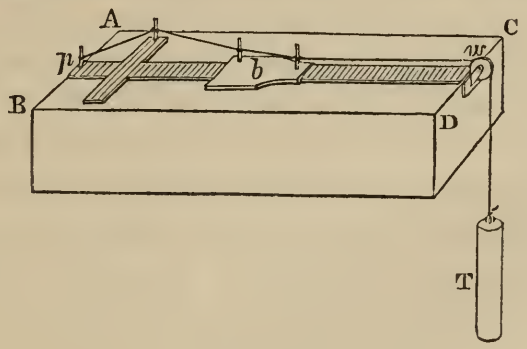


Fig. 8.

the top of which is fastened a narrow slip of wood, certain distances showing the necessary length of a string for the production of a certain note : *b* is a moveable bridge, *p*, a point to which the string is attached at one end, *w*, a wheel or pulley, over which the string passes, and T, a weight, by which the necessary tension is produced. By shifting the bridge, the length of the vibrating part of the string may be

either increased or decreased at pleasure, and the effects may be estimated under different circumstances.

The pitch of any note given out by a tense cord will vary according to the density, length, or degree of tension, possessed by the vibrating body. The reason of this is evident; for the time required to complete a vibration will depend on these circumstances. It requires, as already observed in a former chapter, so many vibrations in a second for the production of one note, and so many, more or less, according to circumstances, for another. The mathematical theory of the vibration of stretched cords is one of great interest, and is remarkable, as Sir John Herschel has stated, "in an historical point of view, as having given rise to the first general solution of an equation of partial differences; and led geometers to the consideration of the nature and management of the arbitrary functions which enter into the integrals of these equations." But as we cannot enter into the mathematical researches which have conducted philosophers to a knowledge of the laws of vibrating, strings we shall merely state the result which has been obtained. The times of vibration in different cords are as their lengths directly, and as the square roots of the tending forces inversely; and the number of vibrations, the time being given, as the length inversely, and the square root of the tensions directly.*

NODAL POINTS.

It is a well-known but curious fact, that in every vibrating string there are certain points which always remain in a state

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* Sound, art. 149—158, Ency. Metrop.

of rest, never leaving the axis. These are called nodal points, and the distances between them are called bellies, or ventral segments. The existence of these nodal points may be readily shown on the monochord, an instrument already explained; for if a small narrow piece of paper in the form of an inverted V, be placed upon the vibrating string, it will be thrown off from every situation, except when on a node.

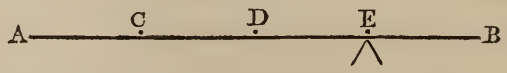
From this fact we are able to account for the production of harmonic sounds in vibrating strings. A delicate and practised ear can generally detect when a string is vibrating certain sounds blending with the fundamental note. This is especially the case when the string is touched lightly at particular points, and, from the concords they form with the fundamental note, they are called harmonic sounds. If the string of a violin, for instance, be lightly touched while sounding, exactly in the middle, the octave of the fundamental sound will be heard.

A cord may, when freely vibrating, have any number of nodes, and consequently be divided into any number of aliquot parts of its whole length. This fact, as well as the production of harmonic sounds as the result, was first observed by Wallis, in 1673, and was afterwards closely investigated by M. Sauveur, in a memoir read before the French Academy, in 1700. Before mathematicians commenced the investigation of this subject, musicians were probably aware that when a vibrating string is lightly touched at certain points, certain notes in concord with the fundamental tone, and consequently called harmonic sounds, were produced. In stringed instruments these attending tones would not be so perceptible as in vibrating bells and plates, and only an accurate ear could

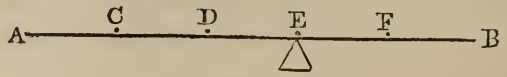
detect them. By the use of the monochord, however, and the adoption of the method now commonly employed, the subject may be investigated experimentally by any of our readers.

VOIGT ON THE NODES OF MUSICAL STRINGS.

In the "Journal der Physick" there is an interesting and important paper by M. Voigt, of Halle, on the vibrating nodes of musical strings, to which we must call the attention of the reader. The facts which he adduces are arranged as a series of experiments, and we may follow the order in which they are placed.

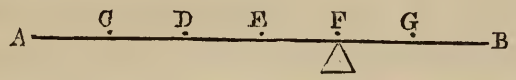


Let A, B be the string of a monochord, and let it be divided into any number, four, for example, of equal parts, by the points C, D, and E, a moveable bridge being placed at the point E. Upon the points C and D, and other parts of the string, drop light pieces of paper, and touch that part of the string represented by A, E, with the bow of a violin, all the pieces of paper, except those lying on the points C and D, will be immediately thrown off by the vibration thus excited. The points C and D are called vibration nodes.



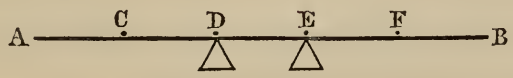
Let A,B be now divided into five equal parts by the points C, D, E, F, and let a moveable bridge be placed at E. On the points C, D, F, and on any other parts of the string at

pleasure, place small pieces of paper as in the former experiment, and put A, E into a state of vibration by the violin bow; all the papers will be thrown off except those which are on the points C and D. The tone produced will be to the whole string as 5 : 2.



Divide the string A, B into six equal parts by the points C, D, E, F, G, and let the bridge be fixed at the point F. Upon the points C, D, E, G, and other parts at pleasure, place pieces of paper as in the former experiments. If F, B should be made to vibrate, all the papers, except that at D, will be thrown off, and a tone will be produced which will be to the tone of the whole string as 6 : 2, or 3 : 1.

If the whole of the string be made to vibrate, the bridge being entirely removed, and papers being placed promiscuously upon any or all parts of it, they will all be thrown from their places.



Divide the string A, B into five equal parts, by the points C, D, E, F, and cut off the part D, E by two bridges. Upon C and F, and other parts of the string, place paper, as already described, and cause E, D to vibrate. All the papers, except those on C and F, will be thrown off, and the tone produced will be to the tone of the whole string as 5 : 1.

From these experiments M. Voigt deduces a series of laws by which the vibration nodes are apparently governed. These principles we shall endeavour to state in a popular manner.

1. The vibration nodes are the only parts of a string in an absolute state of rest.

2. Vibration nodes can only be produced in those cases in which the tones have a certain ratio to the fundamental tone. It must not, however, be expected that this experiment can be made when the string is divided into a great number of parts, as, for instance, to adduce the example employed by the author to whom we have referred, when a string twenty-six inches in length is divided into forty or fifty parts : in this case the vibration nodes are so near to each other, that the paper can scarcely fail to cover more than the point which is at rest, and consequently will be thrown off.

Hitherto we have confined our attention to one class of vibrations ; but solids, whatever may be their nature, may be made, if of a proper form, to vibrate longitudinally. These vibrations resemble those produced in a column of air in an organ pipe. They are, however, more frequent ; for the velocity with which an impulse is transmitted by solids, is very much greater than by air. They may be obtained by holding a long bar of iron or brass in the middle of its length, and striking one end by a small hammer.

Dr. Chladni was the first philosopher who exhibited the longitudinal vibration of solids, and proved that the laws in this case differ entirely from those which relate to transverse vibrations. This he did first of all, in his " Theory of Sound *," in reference to strings, and afterwards to rods. All his experiments seem to have been performed under the conviction

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* Entdeckungen über die Theorie des Klanges, p. 76.

that solids might be made to vibrate in the same manner as a column of air in wind instruments.

A string in a state of longitudinal vibration is considered by Chladni not as a filiform body rendered elastic by tension, but as a solid extended in length, and vibrating in the same manner as a rod fastened at both ends. The longitudinal vibrations of a string may be throughout its length, or in the separate parts into which it is divided ; each being subject to the same motion. The tones, which, compared with those obtained from transverse vibrations, are exceedingly high, are to each other as the number of vibrating parts. The tones produced by the longitudinal vibrations, like those obtained from the transverse, are in inverse ratio to the length of the strings. In the transverse vibrations, however, the sound greatly depends on the thickness of the string ; but in the longitudinal, this has no influence. The nature of the substance, on the other hand, which has no effect on the tones produced by transverse vibration, has upon those obtained from the longitudinal. The note from a brass string of a certain length is about a sixth higher than that produced from a cat-gut string, and that from steel nearly a fifth higher. The only conditions in the production of a particular note from strings having a transverse vibration, are length, tension, and density.

The best method of producing the longitudinal vibration of rods is, according to Chladni, by rubbing the rod in the direction of its length, with some soft substance covered with powdered resin, or by the finger. If glass tubes are employed, they should be rubbed with a piece of rag spread over with fine sand, the tube being held at one of the nodes. " In all longitudinal vibrations," says the same

author, "the tones depend merely on the length of the sonorous body, and on the quality of the substance, the thickness and form being of no consideration; yet the tones are not varied by the specific gravity of the vibrating substance, for fir-wood, glass, and iron, give almost the same tone as brass, oak, and the shanks of tobacco-pipes." He also speaks of several kinds of longitudinal vibration: in one, to use his own words, "there is a certain point in the middle at which the vibration of each half stops; in the next there are two, each at the distance of a fourth part from the end, and in the following there are three or more. The tones correspond with the natural series of the numbers 1, 2, 3, 4, &c. If a rod be fastened at one end, during the first kind of longitudinal vibration, the alternate expansion and contraction of the whole rod will take place in such a manner, that they stop at the fixed end; in the next tone there is a resting point at the distance of one-third from the free end; and in the following there are two. The tones correspond with the numbers 1, 3, 5, 7, and the first of these tones is an octave lower than the first tone of the same rod when perfectly free."

We must now turn to a more generally interesting and not less important branch of the science of vibrating strings, the application of the facts and laws already explained. With regard to the last-mentioned subject, the longitudinal vibration of solids, it is necessary to observe, that we shall not at present allude to any instruments formed on this principle, they will be more properly considered, when we speak of vibrating plates and bars.

Musical instruments, like all other works of art among

the ancient nations, were in a rude and imperfect state. The arts have invariably been aided by the progress of science, and should never precede it. An accidental discovery will sometimes lead to a great improvement in some one branch of the arts; but if this be not afterwards established on some philosophical principle, there is no security for the permanence of the information. We have only to take a review of the arts which flourished among the Egyptians, to obtain evidence of the truth of these remarks. Their knowledge was empirical, and one by one their arts were lost; and although we have in the present day specimens of their ingenuity, we have no information concerning the processes they adopted. The arts, therefore, may be said to depend on scientific knowledge; and when we consider the uncertain state of the practical sciences, we may readily account for the imperfection of the instruments employed by the ancients. This was more especially the case in all musical instruments, in the construction of which a more than ordinary amount of scientific knowledge is required.

In attempting to describe the musical instruments which are composed of vibrating strings, it will be better to speak first of those which are in use among the moderns, for a passing notice of the ancient inventions will be sufficient.

The violin, which has four strings, tuned to fifths, and played with a bow, is one of the most important stringed instruments, for it is the most powerful, perfect, and generally available that has ever been invented. Its tones, when touched by an unpractised hand, are harsh and far from melodious; but when the instrument is held by a master, not to say by a Paganini, they are full, rich, and surprisingly

powerful. In almost all cases it is the leading instrument in an orchestra, and the perfection of its intonations is not equalled by any other stringed instrument.

It has been doubted by many writers, whether any instrument played by the bow was known to the ancients. Others, however, have entertained a different opinion, founded on the fact, that a little figure of Apollo playing on a kind of violin, in the collection of the Grand Duke at Florence, had something in his hand like a bow. This figure, which Mr. Addison supposed to be ancient, has been proved to be of modern workmanship, and it is therefore now almost unanimously allowed by all recent writers, that the ancients were unacquainted with the use of the bow.

We are informed by Burney, in his "History of Music," that on the largest Egyptian obelisk brought from Egypt by Augustus, and fixed in the Campus Martius, there is a sculpture of a stringed instrument which deserves notice. When the ancient city was sacked and burned in the year 1527, by the Duke of Bourbon, general of Charles the Fifth's army, this column was thrown down and broken, and still lies, it is said, in the Campus Martius, and is known among the inhabitants as the *guglia rotta*, or broken pillar. Upon this, Dr. Burney observed the representation of a musical instrument of two strings, with a neck resembling the calascione, an instrument still used in the kingdom of Naples.

From this figure it may be supposed that the Egyptians had made some advance in musical performances, for, although the instrument had only two strings, many notes might be obtained from it. Dr. Burney says, that he has never been able to find, in any remains of Grecian sculpture, an instru-

ment with a neck, and quotes the observation of Montfaucon, who, after examining the representation of nearly five hundred ancient lyres, harps, and cytheras, had not found one, in which there was any contrivance for the shortening of the strings during the time of performance by a neck and finger-board, as there must have been in the Egyptian instrument.

The French writers say that the violin was invented about the ninth or tenth century, but by whom or where they cannot determine. "To this opinion we should have subscribed," says a modern author*, "had not some ancient monuments remained with an exact representation of its form. In the pictures of Philostratus in an ancient grotto, may be seen many violins, which are represented much like those of the present times, except that the neck is shorter. Amphion is there represented playing upon a viol or a violin, with five strings and with a bow like ours, and quite different from the plectrum of the ancients. It is believed that Athenæus means the bow, when he says 'the sceptre is one thing and the plectrum another.' It is imagined that by the sceptre he means the bow, which is very probable, especially after the ancient monuments, of which we have preserved the figures. The pit or grotto, on the walls of which we see violins like the present, is found on silver medals, which were struck by order of Scribonius Libo, a very considerable personage at Rome. An account of these may be seen in Pierre Valerien, author of the Hieroglyphics."

Galileo says, that "both the violin and bass, or violoncello, were invented by the Italians, perhaps by the Neapolitans."

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* Rees's Encyclopædia.

This opinion may be accurate, but upon what evidence it can be proved we do not know. The rebec, an instrument of three strings used by the romancers and troubadours of the middle ages, was the first kind of violin used in France. We believe that a figure of Colin Muset, the minstrel, playing on this instrument, is still preserved in the entrance of the church of St. Julien de Menestriers at Paris. The three stringed instruments are still used in Turkey, and other eastern countries; and when the fourth string was added, cannot be determined. It appears, however, that the oldest violins are those made by Amati, at Cremona, in the reign of Charles the Ninth, which are to the present time most highly esteemed, and considered to be the finest instruments. Corelli's violin was made in the year 1573.

The violin was introduced into the French and Italian courts some time before it was known in England. In the reign of Charles the Second it came into use, but chiefly for the performance of light music. This prince established a band of twenty-four violins, tenors, and basses; and from that time the violin has held the most important place in every band, except those strictly military. Soon after this the Italian music was introduced, and a more cultivated taste was excited.

In the last century, Giardini, the first violinist of his day, visited England, and formed a school which supplied us with a greater number, to use the words of a modern writer, of able performers than can be found in the capital of any other country in Europe.

The violin is especially adapted for the performance of light airs, and might be considered, when in the hands of

a moderately good performer, as suited only to the simplest music, and to dances in particular. It is, however, well known to those who have had an opportunity of hearing the best performers, that no music is too difficult; and its power and variety of intonation is so great, that it is as fitted for the grave as the lively, and the most solemn church music may be played on it with full force of expression.

It has been already remarked that the violin is tuned to fifths; the second string is tuned to a fifth below the first, the third a fifth below the second, the fourth, a fifth below the third.

It is not necessary that we should, after what has been said concerning the violin, make many observations on the violoncello, an instrument which is a natural bass to the violin and tenor. It is at the present time much used by musical performers, and is remarkable for the sweetness of its tones, its power, and compass. The bass-viol, a six-stringed instrument, was once commonly introduced in concerts; but it was so defective in execution, and the nasal quality of its tones were so unpleasant, that it never became a favourite, although Abel, "by his exquisite taste, prodigious execution, genius, and profound knowledge of composition, delighted all hearers, and made them forget, or at least forgive," the defects of the instrument. As the viol lost favour with the English public, the violoncello was introduced; and Cervetto the elder and younger, Caporale, Gordon, Paxton, and Crosdil, have been in their times celebrated performers; but none, perhaps, have excelled Lindley, who as early as the year 1804 was pronounced a wonderful player, and is still unequalled.

The violone, or double-bass, is an instrument similar in form to the violoncello, but nearly twice as large, and having strings larger and longer in proportion. It is tuned to an octave below the violoncello. In the method of tuning, however, there is a considerable difference, for some performers use three, and others, four strings. The violone is an exceedingly useful and important instrument when used judiciously; it should be introduced to sustain the harmony. "Divided basses are improper for it, the strings not answering immediately to the percussion of the bow: these can only be executed with good effect on the violoncello, the sounds of which are more articulate and distinct."

The harp is a stringed instrument of some antiquity, but its precise origin cannot be determined. Philologists have disputed about the derivation of the name, each supporting that analogy which best suits his own theory. Some writers are of opinion that the word harp is derived from the Latin *carpo*, because touched with the fingers; some attribute the invention to the Arpii, an Italian tribe, who are by these persons supposed to have invented it; while others trace it from the Anglo-Saxon word *harpa*. Many other opinions have been expressed, but what dependence can be placed on them, we do not pretend to determine.

The harp in its many different forms has been a favourite instrument among almost all ancient as well as modern nations, and especially among our forefathers.

> "A harpe well playde on shewythe swete melody;
> A harper with his wrest may tune the harp wrong,
> Mystuning of an instrument shal hurte a true song."
>
> SHELTON.

"And can no lesse
Tame the fierce walkers of the wildernesse
Than that Œagrian harpist, for whose lay,
Tigers with hunger pinde and left their pray."

BROWNE.

Of the harps used by ancient nations, we shall have occasion to speak presently; that now commonly employed in Europe is a triangular formed instrument, and stands upright between the legs of the player. The strings are touched with the fingers of both hands. The harp in the days of the romancers was very highly esteemed by all classes of society, and hence it is that they always place it in the hands of their heroes. An ancient writer, speaking of it in terms of the highest praise, says, "that it is too solemn an instrument to be profaned in taverns and places of merriment, and should be used only by knights, esquires, ladies with beautiful hands, clerks, and men of highest quality."

Mr. Walker, in his "Historical Account of the Irish Bards," informs us, that the Irish have four different kind of harps.

1. The *clar-sch*, or *clar-seach*, which is distinguished pre-eminently as the Irish harp.

2. The *keirnine*, a species of dulcimer.

3. The *cionu-cruit*, an instrument of ten strings, which might with more propriety be called a guitar.

4. The *greamthine-cruit*, which is the *crŵth* of the Welsh.

There can be little doubt that the harp has long been a national instrument among the Irish, whether before or after its introduction into England, is disputed. Galilei, the father of the celebrated Galileo, says, that the harp was known to the Italians before the time of Dante, and that they were first made acquainted with the instrument by the Irish. In

the Appendix to Walker's "Irish Bards," we find an interesting paper on the Irish Harp, by the Rev. Edward Ledwich; and from this we must be permitted to make one or two extracts, as the author's opinions will be best conveyed in his own words. He considers the harp to have been altogether unknown to the Greeks and Romans, except as they may have seen it in the hands of the people whom they conquered. That it was confined to the northern European tribes is probable, as it is not mentioned by Isidore Hispalensis in his "Origines," or by Suidas in his "Lexicon." The Anglo-Saxons introduced it into Britain. The ancient Britons, or rather the Bards, who were a sacred class, played on the crŵth. The state of music among the Teutonic tribes, may be gathered from the following allusion to the Sarmatians by Ovid:—

> "Omnia barbaricæ loca sunt, vociquæ ferinæ,
> Omnia sunt Getici plena timore soni."

The harshness and discord of voice peculiar to the Germans, and mentioned by many of the ancient writers, was not, it may be supposed, in any way compensated for, by their national instrument the harp. "Inflamed with a thirst of conquest, and eager to possess alone that fertile isle, they almost exterminated the natives, and totally erased every vestige of Roman and British civility. The gentler modulations and softer harmony of the crwth were equally despised with its performers and admirers: this instrument was banished to Wales, Cornwall, and Armorica; in the last country Venantius found it in the sixth century.

"The Irish, I think, received it in the fourth and fifth centuries, from their close connexion with the Saxons, and

other rovers from the Baltic shores, who conjunctly ravaged the coasts of Britain and Gaul in those ages. I know that Mr. Macpherson has ingeniously combatted the opinion of this connexion, but it is impossible to invalidate all the arguments supplied by antiquity in its favour. Giraldus Cambrensis speaks of St. Patrick's harp, which, if any faith is to be placed on legends, he might have brought from Tours, where he studied ; and where, no doubt, it was cultivated by the barbarians. The harp is mentioned by Ido in the ninth century ; he was a monk of St. Gall. The founder of this abbey being an Irishman, and the monks for the most part, of the same nation, who fled from the Danish tyranny, they could be no strangers to this instrument."

" The harp is now the national emblem of Ireland, and there has been much dispute as to the time when it was adopted. Hereditary coats of arms were not introduced in Europe till about the middle of the eleventh century. Hector Boethius relates, that on a treaty concluded between Charlemagne and the Scottish king Achaius, A. D. 791, it was granted that the latter prince should bear a red lion in a counter-charged border of fleurs-de-lis. As the Irish were equal favourites with that great monarch, he might have conferred the same honour on our kings ; though from what has been advanced, there is not the least probability of this being so. Besides, had the taste for heraldic pageantry been then fashionable, some specimens would have been displayed on his coins, whereas they exhibit nothing but simple monograms."

There is sufficient evidence to prove, that in the reign of Henry the Third, Wales, Scotland, and the Isle of Man, had their armorial bearings, and even the principal nobility of

the kingdom, but there is no allusion to the arms; from which circumstance we may fairly conclude that Ireland had none. When Henry the Eighth was proclaimed king of Ireland, he gave the national arms, and as he could find (we express the opinion of an Irish author) no other thing in which the people excelled, than in their performance on the harp, (always excepting their bravery,) he gave them that instrument as their national emblem.

The triple harp of the present day has five octaves, from double C in the bass to double G alt. It has altogether ninety-seven strings, which are placed in three rows, the two outer are in unison, and the middle give the semi-tones. On the right-hand side are the bass strings, thirty-six in number; on the left the treble, twenty-six in number; and in the middle there are thirty-five strings.

How greatly the harp has been esteemed by the Welsh, may be gathered from the laws which have been made to encourage the practice of it among persons of quality. The possession of a harp, and an ability to play upon it, was one of the three qualities required to constitute a gentleman. The slaves were not permitted to own one, and all persons were forbidden to teach them the art of playing. The king, the king's musicians, and gentlemen, were the only persons who were permitted to have a harp in their possession. The value thus placed upon the instrument was no doubt the reason why it could not be seized to liquidate a debt, for to have lost it would have been paramount to a loss of rank.

In the sacred Scriptures there are frequent allusions to the harp. David is said to have played on the harp before Saul; and when raised to the throne frequently exercised him-

self on the same instrument. We have no evidence, however, that the instrument which the Hebrews called the *chinnar*, and which we have translated the harp, at all resembles either of those to which we have alluded in the preceding pages. There is nothing more difficult than to distinguish or describe the ancient musical instruments. Many representations of these may be found on ancient sculptures, but what names are to be given to them must be a matter of conjecture. On a Hebrew medal of Simon Maccabæus, two stringed instruments are exhibited, but neither of them has more than four strings, and cannot therefore at all resemble the modern harp.

That the lyre used by the Romans is a very different instrument from the harp, all writers believe; and we have the best evidence of the fact in the following passage from Fortunatus, who places the two instruments in contrast :—

> " Romanusque lyra, plaudat tibi barbarus harpa,
> Grecus Achilliacha crotta Britanna canat."

In one of the grottos of the first kings of Egypt, Mr. Bruce, the African traveller, observed a painting of the Theban harp, to which we must allude before we pass on to consider any other musical instrument. When his description and drawings were first made public, many persons objected to them, and indulged in expressions of incredulity not altogether fair to the enterprising traveller. The truth of his description is now attested by Sir William Jones, and the French philosophers who visited Egypt with Buonaparte.

To the north-west of the ruins of the Egyptian Thebes there are several " mountains," which have been hollowed as tombs, and are said to contain the bodies of the kings of

Thebes. In the most considerable of these "mountains" there is one cave which contains a large granitic sarcophagus, quite perfect, except that the lid is broken. At the end of the passage leading to the chamber in which the sarcophagus is placed, there is the figure of a man playing on the harp, painted on the wall in fresco. This figure attracted the attention of Bruce, and the account he has given is peculiarly interesting, not only as affording evidence that the harp was probably known at a very early age, but also that it is quite impossible ever to know the extent of information among a people who do not possess the art of printing.

The figure is dressed in a costume similar to that still worn by the men of Nubia. The body is covered by a shirt reaching to the ancles, and apparently formed of white muslin with narrow strips of red ; the feet are uncovered. The dress is gathered above the elbow, so that the neck and arms are left bare. The figure is in a stooping posture, the right hand being at the bottom of the instrument, as though the performer were about to strike all the notes upwards with great rapidity. Taking the stature of the man at about five feet ten inches, the harp was estimated at something less than six feet and a half. The instrument, according to Burney's description, wants "the fore-piece, or stay of the frame, opposite to the longest string, which certainly must have improved the tone, and that deficiency must have rendered it very subject to go out of tune. The back part is the sounding-board, composed of four thin pieces of wood joined together in the form of a cone, that is, growing wider towards the bottom, so that as the length of the string increases, the square of the correspondent space in the sounding board, in which the

sound is to undulate, always increases in proportion." The harp has thirteen strings, and therefore the addition of two more would have formed two complete octaves. Whether we are to consider the omission of these as an error committed by the painter, or whether the instrument was in this respect defective, cannot at present be determined. Taking into consideration the fact, that the painting was evidently done by one who was not a master of his art, that the instrument is constructed on scientific principles, and decorated in an ingenious and even elegant manner,—we are not unwilling to believe that the want of two strings may be traced to the negligence or ignorance of the painter. This view of the question is not, however, that proposed by Burney ; for he says that if the harp be painted in accurate proportion, it could not bear more than the thirteen strings ; but to this he adds—and the remark in some degree destroys the first objection—that if the four longer strings were made of the same size and density as the strings of the modern harp, and tuned to the same pitch, they would of themselves break the cross-bar. But however this question may be settled by any discovery that may be hereafter made, it is quite evident, that the harp must have been known in Egypt at an early age.

Before we pass on to consider the manner in which other stringed instruments are constructed, and to give a brief history of their invention and introduction into various countries, it may be necessary to refer again to the action of vibrating cords. In some of the musical instruments already described, the strings are formed of the same material, and differ only in thickness, while in others different substances are used. In the violin, for instance, we have a four-stringed instrument,

and all the strings are formed of cat-gut; in the violoncello, a metallic string is introduced; and in the harp we have not only strings formed of different substances, but also of various lengths. The sounds produced from musical strings are, as already proved, more and more grave, as their lengths and diameters are increased, and as their tension is decreased. In every attempt to produce musical sounds from vibrating strings, regard must be paid to the intensity and perfection of the tones, that they may be sufficiently full for a certain length of time. When the diameter of a string is too large, the sound will not last; and when too small, its intensity will be less than is desired. These facts will immediately suggest to the reader, that the same material cannot be employed with equal advantage in all instances. We must sometimes add to the weight or density of a string, instead of increasing the diameter as much as would otherwise be necessary. This is frequently done (as in the harp and other strings) by wrapping thin wires round them.

Cat-gut, an animal fibre, is more commonly used than any other substance for musical strings, and is the best that can be employed. The principal objection to it is, a great liability to be affected by hygrometrical changes. The moisture or dryness of the atmosphere causes it to contract or expand, and to this must be chiefly attributed the great difficulty of keeping a stringed instrument in tune. The strings of the harp are broken from the same action. An attempt was made, many years since, to use silk instead of cat-gut. A sufficient number of the single threads of the silkworm were taken to form a cord of the required thickness; these were smeared over with the white of eggs, which was rendered

consistent by passing the threads through heated oil. The string was exceedingly uniform in its thickness, but produced a tone which the performer called tubby. We are not aware that an effort has been since made to introduce any other substances for musical strings.

The next and most important stringed instrument demanding our attention is the harpsichord. All the instruments hitherto spoken of are either played with the fingers or with a bow, but this with keys, which are made to act on a mechanical arrangement called a jack. The jack is usually constructed of pear wood, and has a tongue and quill. It rests on the end of the key, and when thrown up by pressing the key downwards, the quill strikes the string, and returns to its place when the pressure is removed. The tongue moves on a swivel, and being thrown back by passing the string, is forced into its perpendicular position by a spring behind it. A double spinet or virginal is in fact the same as a harpsichord of two unisons and one set of keys. The double harpsichord has two sets of keys. The instrument was at first defective in tone, but at the commencement of the eighteenth century the hammer harpsichord was invented at Florence, and notwithstanding the imperfection of its mechanism, the instrument was greatly admired. The first pianoforte (for such is the name now given to the instrument) that was brought into England, was made by Father Wood, an English monk at Rome, for Mr. Crisp, and was afterwards purchased by Mr. Greville for one hundred guineas, being then unique in this country. For some time the instrument excited but little public attention, for no effort was made to introduce it,

until Plenius, the maker of the lyrichord, constructed one in imitation of that in the possession of Mr. Greville.

A very full description and history of the pianoforte is given in the "Giornale d' Italia*," but we cannot follow the author through all his details. It is said to have been invented by Bartolommeo Cristofali, a harpsichord maker in the service of the grand duke of Tuscany. Backers was the first person who constructed any number of pianofortes in England, and although he improved the mechanism of the parts in several particulars, his instruments wanted the spirit of the harpsichord, and their tones were little if at all superior. Many attempts were afterwards made by various persons, with no better success, and at last it almost became a matter of doubt whether an improvement could be introduced to supersede the harpsichord. The instrument makers, however, were not discouraged, in spite of their failures, but were put in the right course, though for them too late, by Zumpé, a German, who commenced the manufacture of small pianofortes, of the size and shape of the virginal. The tone and execution of these were much admired, and the demand was so great that he could not possibly supply a sufficient number to meet the demand. This was in some respects a public disadvantage, for there were many manufacturers, imperfectly acquainted with the method of construction, who were from this cause able to dispose of their imperfect instruments to those whom Zumpé could not supply.

At different times the pianoforte received great improvements in the construction and tone; we may especially notice

* Tomo v. p. 144.

Merlin, Broadwood, and Stoddard, among those who assisted in bringing it to the present perfect state. It is now an almost universal instrument. There are few families which do not possess one, and wherever it is found there is a never-failing source of delight. The pianoforte is in every respect a domestic instrument. Around it the members of families and the friends who form almost a part of the household, assemble, and enjoy the high pleasure of reciprocally pleasing and being pleased. The music of all ages, and the productions of men of the greatest genius, are now not only possessed, but appreciated in the parlour (a room especially the place of enjoyment) of almost all English families in the middle walks of society.

The pianoforte is especially adapted for domestic purposes; its tones are rich, full, and calculated to accompany the human voice; it is but little affected by hygrometrical changes in the atmosphere; it is easily tuned when required; and, above all, it has a great capability of execution. The ancients were altogether unacquainted with keyed instruments; they possessed stringed instruments, as we shall presently have occasion to prove; but the vibrations were always produced either by striking the cords with some substance of a convenient shape, or with the fingers. The introduction of keys greatly facilitates the operations of the performer, and gives him an opportunity of a desirable execution. In the pianoforte, and also in other keyed instruments, twelve notes are produced in each octave, seven from white and five from black keys, not including the octave.

The lute was a favourite instrument in this country during the sixteenth and seventeenth centuries. It is now but little

known, and seldom if ever practised. The older poets frequently mention it, and give us reason to believe that it was in their times common in many other countries beside England. Thus Chaucer, in his Pardoner's Tale, says,—

> In Flanders whilom was a compagnie
> Of younge folke that haunted in folie,
> As hazard, riot, stewes, and tavèrnes;
> Whereat with harpès, lutès, and guitèrnes,
> They daunce and play.

There are many other stringed instruments which might be here described, but we shall only mention the guitar, or guittara. It is an instrument which has been popular in almost all the southern countries of Europe, and is still a national instrument in Spain and Portugal. It is stated as an historical fact, that the Portuguese having once lost a battle, fourteen thousand guitars were found on the field. In the time of Louis the Fourteenth, the guitar was common in France. It was probably brought into Spain by the Moors, and the Spaniards undoubtedly introduced it into the other parts of Europe. Its tones are rich and melancholy, and admirably suited to the listless and amorous character of the inhabitants of southern climes. It may be, as a modern author suggests, that the silence of the beautiful nights in Spain, when the inhabitants are most alert and active, is favourable to its mild and dulcet harmony.

About the middle of the last century, the guitar was so fashionable in England as to threaten the ruin of those persons engaged in the manufacture of other instruments. The use of the guitar is said to have been stopped by Kirkman, a harpsichord maker. Having bought a number of cheap

guitars, he gave them to ballad-singers, and persons in the lowest sphere of life, teaching them at the same time how to play a few popular songs. As soon as the instrument became common, those who had been most interested with it as a fashionable toy, threw it by in disgust, and commenced again the study of the pianoforte. Thus it is that fashion governs the inventions of the wisest, and consigns to neglect, or raises into estimation, the talents, genius, and industry, of the greatest men in all ages and countries.

The Spanish guitar is much larger than that used in England. It has sometimes four strings, and the neck of the instrument is divided into ten parts by notches or frets, which direct the performer. The strings are attached to a bridge at the lowest part of the belly. Five double strings are now frequently employed, and its compass is two octaves and a fifth.

The guitar is still esteemed, but less for its own merits than for its association with the history of the romancers. The very name recals the imagination to scenes which passed in review before the mind in the days of childhood and youth—the festive scene with its gay appendages ; the mournful and heart-broken lover ; the gay gallant, and the anxious maiden, who cheered her hopes with the songs which encourage the warrior.

In reference to the stringed instruments of antiquity but little can be said, unless we were to enumerate all the opinions which have been expressed by various authors, a task by no means calculated to give the reader satisfaction. The names of the principal instruments are, the lyre, cithara, chelys, psaltry, and harp. We have had already occasion to state

that the harp must have been a very different instrument from that now employed. Montfaucon says that he has examined the representations of six hundred lyres and citharas in ancient sculpture. Burney, in his " Reflections on the Construction of Ancient Musical Instruments," quotes a passage from Quintilian, which seems to give us some idea of the difference between ancient musical instruments. " Among the stringed instruments you will find the lyre, of a character analogous to masculine, from the great depth or gravity, and roughness of its tones ; the sambuca of a feminine character, weak and delicate, and from its great acuteness, and the smallness of its strings, tending to dissolve and enervate. Of the intermediate instruments, the polypthongum partakes most of the feminine ; but the cithara differs not much from the masculine character of the lyre."

From this description we learn that the Greeks had two classes, as they imagined, of stringed instruments ; one producing tones called masculine, the other those which were considered of a feminine character. The Greeks were especially distinguished by a regard to nature in all their works. To them we are indebted for the noblest specimens of architectural taste, and, if we may believe their disciples and annotators, they established the three orders from a consideration of the human fignre. The Doric represents masculine strength ; the Corinthian, virginal elegance and grace ; the Ionic, matronal simplicity, and an avoidance of redundant ornament. So, it appears from the passage just quoted, they were accustomed to classify their instruments. There are two characters mentioned—the lyre, distinguished for its masculine tones, and the polypthongum, an instrument spoken of

by Homer, for its feminine character. Between these two extremes there were, in all probability, many varieties, the cithara resembling the lyre, and the sambuca having a similarity to the polypthongum.

The ancient lyre of the Greeks was an instrument of seven strings. This fact we may learn from the celebrated Spartan edict against Timotheus. Timotheus was born at Miletus, 446 years before Christ, and was the most celebrated poet and musician of his day. According to many ancient writers, the Grecian lyre had at first only four strings, and three others were added to it by Terpander. A hundred and fifty years after that period, Pythagoras added an eighth. Among the Spartans, however, the instrument could have had only seven strings, as will appear from the following curious proclamation against Timotheus: "Whereas Timotheus, the Miletian, coming to our city, has dishonoured our ancient music, and, despising the lyre of seven strings, has, by the introduction of a greater variety of notes, corrupted the ears of our youth; and, by the number of his strings and the novelty of his melody, has given to our music a curious and effeminate dress, instead of the plain and orderly one in which it has hitherto appeared; rendering melody infamous, by composing in the chromatic, instead of the enharmonic . . . The kings and the ephori have resolved to pass censure upon Timotheus for these things; and further, to oblige him to cut all the superfluous strings of his eleven, leaving only the seven tones; and to banish him from our city: that men may be warned for the future not to introduce into Sparta any unbecoming customs."

The lyre was highly esteemed by the Greeks, and its inven-

tion was assigned to the gods. Some say it was discovered by Mercury, while others attribute it to Apollo, or Orpheus. Most writers, however, consider Mercury to have the highest title to the honour. Apollodorus gives a pretty fable, to account for the invention of the lyre: the waters of the Nile, when they overflowed their banks, threw a turtle on the shore, which died, and was not swept away by the retiring flood. Exposed to the atmosphere, the animal substance was soon decomposed, and nothing was left but the shell and the tense fibres. The Egyptian Mercury, when walking by the shore, observed and examined the remains of the animal, and immediately afterwards constructed the lyre in imitation of what he had seen.

Although the ancients had many stringed instruments, more than we are acquainted with, there are only two representations of instruments with necks—one on the obelisk at Rome, and one in the sepulchral grotto in the city of Tarquina. The allusions to musical instruments are frequent in the Greek and Roman writers; but they do not generally give a description of them. Little dependence can, on the other hand, be placed upon the various representations in ancient sculpture, for none but the most simple instruments are introduced.

CHAPTER VI.

VIBRATING PLATES AND BARS.

All solids, when in a state of vibration, give out sounds. The pitch of these sounds depends on the frequency of the vibrations; and their quality and strength are governed by the nature of the vibrating body, the extent of the undulations, and other mechanical circumstances.

In the last chapter, we have considered the vibration of one class of solids, namely, strings. The motion in these bodies is produced by an external tension; but in plates, bars, bells, and vessels of various kinds, the vibrations result from their own elasticity. When speaking of strings, we took occasion to describe the nature of longitudinal vibrations, not so much because it was a subject strictly belonging to that part of our inquiry, but because it assisted our investigations. Referring again to the character of the vibrations produced in solids, it will be remembered that an undulation may be propagated through them in the same manner as in an elastic fluid, and obeys the same laws; or they may be struck in the direction of their length, and the vibration is then said to be longitudinal. The nature of these longitudinal vibrations may be still further illustrated by a description of the euphone.

The euphone is an instrument invented by Dr. Chladni. This philosopher, when examining the nature of sonorous

bodies, imagined the possibility of producing musical sounds by rubbing glass tubes longitudinally. "I was quite aware," he says, "that tones could not be obtained by merely rubbing glass tubes, and it therefore became a question of great difficulty to determine the manner in which the instrument should be constructed." For more than eighteen months his mind seems to have been engrossed with the idea of producing a new instrument; yet the difficulties which stood in his way were augmented rather than diminished. The manner in which he at last obtained his object is remarkable, but is related by himself, and may therefore be repeated. In the summer of 1789, he returned home in the evening, exhausted with walking, and fell asleep in his chair, but had scarcely closed his eyes when the arrangement which he had been so long seeking was presented to his mind. He immediately started up, recovering all his enthusiasm, and after a few experiments, convinced himself that his object had been attained. In March of the following year, he had completed his instrument, and was able to play upon it a few simple tunes. In every respect it answered his expectations, but in its construction was so deficient in strength that it was constantly needing repair, and to have conveyed it a mile, he says, would have almost totally destroyed it.

The euphone, a name which signifies an instrument that has a pleasant sound, consists of forty-one fixed and parallel cylinders of glass, of equal length and thickness. They were at first, for want of better materials, constructed of thermometer tubes, the whole and half tones being distinguished by a coating of sealing-wax on the under side. Tubes of different colours are now employed for the same purpose. The euphone,

in its external appearance, resembles a small writing-desk, which, when opened, presents a series of glass tubes, about the thickness of a quill, and about sixteen inches long. In the back part of the instrument, there is a perpendicular sounding-board, into which the tubes are fixed. When used, the tubes are wetted with a sponge, and stroked in the direction of their length with wet fingers, so that the intensity of the tone may be varied by a greater or less pressure.

From the pains which the Doctor has taken to compare his own instrument with the harmonica, it would appear that some persons in his own day considered it as only a modification of that instrument. He has given seven reasons why an unprejudiced person should prefer the euphone.

1. It is less complex in its construction, and requires neither turning nor stamping, but merely the motion of the fingers.

2. The tone is given out as soon as touched, and the full power of the instrument may be obtained; whereas in the harmonica the intensity of the tones must increase gradually.

3. It has more distinctness in quick passages, as the tones do not resound for so long a time.

4. The unison is more perfect than in the harmonica, for in that instrument it is difficult to obtain glasses which in every part shall give tones with mathematical exactness. The euphone, however, he acknowledges, is as difficult to tune as the harmonica.

5. It does not affect the nerves of the performer, for he scarcely feels the slightest agitation in the fingers; but when playing the harmonica, particularly the concords of low notes, the vibrations are felt throughout the whole system.

6. The expense of the instrument is less than the harmonica.

7. When any portion of the instrument is broken, it is easily repaired, and at a small expense.

These are Chladni's reasons for recommending the euphone in preference to the harmonica. Whether he has been guided by the prejudice which an inventor naturally feels for his own instrument, we cannot pretend to state, as we have not hitherto met with an opportunity of examining its claims to attention.

Sir John Herschel still further explains the construction of this instrument, in the following passage: "The longitudinal vibrations of a rod of glass, excited by rubbing it with a wet cloth, may also be used to excite vibrations in a given point of a solid perpendicular to its surface, by applying its end to it, or cementing it to the solid by mastic. In this way Chladni applied it to draw forth the sounds of glass vessels, (which, when hemispherical, and of sufficient size and even thickness, are remarkably rich and melodious,) in an instrument which he called the euphone, exhibited by him in Paris and Brussels. The principle of this instrument was at the same time concealed; but the enigma was subsequently solved by M. Blanc, who on his part made the same remark, and applied it to a similar purpose." The euphone, therefore, although producing sounds by longitudinal vibrations, is also an illustration of the manner in which vibrations are communicated—a subject to be hereafter considered.

Although musical sounds are sometimes obtained from solids by longitudinal vibrations, the most common method of producing undulations is by forcibly disturbing the exter-

nal form of the substance. This is done when a bell is struck, and when a plate, or bar, suspended at one point, is touched at another. Dr. Chladni enumerates six conditions under which solids may be put into a state of vibration and produce sounds.

1. When one end of a rod is firmly fixed in a horizontal position, the other being free.

2. When one end is placed in a perpendicular position against a solid, the other end being free.

3. When the two ends are free.

4. When both ends are applied.

5. When both ends are fixed.

6. When one end is fixed and the other applied.

Speaking of the fourth case, the author to whom we have frequently referred, compares the vibrating bar and string. In the latter the successive harmonics are represented by the numbers 1, 2, 3, 4, 5; in the former by the squares of these numbers, 1, 4, 9, 16, 25. In every other case the series is less simple, and hence it is evident that the theory of harmony cannot be established on the aliquot subdivisions of a vibrating string.

Let us now come to the consideration of the effects produced upon a plate in a state of vibration. Let it, for instance, be imagined, that a plate, having a rectangular figure, is fixed at one point, and that the vibrations are produced at another; there will be certain lines or points which will be at rest, in the same manner as the nodes of a vibrating string. To give an ocular proof of the fact, that there are, in every sounding body, certain parts which remain at rest, and others which are in vibratory motion, the surface of the body may be covered with

some light substance, such as sand, which will be thrown from the parts in motion, and accumulated on those at rest. The plate will, therefore, present a series of nodal lines, represented in fact by accumulations of sand, the distances, arrangement, and position of which may be accurately measured at leisure. The origin of the vibration figures formed upon plates in which undulations have been produced, may be traced to the different conditions of the several parts of the vibrating body; the sand, or other light substance employed, being thrown from the parts in motion, and accumulated on the parts at rest. By the adoption of this method of experimenting, it is easy to determine the precise points of vibration and of rest, which will, whatever may be the form of the plate, be regulated by the position of the point of suspension, the centre of vibration, and the parts which are kept at rest.

The service which Dr. Chladni has rendered to this branch of the science of acoustics, induces us to give a short account of his labours, in which we are assisted by his own description, in an article published in a German philosophical journal * in the year 1788. Chladni was the son of a professor of law at Wittenberg, but received a limited education, both under the paternal roof and in the school of Grimma. This induced him, he says, to think for himself, from a very early age, and to give license to the peculiar disposition of his mind. His father, however, guided by a common and perhaps natural desire that his son should follow the same profession as himself, insisted upon his entering as a student

* Magazin für das neueste aus der Physik, vol. iv, p. 100.

of law, which he did, first at Wittenberg, and then at Leipsic, where he took his degree. Soon after this, his father died, an event that freed him from all control, and caused him to resign his profession, and devote himself to the study of philosophy, and the delivery of lectures on physical and mathematical science, preparatory, as he hoped, to an appointment to some professorship. When nineteen years of age, he learned to play the harpsichord, and read many works on the theory of music, but finding them exceedingly defective in all parts which required experimental or mathematical investigation, he resolved to devote himself entirely, though surrounded with many difficulties, to these studies.

Chladni's first experiments seem to have been on the vibration of strings and cylindrical pieces of wood, the latter having been suggested to him by the mathematical calculations of the elder Euler. While thus experimenting upon the vibrations of bodies, he observed that a plate of glass or metal gave out different tones, according to the manner in which it was held, and the part on which it was struck. To determine the cause of this, then became an object of close attention. He fixed in a vice the axle of a brass plate which belonged to a polishing machine, and discovered that the tones emitted, when the bow of a violin was drawn over it, were stronger and of longer duration than those obtained by percussion. This experiment, and subsequent reflection, in all probability led him to the invention of the euphone, an instrument already described. The advantage derived from his investigations did not end here, for his mind was interested in all the facts connected with the production and modification of sound, and formed from them deductions

which were tested by experiment as soon as they were conceived. To him we are indebted for the discovery of that means of investigating the condition of a vibrating solid, to which a brief allusion has been made.

It may be interesting to the reader to know the manner in which Dr. Chladni made his curious experiments on the figures assumed by sand, and other similar substances, when strewed over vibrating sonorous bodies. Take a square piece of glass, such as that used for windows, not less than four or five inches over, and smooth the edges by grinding. Spread over the plate, as evenly as possible, a little sand, and holding it between the thumb and fore-finger, in the middle, pass the bow of a violin against one of its edges, drawing it either upwards or downwards, in a direction perpendicular to its surface. A tremulous motion will be immediately observed, and the sand will arrange itself in some particular and fixed figure. If the bow be passed over the middle of one of the sides, the sand will arrange itself in the direction of the two diagonals, dividing the square into four isosceles triangles. If the bow be applied at any point which is one-fourth the length of the square from any angle, the sand will arrange itself so as to represent the two diameters of the square, dividing it into four equal figures of the same form. If the square be held at the two extremities of either diameter, and the bow be applied to the extremities of the other diameter, the sand will take the figure of an oval, having its major axis in the same direction as one of the diameters.

The experiment made by Chladni on vibrating surfaces, in 1787, soon attracted the attention of philosophers, and M. Voight was one of the first who repeated them, and added

to Chladni's observations on the curious phenomena. In a foreign journal we find one of his papers which deserves our especial attention. Having explained that the accumulation of the sand on particular points, and consequently the figure produced, is occasioned by the state of rest which some parts of a vibrating surface retain, he states as a principle, that to produce such a figure nothing is necessary but to know the method of bringing that part of the surface which you do not wish to vibrate into a state of rest; and of putting into motion that which you wish to vibrate. To do this, some parts of the plate must be damped, that is to say some parts must be brought into contact with a solid body, or suffer pressure by some other means. The damping may, he says, be best effected by laying hold of the place to be damped between two fingers, or by supporting it only by one finger, or on a piece of cork.

No apology will be required for the introduction of the following translation from M. Voigt's paper on vibrating surfaces. When you wish to produce any figure you must first form it, in idea, on the plate, so that you may be able to

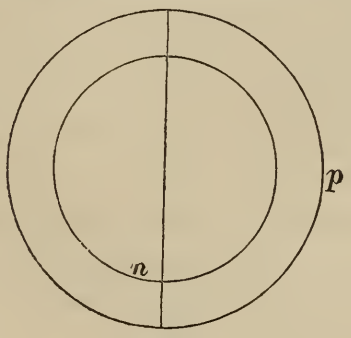

Fig. 9.

determine where a line at rest, and where a vibrating part, will occur. The point of greatest repose will always be

where two or more lines at rest intersect each other, and such places in particular must be damped. For example, in figure 9, the part *n* must be damped, and the bow must be drawn over the point *p*. Figure 10 may be as easily pro-

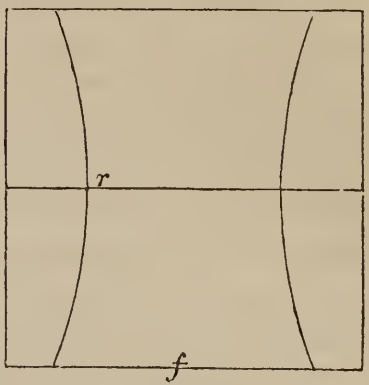

Fig. 10.

duced if you hold the plate at *r*, and excite the vibrations at the point *f*. The strongest vibration seems to be, at all times, in that part of the edge which is bounded by a curve. You must, however, damp not only those points where two lines intersect each other, but endeavour to support at least one which is suited to that figure, and to no other. One of the greatest difficulties in producing the figures, is to determine beforehand the vibrating and resting points which belong to a certain figure and to no other.

Hence it happens, that when a person is not able to support those points which distinguish one figure from another, and the violin bow is rubbed against the plate, several hollow tones are heard, without the sand forming itself as was expected. One must therefore acquire by experience a readiness in searching out among these tones, that

which belongs to the required figure, and to produce it on the plate by rubbing the bow against it. But it requires great practice to determine the figure previously from the tone, or to search out among various tones that which belongs to the figure; and to know how to make the plate vibrate in such a manner that this tone alone, and not another, shall be heard. For this purpose you must first listen, and then alter the mode of rubbing, and as soon as the right tone is produced, you must rub somewhat harder with the violin bow, by pressing it more strongly against the edge of the plate. The latter is especially necessary in the production of high tones. As soon as you have acquired sufficient expertness in this respect, you can, as I have myself experienced, determine beforehand with a considerable degree of certainty the figures to be produced, and even the most difficult. This practice will be attended with the greatest advantage if, when you rub the bow against the plate for the first time, in order to produce a figure, you continue the rubbing that the tone may be remembered; and if you try, after some time, to produce the same tone again. It may be readily conceived that you must not forget what parts of the plate were excited, and in what manner you damped it; and you may mark these points by making a scratch on the plate with a piece of flint.

To perform these experiments, the reader must provide himself with several glass plates of different sizes and shapes. The edges must be ground smooth that they may not destroy the bow, and the surface must be free from hollows. The white flatted glass is better suited than any other for the production of these figures. The necessity of having glass

that is throughout homogeneous must be evident. M. Voigt says, that he had in his possession a circular plate of glass, twenty inches in diameter, on which he could never produce a perfect circle as on other plates, the figure always appearing as a very long ellipse. This he supposed to arise from the numerous stripes in the substance of the glass.

The sand that is used must not be too fine, or it will be thrown from the nodal points, and exhibit an altogether different series of phenomena. To hold the plates, an instrument resembling a pair of curved pliers may be used, a piece of cork or leather being attached to those points which are intended to grasp the plate.

From what has been stated, it must be evident to the reader, that the same plate will exhibit different figures, according to the place in which it is held, and the point upon which the bow is made to act. Let us for instance take a square plate, and holding it in the centre, cause it to vibrate by applying the bow to a point as near as possible to one of the angles. The sand will accumulate in two lines at right angles to each other, dividing the surface into four equal squares. The tone thus obtained, and producing the figure we have described, is the lowest of which the plate is capable.

Still holding the plate in the centre, let the bow be applied at the middle of one side, and two diagonal lines will be formed, that is to say, each line will connect the two opposite angles. The tone produced in this instance is one-fifth higher than that previously obtained. Hence then it will appear, that there are certain nodal lines for every tone that can be produced from a vibrating plate. By changing the position of the instrument which holds or supports the plate,

grasping it, for instance, at one of the edges instead of the centre, a different figure will be obtained, as well as a different tone.

We cannot conclude our remarks upon the figures formed upon vibrating bodies, without an allusion to the experiments made by the celebrated Oersted, and his curious deductions from them. The method adopted in making these experiments, was communicated to Professor Pictet, and the opinions of the writer have not yet, so far as we know, been sufficiently investigated. This ingenious and talented philosopher, when reflecting on Chladni's curious experiments, the nature of which we have just explained, was led to the conclusion, that they do not exhibit the small vibrations which concur to form the undulations from which the figures result, although they evidently exhibit the points of rest between those portions of the surface which are put into vibration. Oersted makes one objection, founded on the fact, that the sand used in Chladni's experiments is too large grained to indicate the direction and force of the motions to which the particles beneath are subject. It may also be urged, that the grains of sand are elastic, and consequently do not remain on the parts upon which they fall: this hinders them from pursuing a regular progressive movement, like that of sonorous undulations. These considerations induced him to employ the lycopodium seed, or the seed of the club-moss, instead of sand. "After having covered," says the writer, "a plate of metal or glass with this substance, I tried to produce a sound in the manner of Chladni, and in an instant I saw the dust distribute itself into a number of little regular tumuli, which put themselves in motion at their ex-

tremities, or formed the figures discovered by this naturalist. They always range themselves in the form of a curve, the convexity of which is in proportion to the point touched by the violin bow; or towards the point which has an analogous situation; the nearer that each of these little heaps is to these points, the greater is its height, a circumstance which gives a remarkable regularity to the figure."

The interior of the small elevations obtained in Oersted's experiments are in constant motion during the continuation of the sound, and the duration of the vibrations may be observed on a plate from four to six inches in diameter. "At one moment," says Oersted, "the height increases, and at another it diminishes, and the dust has the appearance of arranging itself in small globules, which roll one above another."

To give the reader a view of the experiments and results obtained by Oersted, we must place before him an abstract of his paper, which may be done in almost his own words. The motion of the grains is in part vertical and in part horizontal, the latter being composed of two forces, one impelling the grains forward, and the other driving them to the two sides. To examine these forces separately, he took a plate of glass, and, holding it in such a position that his fingers were in contact with the edge of the plate at two or three points, struck the edge which was not touched, with a smooth piece of wood. Every part receiving the shock at the same instant, the powder arranged itself in lines parallel to the edge that was struck. If the blow does not strike upon the whole of the edge, other lines are formed parallel to the direction of the blow, and perpendicular to the edge.

The lines produced in the manner now explained, consist of a series of small elevations less regular than those obtained by vibrations produced with a fiddle bow. From these experiments and observations, the author proceeds to notice some theoretical opinions which are exceedingly curious, and deserve the attention of modern observers; but the inquiries to which they would lead cannot be introduced with any propriety in this work; and we must merely state that electricity is supposed to have some influence in the production of the phenomena.

We have hitherto spoken of two kinds of vibrations to which solid elastic substances are subject—the one transversal and the other longitudinal; the former were first examined by Daniel Bernoulli, and afterwards more completely investigated by Euler*; the latter were discovered by Chladni. To the last-named author we are indebted for some remarks on another kind of vibration, called spiral. We have only met with one paper on this subject, which was written by Chladni himself in a Dutch journal. The spiral vibrations here referred to are produced in a rod when it is made to turn alternately to the right and left, the nodes or quiescent lines, separating the several parts, remaining motionless. To produce these spiral vibrations, a long cylindrical rod, the surface of which must be made as smooth as possible, may be held at a node between the fingers, and a vibrating portion be rubbed in a spiral direction with a woollen rag. When a glass tube is used, the rag must be moistened with water and covered with fine sand; when wood or metal is employed, the woollen

* See Trans. of Imper. Acad. 1769.

must be covered with resin. The character of the tones produced, and the division of the rod into vibrating parts, follow the same law as in rods vibrating longitudinally. According to the observations of Dr. Chladni, however, the tone of a rod vibrating spirally is a fifth higher than when it vibrates longitudinally.

From this discovery, Chladni was led to an explanation of the phenomena produced when a prismatic rod having one end fastened in a vice is rubbed on one edge in a longitudinal direction, sand being strewed over one of its horizontal sides. The sand is in this case accumulated on a line proceeding along its whole length, a phenomenon which may be explained by supposing the range to be greater at the edges further distant from the axis than in the middle of each side. This being the case, the sand thrown from the places near the edges will be accumulated in the middle near the axis, where the vibration is weakest; and consequently must take a longitudinal direction.

The account which has here been given of vibrating figures and the manner in which they are obtained, ought not to satisfy the inquiries of the student. Although we are confined by the number of our pages, to a brief explanation, the reader will, perhaps, find in them a greater variety of facts than he could collect, without searching the pages of the various philosophical journals: his own studies will supply the deficiency.

In a former part of this work we have spoken of the conducting power of solids, but as this is a subject intimately connected with the inquiry to which we are about to direct the attention of the reader, a further allusion to the facts which have been discovered will not be improper. We shall, how-

ever, confine ourselves to an account of a few experiments relative to the propagation of sound in different solid and fluid media, performed in the year 1797, by M. Perrole *.

If the ears be closed with mashed paper, and one ear be brought near to a watch suspended from a hook, the beat will not be heard. Then take a solid body, such as a cylinder of wood, about a foot in length, and bringing one end in contact with the watch, let the other come in contact with the cartilaginous part of the ear, and the beat of the watch will not only be heard, but much more distinctly than if the ear had not been closed, and air had been the communicating medium.

M. Perrole took cylinders of different woods, as of fir, oak, box, cherry-tree, chesnut, and logwood, all being of the same size, about a line in diameter, and a foot in length. These were successively brought into contact with the ear and the watch, and they all transmitted the sound as in the former instance, but there was a great difference in the quality and intensity of the tone. The metals were examined in the same manner, but did not transmit the sound so readily as wood, and the tone was not so intense.

These experiments are of the greatest value in the construction of musical instruments, as we shall perceive when we come to inquire into the communication of sounds. Take a watch, and holding it suspended in the air, the ticking sound will not be heard at the distance of a few feet. Place the same watch upon a table, and its sound will be very perceptibly increased. Let a tuning-fork be put into vibration by

* Nicholson's Journal, vol. i. p. 411.

percussion, and the sound given out when held in the hand, will be only heard when the broad surface of one tong is brought near to the ear; but if the flat surface which terminates the stem of the fork be brought into contact with a table or any other extended piece of wood, the sound may be heard at a great distance. These experiments suggest to us at once, a means by which the intensity of a sound may be increased, and, as will afterwards appear, its quality may be improved.

M. Perrole, reasoning upon the experiments which he had made upon the conducting power of solids, was led to the supposition that the increase of intensity in the two instances last mentioned, was owing to the power of the wood in conducting sound. To put this supposition to the test of experiment, he placed his watch on a slab of marble, and little or no increase of power was observed. He then took one of the cylinders of wood before mentioned, and using it in the same manner, heard an imperfect and indistinct sound. Many other experiments, which cannot be here detailed, were made by the same philosopher, and from the whole he deduces the following principles.

1. That the woods and metals fortify the weak sounds of those bodies with which they are in contact, and modify the tone in a manner peculiar to each.

2. That these effects arise from the power of conduction in metals being greater than that of air, each having the power of giving a peculiar modification of sound.

3. The resonance of musical instruments is more particularly to be attributed to this cause.

4. The experiments made on musical instruments afford

reason to conclude that volume has an influence on resounding bodies.

5. Although M. de Maupertuis is of opinion that the resonance of musical instruments may be traced to the existence of fibres in them of every possible length, from which supposition it would necessarily follow there must be some which may vibrate in unison with a string, whatever tone it may produce; yet one of the experiments made by M. Perrole is opposed to this ingenious supposition.

There are many persons who imagine, for want of careful investigation, or in other words, because they take opinions they have heard from others, or have formed themselves from a casual inquiry without sufficient evidence, that the circumstances under which a vibrating body is placed can have little if any influence on the quality or intensity of the sound. The slightest reflection would correct this error, and yet it is indulged by many persons in spite of evidence calculated to establish a more accurate principle. The experiment already alluded to, of placing a watch on a table, or resting a vibrating fork on a surface of wood, might correct the error; or, as a still further means of testing the accuracy of the statement, the tone of a cord producing the same note as any string of a violin might be compared with the sound given out by that instrument; and an inexperienced ear would instantly detect the difference of quality and intensity.

The violin offers us an excellent illustration of the manner in which undulations may be communicated by a vibrating body to a quiescent surface. The violin is an instrument essentially consisting of four stretched cords drawn over a hollow case, and attached at one end to pegs, which, fitted

into the neck of the instrument, give an opportunity of increasing or decreasing the tension at pleasure. The strings are divided into two unequal portions by a bridge which serves the purpose of supporting the strings, each one fitting into a notch, so that it cannot, when tightly strung, slip either on one side or the other. The longer part of the string is put into vibration by a bow, and rests at one end upon the upper portion of the finger-board, and at the other upon the bridge. When a string is made to sound, or, in other words, is put into a state of vibration, the bridge participates in the motion, and moves from one side to the other, each leg in its turn rising and falling. The vibrations are then communicated to the upper face of the instrument, and by an upright, called the sounding post, to the other surface. The whole of the instrument is therefore in vibration, as may be proved by touching the several parts, and vibration figures might be produced if the surfaces were not curved.

M. Savart, to whom this branch of science is especially indebted for the discovery of many of its most important principles, is said to have been the first who observed that if the note given out by a vibrating string be changed by increasing its length or diminishing its tension, the solid in contact with it will undergo the same change and still vibrate in unison. Hence it will appear that a string, and the solid with which it may be united, form a vibrating system. Some philosophers have imagined that there are certain fibres in a sounding-board which vibrate to one tone, and others which vibrate to another, and that in no case the entire board can be made to sympathise with any particular sound. From M. Savart's experiments it is evident that the board in every instance becomes

a part of a vibratory system, and acts in unison with every note, although much more perfectly with some than with others. To this philosopher much honour is due for the accurate and ingenious manner in which his experiments were made, as well as for the splendid results he obtained; but it ought in fairness to be stated, that the fact here alluded to was first observed by M. Perrole.

The vibratory communication has been already noticed incidentally, when speaking of Chladni's euphone, an instrument in which a rod of glass is made to vibrate longitudinally, and communicate its vibrations to a solid, fixed in a perpendicular position. Many interesting experiments may be made illustrative of this principle. Take a small circular glass disc, and attach it to a rod or tube of much smaller comparative dimension, excite vibrations by a blow, or otherwise, and the note given out will be that of the disc, the sound belonging to the rod being merged with that of the larger body with which it is in contact. On the other hand, take another circular disc which is small in comparison to the rod, and the sound will be that which belongs to the rod alone. If the rod and disc be formed of such dimensions as to be intermediate between these two extremes, the sound given out will not be the same as that obtained from either, for they will vibrate as a system, and produce an intermediate tone. A very curious and similar observation was made by Ellicot, who noticed that two clocks, resting on the same stand, beat precisely the same moment, although their rates of going may be very different when apart.

From what has been here stated, it might be supposed that the several parts of a vibratory system would yield, when

sand is strewed over them, precisely the same figure. This supposition does not seem to be substantiated by experiment. If two discs of unequal size or density, and consequently having different tones, be united together, and made to vibrate as a system, an intermediate sound will be produced, but the nodal figures will not correspond. If two circular discs, having the same tone, be united at their centres, the primitive tone will be produced, and the nodal figure formed upon the surface of one, will correspond with that on the other.

M. Savart has further proved, that all the particles of a body put into a state of vibration by communication, are excited by motions that are parallel in direction to those of the original source of motion. We shall proceed to mention a few experiments illustrative of the communication of vibrations from one body to another.

Take a long flat plate of glass, and cement it to the edge of a bell-shaped vessel of the same substance; support the opposite end by a piece of cork; cause the glass to vibrate, by rubbing the point opposite to the plate with the bow of a violin, and the glass vessel will vibrate transversely. The sound produced will not be the same as that obtained from either separately, for the bell and the plate will vibrate as a system. "The bell-glass will vibrate transversely, that is to say, the motions of its molecules will be perpendicular to its surface; and these motions will be communicated to the rod, without any change in their direction."

Take a circular glass vessel, and over the mouth, or open end, stretch a piece of thin paper, or some light membrane. Upon its surface strew fine sand. Then bring a circular disc

of glass, the plane of which is parallel to the surface of the membrane immediately over the mouth or open end of the glass, and the figure which would be formed on one would be equally produced on the other.

The communication of vibrations may be further exhibited by another interesting experiment. Let a rectangular plate of glass be supported on two vertical pieces of cork, fastened to a wooden block or base. In the centre of the horizontal glass plate, cement a square plate of the same substance, at right angles to it, or in other words, in a perpendicular or upright position. Cover the horizontal plate with sand, and cause the vertical one to vibrate by rubbing it with a wet cloth, a vibration figure will be formed, the nodes being above those points which are supported by the cork.

This experiment may be varied in the following manner. Instead of fixing a single vertical plate upon the horizontal strip of glass, as in the former experiment, place upon it and in the centre, an alternate system of plates and discs; strew all the horizontal surfaces with sand, and put the supporting plate into a state of vibration; the sand will arrange itself on the plate, on every alternate disc in one particular figure, and on every other disc in some other figure. But if the apparatus be inverted, the highest disc forming the base, the horizontal plate being at the summit, the figures will be reversed. The connecting piece between the discs vibrates transversely, the discs and plate tangentially.

From what has been now stated it will be evident, that an elastic substance may be put into vibration not only by an impulse from contact, or percussion, but also from proximity, under certain circumstances, to a vibrating body. When a

substance is thus excited, it is said to reciprocate to the sounding body, and the effect is called resonance. The cause of the reciprocation is a communication by the air, or some other agent, of the undulations of the vibrating body to a substance previously quiescent. Now it is well known, even to those who have not studied the science of acoustics, that the undulations of any vibrating body can put into motion any other body whose pulses are the same. By modifying the voice to the tone of a drinking glass, the latter may be made to vibrate so violently as to crack it, a feat that has, perhaps, been seen by the majority of our readers.

We have already given some instances to show the manner in which vibrations are communicated by solids, and how bodies may be made to vibrate as a system. We must now endeavour to illustrate the laws of resonance of columns of air, a subject which has been carefully investigated by Professor Wheatstone*. This might be supposed to come more naturally under our consideration, when the action of vibrating columns of air, and the construction of wind instruments, had been considered ; but if it be only understood that when a tube is made to sound, as we are accustomed to say in ordinary conversation, the column of air contained in it, is in a constant vibration, there will be no difficulty in entering upon the consideration at the present time.

Mr. Wheatstone commences his interesting paper just alluded to, by describing a very beautiful experiment. Take a flute and bring it to the same tone as a tuning-fork, by closing such of the holes as may be necessary for that pur-

* Quarterly Journal, vol. iii. p. 178.

pose. Then bring one of the vibrating branches of the fork over, or near, the embouchure of the flute, and the feeble tone at first produced will be suddenly augmented by the rich resonance of the column of air. If the tone of the flute be changed by closing another hole, or by opening one that had been previously closed, the column of air will no longer reciprocate, and the rich melodious tone will be diminished, or destroyed, altogether.

Mr. Wheatstone then goes on to prove, that a column of air may reciprocate to a sound produced by a wind instrument. This fact is shown by the following interesting experiment. Take two flutes which are in unison, or nearly so, the one which is not to be blown into, being about a semitone flatter than the other, as an equivalent for the flattening produced by covering the embouchure with the lip. Place these flutes near and parallel to each other. Let C sharp be produced on the flute prepared for the purpose, and the intensity of the sound will be increased or diminished as the other is brought near or removed. That this is not produced by the passage of any wind into the second flute, is evident from the circumstance, that if the instrument be put into a condition to produce any other note, by closing one or more of the finger-holes, the increase of tone will be no longer observed, for the instrument is not then in a condition to reciprocate the original sound. From this, and the previous experiment, it will appear, that a column of air, if in a suitable condition, will reciprocate to a tone produced by either a vibrating plate, or a vibrating column of air.

If two sounds be obtained simultaneously, from two vibrating tuning-forks of different pitch for instance, either

sound may be made to predominate, by changing the length of the column of air. Bring the two forks when vibrating over a closed tube, furnished with a moveable piston; and according as it is lengthened or shortened either sound may be obtained. This experiment may be made, as recommended by Mr. Wheatstone, by selecting two bottles, which may be tuned with water, each corresponding to the sound of one tuning-fork.

In this result we have a conclusive evidence of the origin of those melodious sounds, obtained when a weak and almost inaudible sonorous body is brought near to a previously quiescent column of air. It is but a variation of the experiment already described, in which the note of a tuning-fork is altered in intensity and quality by the resonance of a column of air. We know not to what other cause than that stated already the phenomenon could be attributed; but if there should be any doubt of the accuracy of the explanation, the resonance of one sound by a column of air having a particular length, in preference to another produced at the same moment, must be conclusive.

We must now bring before the attention of the reader a new class of phenomena, first observed and investigated by Mr. Wheatstone. In all the reciprocated vibrations hitherto spoken of, the sounding body and the resonance have been in unison; but Mr. Wheatstone has proved that a column of air may vibrate by reciprocation, when the number of its vibrations are any multiple of those of the original sounding body. This he proved in the following manner. When a tube, closed at one end, was furnished with a moveable piston, he found that the tone of a tuning-fork at C was reciprocated

by the column of air when six inches in length. The column was then diminished to three inches, and the octave of the original sound was obtained. By using forks of lower tone, and very small tubes, and adjusting the length of the column of air, Professor Wheatstone obtained the octave, twelfth, double octave, and other concords of the original sound. By these experiments he was led to discover the important law, that a column of air may vibrate by reciprocation when the number of its vibrations is a multiple of those of the original sounding body. The converse of this law, he says, is not true.

Many of the Asiatic and African nations have had musical instruments in which unisonant columns of air have been employed to augment the sounds produced by vibrating metallic plates. An instrument of this kind was brought from Java by Sir Stamford Raffles; and one of them may be seen in the museum of the Honourable East India Company, and is called the gender. It consists essentially of metallic plates, which are suspended by two strings in a horizontal position. Beneath each plate is fixed an upright bamboo of a proper length, to reciprocate the sound of the plate. When the plates, therefore, are struck, a rich and full tone is produced by the resonance of the columns of air contained in the respective tubes. The sight of this instrument appears to have suggested to Mr. Wheatstone the importance of adopting the same principle in the construction of musical instruments. No serious attempt was made until he undertook the task, and how successful he has been is well known to our readers. On this subject, however, we shall have occasion to speak more

fully, after we have alluded to the construction and operation of the Jew's-harp.

The Jew's-harp is the most simple of all the musical instruments which produce sound by vibrating plates; and by introducing an explanation of it in this place, the importance of previously entering upon the consideration of resonance will be perceived. The Jew's-harp, or guimbarde, consists of an elastic steel tongue fixed in a brass or silver frame, and having its disengaged end turned in a direction at right angles to the plate, so that it may be struck with the finger when the harp is placed in the mouth. The instrument acts upon the principle of resonance already described. From the tongue itself only one sound can be obtained; but when placed before the mouth, many may be produced by increasing or decreasing the volume of air in the mouth; in fact, it will obey the law discovered by Professor Wheatstone, and sounds will be produced whenever the vibrations of the contained volume of air are a multiple of the vibrations of the original sound. The number of tones, however, from one plate, are at best but few, and to gain a sufficient scale several plates must be used. M. Eülenstein, the celebrated Jew's-harp player, employed a scale of sixteen plates.

Several attempts have been made at different times and by different persons to construct musical instruments which should consist of vibrating plates instead of cords. We have seen a model of this sort in the hands of an ingenious mechanic. The plates were ranged parallel to each other; and in external appearance the instrument resembled the model of a pianoforte. The compass of the instrument was two

octaves, and the vibrations were produced by currents of air excited by a pair of foot-bellows. In this instrument the principle of resonance was very imperfectly applied, but the tones of the instrument were exceedingly sweet and melodious. Such attempts as this have no doubt been frequently made ; but it is to Professor Wheatstone alone that we are indebted for the full investigation of reciprocation, a development of its laws, and an application of them to musical instruments.

No allusion has yet been made to those instruments which essentially consist of stretched membranes. They might have been properly considered when we described the action of vibrating strings ; but as the sounds obtained from them are evidently to be in part attributed to resonance, a short notice of the drum, which is a type of them all, will be now more appropriate.

The drum is an instrument chiefly used in martial music ; but in a particular shape is sometimes introduced in the performance of concertos. It consists of a cylinder of wood, or metal, covered at each end with parchment. To tighten or relax the membranes as may be required, a cord is passed alternately from a hoop at one end to that at the other, called the bracing-hoops. The cords are tightened by leather braces.

The long and the side drums are, we believe, almost entirely confined to European nations. The Hindoos use one in their religious processions, which is about twenty inches in length and a foot in diameter. The kettle-drum, which has but one vibrating membrane, received its name from its peculiar form, greatly resembling that utensil after which it is called. The bottom is generally made of copper,

and it stands on three or four short legs, in the same manner as an iron pot. These drums are always used in pairs, one being pitched to the key-note, and the other to a fourth below. In Rees's Cyclopædia, a work in which the articles on music and musical instruments are exceedingly valuable, we find the following very judicious remarks: "In some instances three kettle-drums have been used. It were to be wished, that practice were more common; because not only could the kettle-drums then accompany in the key and its adjuncts, but when performing in the key, the perfect cadence could be completely supported by this powerful instrument." The instance given by the writer is a piece composed in C major, the third drum being tuned a fifth below the key; one would be C, another G, and the third F; the perfect cadence would therefore be obtained.

The kettle-drum is an instrument very common in many parts of Asia; it is in fact a royal instrument, and may always be found in the train of the monarch. Sometimes persons in authority will presume to adopt it, but this is not generally allowed. The Hindoos also use a pair of very small kettle-drums, called tanblahs, which they carry before them. These are struck with the fingers, and by varying the intensity of the blow, and the point where it is struck, the tones are by no means unpleasant.

From what has been stated in this chapter, we may learn that the action of musical instruments does not entirely depend on the vibrations of the sounding body. In stringed instruments the sound is not produced by the vibration of the strings alone, but by the communication of those vibrations to the substances that surround them. The violin is an

example already alluded to ; and experiments have been mentioned to prove the absolute vibration of the body of the instrument. The pitch of a sound is regulated by certain immutable laws, and whatever may be the condition in which the vibrating body is placed, the pitch must always be the same, all things being equal ; but the quality of the tone will be regulated, not only by the material of which the cord or string is produced, but also by the means adopted to excite the vibrations, and the circumstances under which the strings are placed. Every one can appreciate the difference in the quality of a tone obtained from a violin and guitar, a pianoforte and a harp.

The illustrations adduced to prove and explain the resonance of sound, open a new and very interesting field of inquiry. The weak and almost inaudible sound of a vibrating plate, becomes a rich and melodious tone, when a column of air is made to reciprocate to its vibrations. A new class of instruments will, therefore, now be introduced, and a pleasing variety be given to those which are especially designed for private performance. Considering how short a time the attention has been drawn to this principle, much has been accomplished ; but we look forward to the period, and it is not probably far distant, when instruments formed of vibrating plates will be among those most esteemed for the softness and melodious harmony of their tones.

CHAPTER VII.

VIBRATING COLUMNS OF AIR.

MANY persons imagine that the production of sound from flutes, trumpets, and other wind instruments, arises from the vibration of the wood or metal of which they are composed; but it is in fact entirely due to the air that is contained within them. This is evident from the circumstance that the pitch is always the same, the column of air being equal, whatever may be the thickness or character of the material employed in the construction of the pipe. Thus, for instance, a pipe of glass, and another of wood, would give out, under similar circumstances, precisely the same note. Flutes are made of wood, ivory, glass, and other substances, and yet the same tone may be obtained from all. It is true that the quality of a sound does in part depend on the substance of which the pipe is formed, for there will be a feeble vibration of the material arising from the friction of the air within, but it is to the motion of the air that the sound must be attributed.

Allusion has already been made to the analogy between the vibrations of air in a pipe, and the undulations of a stretched cord. It must be further observed that a column of air in a closed tube may be divided in the same manner, into ventral segments by nodes or points in a state of rest. Thus if the column of air be set in vibration from the centre

of the column, there will be a constant motion on each side in opposite directions, and consequently a division into two aliquot parts.

Mr. Wheatstone has shown that a cylindric or prismatic column of air in an open tube may vibrate in any number of aliquot parts; and that in all cases the number of vibrations is inversely as the length of a single vibrating part. "As a column of air is capable of reciprocating every sound which, according to its different modes of vibration, it is itself capable of producing; supposing $1=C^1$ to represent the lowest sound of the tube, it will, without any change in its length, reciprocate sounds whose relations are $\frac{1}{C^1}$, $\frac{2}{C^2}$, $\frac{3}{G^2}$, $\frac{4}{C^3}$, $\frac{5}{E^3}$, $\frac{6}{G^3}$, $\frac{7}{B^{b3}}$, $\frac{8}{C^4}$, &c.

"The harmonic subdivisions of a column of air in a tube closed at one end, are different; a semi-vibrating part always exists near the closed end, but between two nodes, or a node and the open end, complete vibrating parts, as in an open tube, exists. The fundamental sound above mentioned of an open tube, is given by a tube closed at one end, of one-half its length, the series corresponding with the subdivisions, compared with the above, is $\frac{1}{C^1}$, $\frac{3}{G^2}$, $\frac{5}{E^3}$, $\frac{7}{B^{b3}}$, $\frac{9}{D^4}$, &c., and these sounds it can consequently reciprocate."

Before we enter further into the consideration of the philosophical principles of wind instruments, it may, perhaps, be desirable to mention one or two instances in which sounds are produced by the vibration of columns of air. That our book may not be tedious to those for whom it is especially

written, we have blended historical details with philosophical principles; and although it may on this account be a less connected performance, it will not be the less interesting. Tubes intended for the production of sound are of various kinds; some are open at both ends, some closed, and others open at one end. We will first describe and give a short history of the flute, an instrument which is closed at one end.

The flute is the most simple of all the wind instruments. It is a tube with seven apertures, one nearly at the end, through which the performer blows, and six others, at fixed intervals, which are closed with the fingers, as occasion may require for the production of certain notes. Keys also are added for the production of the half tones. It consists of four pieces or joints, which are inserted into each other.

Although the flute is a simple, and in this country a very common musical instrument, there are few good players. It is not difficult to obtain a command of the keys, and even to perform quick passages; but it is difficult to obtain a clear and full tone, or, in other words, a good embouchure. This essential object in flute-playing is but little considered, although the greatest command of the instrument is useless without it. The flute, when well played, is a sweet instrument, and its tones approach nearer to those of the human voice than any other with which we are acquainted. A few years ago it was fashionable to play on the flute, and the ear was in almost every house tired and disgusted with the abortive efforts that were made to produce musical sounds. The fashion changed, and, to the delight of all persons, the flutes of the young aspirants are now allowed to remain in their cases.

The word flute has been used as applicable to many very

differently-constructed ancient instruments. The fistula or flute of the Romans, and the tibia or pipe of the same people, were undoubtedly different instruments, but in what the difference consisted, cannot be determined with any certainty. We are equally at a loss to know the manner in which these instruments were played. Galileo states that the German flute, which is that we have already described,—one in which the performer blows into an aperture at the side of the tube, two or three inches from the closed end,—was invented by the Helvetians; but on the tesselated pavement of Fortuna Virilis, there is the representation of a young man playing on one of these instruments. There is also in existence an antique statue of a fawn with a transverse pipe. Ovid says that the flute was invented by Minerva, and was made of box-wood. This goddess is said to have invented it from the inconvenience of using the syrinx, or Pan's pipes, from which circumstance it may be supposed that the instrument alluded to by Ovid, is not the same as that now called the German flute; for we are told that she found it practicable to obtain all the tones from one pipe. It is therefore probable that the instrument referred to was open at both ends, and blown into at one of these.

We have another reason for the same opinion, in the tale that is told to explain why Minerva relinquished the flute, her own invention, and adopted the lyre. Her mother, Juno, and her sister, Venus, derided her whenever she played in their presence; and to know the reason of their mirth, she viewed herself in a fountain, and found that her cheeks were unnaturally distorted, and her face disfigured. This could

hardly have happened had it been the transverse flute on which she had been playing.

In the classical Roman authors there are constant allusions to the flute, a term which we may suppose to have been applied to an entire class of musical instruments. This is evident from the manner in which the several kinds are distinguished. Thus we find them nearly always mentioned with some particular designation, as, for instance, the Phrygian, Lydian, and Sarrana flutes; equal and unequal, right and left-handed flutes. M. le Fevre, who undertook the investigation of this curious subject, applauds Minerva for her wisdom in throwing the flute into the sea; but the Greeks, as well as the Romans, appear to have had a very different opinion of the instrument, for it was held in high estimation throughout Greece, and prizes were given to the best players at the Panathenæan games.

From the comedies of Terence it is evident that two flutes were sometimes played on at the same time, the one held in the right hand being called the right, the other the left flute. The flutes were sometimes in unison, and the manner in which a piece was played was then distinguished according as right or left-handed flutes were employed; when the former, it was played "tibiis paribus dextris;" when the latter, "tibiis paribus sinistris." When the flutes were not in unison, the music was said to be played "tibiis imparibus." The right-hand flute had a less number of holes than the left, and produced the lowest notes.

An attempt has been made to determine the reasons why the same flutes were not always used together, but we have

not met with any very satisfactory evidence to explain on what occasions the ancients associated one kind with the other. Donat says that the right-hand flutes were played together when the drama was tragical or serious; the left-hand flutes when it was gay and lively; and that one of each was employed when the character of the piece was an intermixture of the lively and solemn. This, however, is an explanation which it would be difficult to prove by any satisfactory evidence.

Aristotle says, that when the flute was first invented it was considered a mean and ignoble instrument, and was consequently only used by slaves; but that after the Persian invasion it became so great a favourite among the higher classes that it was almost a disgrace not to be able to perform on it.

The Thebans were celebrated through all Greece as being the best flute-players, and the estimation in which they were held from this circumstance was great. In Rome also the flute was a favourite instrument, and in the time of Horace, there were companies or colleges of flute-players. So numerous, however, were the persons thus employed, and so licentious their habits, that it became necessary to abolish the order in the reign of Justinian.

Plutarch says, "nothing is more useful than music to stimulate mankind to virtuous actions, particularly in exciting that degree of courage which is necessary to brave the dangers of war. To this end some have used the flute, others the lyre. The Lacedemonians played upon the flute, in approaching the enemy, the air or melody that was set to the song or

hymn addressed to Castor; and the Cretans played their military marches for many ages on the lyre."

We may here give an account of one or two of the most celebrated performers on the flute among the ancients, as it will tend to illustrate the estimation in which the instrument, and the performers for its sake, were held.

Among the most celebrated performers of antiquity, we must place Antigenides, and, judging from what has been said in his praise, among those best acquainted with the science of music. He was a native of Thebes, in Bœotia, and the son of Satyrus, who was also a celebrated performer. He was invited to Athens by Pericles, and enjoyed great popularity, though he entertained a very mean opinion of the public taste. One day, hearing at a distance a flute-player violently applauded, he said, "There must be something very bad in that man's performance, or those people would not be so lavish of their praises." The same feeling is exhibited in another anecdote which is told of him. One of his pupils who possessed great talent, and deserved the public approbation, had played and received but little applause: "The next time you play," said Antigenides, "shall be to me and the Muses." He is also mentioned by several of the ancient authors as having greatly improved the construction of the instrument and increased its compass.

Dorian also is spoken of as a flute-player who introduced many improvements in the instrument, and was not only the contemporary but the opponent of Antigenides, these two players being at the head of different schools or sects. From the account that is given of him it is probable that he was

encouraged among the higher classes of society, and especially by Philip of Macedon, as much for his wit as for his musical performances. He was everywhere known as a voluptuary and glutton, but his ready humour made him always a welcome guest. Many of his witticisms have been preserved; we will mention but one. Having lost his shoe when at a banquet, and being at the time suffering from gout, he said to one who was near him, "The only harm I wish the thief, is, that it may fit him."

It must not be supposed that the flute-players held an inferior rank in society. Such persons lived in great style, and were notorious for the number of their servants, and the luxurious habits of their life. Xenophon recommends a young man who cannot obtain the success he desires, to take a large house and live in great style, that he may be thought a first-rate performer. We may have some idea of the riches they accumulated, from the immense sums they frequently gave for their instruments. It is reported of Ismenias, that he gave three talents, a sum equal to 581*l.* 5*s.* for a flute, at Corinth. This man, however, was notorious for his profligate habits and for his love of finery. Having once commissioned a person to buy a jewel for him, it was purchased at a sum which Ismenias considered much below its value: "You have done your business like a fool," said the musician, "and disgraced the gem."

Among the female performers of antiquity, Lamia is certainly the most celebrated; how much her fame may have been aided by her beauty we cannot determine. She was everywhere received with honour, and according to Plutarch, equally admired for her wit, beauty, and musical performance.

She was a native of Athens, but travelled into Egypt to hear the celebrated flute-players of that country. During her residence at the court of Alexandria, Ptolemy Soter was defeated in a naval engagement by Demetrius, and all his wives and domestics fell into the hands of the conqueror. Lamia was among the number; but Demetrius was so attracted by her beauty and skill, that he raised her to the highest rank, and, from her solicitations, conferred such benefits on the Athenians, that they gave him divine honours and dedicated a temple to "Venus Lamia."

Although the ancients were acquainted with the construction and use of many wind instruments, and were addicted to the practice of music, it might be doubted whether they were able to explain the origin of the sounds they obtained from their flutes, had we not sufficient evidence to prove that they were far from ignorant of the principles of music, and the cause of musical sounds. Pythagoras seems to have been the first philosopher who carefully observed the phenomena of sound. Aristotle pursued the investigation. He was acquainted with the nature of the motion by which air is capable of producing sound; and he was not ignorant of the fact, that a pipe twice the length of another, gave the octave, or that the concords were regulated by the times occupied in the vibrations. The extent of information possessed by Pythagoras we have no means of determining.

That the ancients had made considerable progress in the science of music, may be gathered from the fact, that Ctesibius, of Alexandria, invented the organ, an instrument but little different in principle from that used in modern times. It consisted of a series of pipes, the valves of which were opened

by keys forced down by the fingers of the performer. The large instruments were supplied with air by hydraulic, the small ones by common leather, bellows."

A knowledge of the fact, that a confined current of air put into a state of vibration produces sound, will enable us to explain many curious natural phenomena; such, for instance, as that mentioned by Baron Humboldt. This enterprising traveller and celebrated philosopher, informs us, on the authority of credible witnesses, that subterranean sounds resembling the tones of an organ, are heard on the banks of the Oroonoko. He accounts for the curious phenomenon on the supposition, that there is a difference of temperature between the external atmosphere and the air confined in the crevices of the granitic rocks which constitute the geological formation of the district. The temperature of the confined air is greatly increased during the day, it is supposed, from the conduction of heat by the rocks; and as the difference of temperature between it and the atmosphere will be at the maximum about sun-rise, the escaping current must be the origin of the sounds. The projecting elastic films of mica, which may, in all probability, project from the walls of the crevices, modify and alter the tones that are produced. This theory is ingenious, and, as will be perceived by the reader, founded entirely upon the principles already stated. There is, however, a fact which suggests an objection to our minds. The sounds are only heard at particular times, and yet if the column of air in the crevice be of a higher temperature than the atmosphere, it must be always issuing from the opening.

It is well known, that in the road between Savoy and France, cut by Napoleon, there is, about two miles from

Les Echelles, a gallery twenty-seven feet high and broad, and nine hundred and sixty feet in length, cut through the solid rock. Mr. Bakewell states, that when this road was nearly complete, and the excavations commenced at each end almost met, the partition was broken through by a pick-axe, and a loud and deep sound was heard. Mr. Bakewell accounts for this in the following manner. The mountain, he says, rises full one thousand feet above the passage, and fifteen hundred above the valley. The air on the eastern side of the mountain is sheltered both on the south and west from the sun's rays, and consequently must be much colder than on the western side. The mountain, therefore, formed a partition between the hot air of the valley and the cold air of the ravines on the eastern side. When the opening was made, the cold, and therefore denser air, rushed into that rarified by heat, and a loud report was produced, in the same manner as when a bladder is burst over an exhausted air-pump receiver. The rumbling character of the sound would be produced by reverberation.

This fact suggests to our mind a curious little instrument, invented by Baron Cogniard de la Tour, which he has called the sirene. It consists of a circular copper box, about four inches in diameter, the upper surface of which is pierced with a hundred small oblique apertures ranged in a circle. In the centre of this surface there is an axis which carries another circular plate, with holes having the same obliquity as those on the surface of the box, but in an opposite direction. Attached to the box there is a pair of bellows, and a current of air induced by them issues from the small apertures at the top of the instrument, and gives a rotatory motion to the

plate, by which means the holes are alternately opened and shut: sound will, of course, be the result of the passage of the air, and the pitch will be regulated by the velocity of the plate. This instrument produces sounds very similar to those of the human voice.

Before we pass on to a consideration of other wind instruments, and the principle of their action, it may be desirable to mention the experiment of producing sounds by burning a jet of hydrogen in a glass tube; first observed by Dr. Higgins, of Dublin, and afterwards examined by Brugnatelli, Pictet, Delarive, Faraday, and others.

Take a tube formed of some elastic and sonorous substance, and if a jet of inflamed hydrogen be introduced within it, a musical sound will be produced. That the tone may be full and clear, the tube should be open at both extremities; but the sound may be produced in a tube closed at one end, if the experiment be carefully managed; the diameter of the tube being sufficiently large to admit the circulation of a quantity of atmospheric air to maintain the combustion. Delarive, and those who preceded him, state that two conditions are required for the production of these sounds. First, the tube must be formed of some elastic substance—one of glass, metal, or dry wood, will be most convenient; but from one formed of pasteboard no sound can be obtained. Secondly, the flame must be produced by hydrogen gas. A flame from the combustion of the vapour of ether or spirits of wine will not produce the same effect.

M. Pictet says, that the centre of vibration, or in other words the point from which the surrounding air obtains its undulatory motion, is the place of combustion. This fact

may be readily proved by changing the position of the flame, which invariably causes an alteration in the sound. By filling the tube with a dense vapour or smoke, a continual succession of vibrations from the point of combustion will be observed. From the sides of the tube these vibrations are reflected; and when they are isochronous with the natural vibrations of the sounding substance under its peculiar circumstances, the intensity is increased, and the sound becomes musically appreciable. It appears also, says Delarive, that the reflected undulations re-act on the primitive vibrations produced in the place of combustion, and render them harmonically regular with them; for a certain space of time is almost always necessary before the instrument has acquired a regular and full sound: the tone of the tube will be higher or lower, according to the greater or less number of undulations which take place in a given time. Another fact worthy of remark, as leading M. Pictet to his theory of the origin of the sound, is that the temperature of the column of air in the tube is unequal, being greatest of course at the point of combustion, and there exceedingly high, sufficiently so to keep the jet of a glass tube in a state of constant incandescence. The hot vapour is at the moment of its production in contact with cold air, which is continually entering from below and escaping above. This contact with the cold air is supposed to produce a momentary contraction in the vapour—the intense heat, however, soon restores its bulk; new vapours succeed, and an alternate expansion and contraction is maintained, causing an undulatory motion in the air, and consequently producing sound.

While M. Pictet was examining the cause of the production

of sounds in tubes when an ignited jet of hydrogen is introduced, he observed a similar result, which led him to a theory of their cause. The experiment is sufficiently interesting to be mentioned in this place, and is connected with the present subject of inquiry. He had a thermometer tube about a line in diameter. In the bulb was a drop of water which he wished to expel, and for this purpose he exposed it to the flame of a spirit lamp: musical sounds were to his great surprise produced. To perform this experiment, the tube should be from one to three lines in diameter, and from three to five inches in length, and the bulb should be about three times the diameter of the tube. A very small quantity of water should be introduced into the bulb, which must then be exposed to the flame of a spirit lamp, or some other source of heat. When the bulb has been thus exposed for a short time, sounds will be emitted.

Four conditions are necessary for the production of this effect. 1, The tube must be supplied with a bulb; if only hermetically sealed at one end the sounds cannot be produced. 2, The bulb must contain a liquid capable of evaporation; but all liquids having this property at the temperature applied are not suited, as the sounds are not produced with either ether or spirits of wine. 3, The temperature of the bulb must be raised, and that of the tube be kept as low as possible. The production of sounds is dependant on the difference of temperature between the bulb and tube. 4, Atmospheric air is necessary.

M. Pictet further observed, when endeavouring to ascertain the origin of the sounds, that the liquid might be slowly vaporized, and the vapour be again condensed, without pro-

ducing sound. When experimenting with a drop of water he could produce the sound immediately the whole of the water was evaporated, but no sounds could be obtained so long as any liquid remained in the bulb. From this he deduced that the sound was occasioned by the expansion and increased elasticity of the vapour by the instantaneous action of heat upon it. The theory may be further explained by tracing the effects. The tube and bulb are at first filled with atmospheric air, but as the process of vaporization goes on the air is expelled from the bulb, and the vapour occupies its place. When all the liquid has been forced into an elastic state, the heat acts upon the vapour increasing its temperature, and consequently causing expansion. A portion of it, therefore, must rush into the tube, when, coming into contact with the colder atmosphere and the sides of the tube, it has a diminution of bulk, and, for an instant, a vacuum is produced. The addition of heat restores the bulk of the vapour, and contraction again follows. In this manner undulations are supposed to be excited in the air. The sounds cannot be produced by all tubes, because, as M. Pictet states, the reflected undulations from the sides of the tubes do not harmonize with the primitive undulations. When the sides of the tube gain an increased temperature, the sounds decrease, and ultimately die away. That this is the cause of the diminution and cessation of the sound, is evident, he says; for if, when the sounds are no longer heard, the sides of the tube are cooled, or the bulb made suddenly hotter, they will be restored.

This ingenious theory, founded on very accurate observations and experiments, was generally received by philoso-

phers; and no further observations were, we believe, made for many years.

In the year 1818, the attention of Mr. Faraday was drawn to this experiment, and he was soon satisfied by his inquiries that no correct explanation had been given of the phenomenon. That the sounds did not in any degree depend upon the formation of aqueous vapour, he proved by producing them with a jet of carbonic oxide, and also showed that they are not caused by the vibrations of the tube; for he obtained them when cracked glasses were employed, and when the tubes were wrapped in a cloth.

When the flame is introduced into a tube, a current of air will begin to pass, which compresses it into a smaller space; when introduced to a greater distance, and the tube becomes warm, the flame is still more depressed, and a faint sound is heard. As the intensity of the sound increases, vibrations will be perceived in the flame, particularly in the upper part. Reasoning upon these appearances, and varying his experiments, Mr. Faraday was led to the conclusion, that the sounds produced by flames in tubes, are caused by a continued series of detonations or explosions. For further information on this curious subject, we must refer the reader to the original article *.

It will now be understood that the sounds obtained from wind instruments are due to the vibration of the column of air they contain: the manner in which these vibrations may be excited, is next to be pointed out. There are two ways in which the vibrations may be produced; by blowing over

* Journal of Science, vol. v. p. 274.

or into the tube, either at the open end, as in the Pan's pipe, or at the side, as in the flute, and by blowing through a small aperture of a particular form, called a reed.

Those who are accustomed to the use of either of the instruments just named, are very well aware that to produce musical sounds from them it is not necessary to blow into, but over or across the orifice. When the breath is thus directed, a small portion will be caught by the edge of the tube, and entering, gives an impulse to the contained air, causing a slight condensation. The pulse is communicated through the whole length of the tube, and the wave has then a retrograde motion. At the embouchure it meets the impinging current, which for an instant suspends the impulse on the edge of the aperture. The condensation is again produced, and a pulse is propagated through the column. In this way, the current passing from the mouth into the tube is constantly interfered with, the interval being equal to the time required for the wave to pass twice the length of the column, whatever that may be.

A reed is a narrow aperture in which an elastic plate, called the tongue, is so placed, that when excited by a current of air, it may by its vibrations, alternately close and open the aperture. It is opened by the passage of the air, but returns by its own elasticity. Hence, then, it will appear that the reed is intended to produce a continued and periodical interruption in the continuity of the stream. To this cause the sound may be attributed, and its pitch will be regulated by the number of the interruptions in a given time. That the reed may be truly effective, it is necessary that its own vibrations should correspond with the vibrations of the air contained in

the pipe, or the reed only will produce sound, as will be evident from the principles of resonance. To obtain a full and rich tone, it is necessary that the column of air should reciprocate the sound of the reed, for if it were not so, there would be no good reason for the introduction of the pipe. The influence of the resonance in the production of musical sounds, may be proved by causing the reed to vibrate without placing it in a position suited to the production of resonance, and it will then yield a very feeble and imperfect sound. It is not absolutely necessary that the reed and the tube should be in unison, but as the reed has an almost unlimited effect upon the tube, the most perfect and the richest tones will be produced when they are so. We must not be understood to state, that no musical sound can be produced except when the reed and tube are in unison; but it may be asserted as an incontrovertible fact, that the sound is always most pleasing when the unison is perfect. The thickness and flexibility of the reed, and the size of the pipe, have a certain influence, and give a latitude to the statement of the rule. When the two essential parts of an instrument have not the power to accommodate in any degree their vibrations to each other, a tone may be produced, but it will be one inferior in quality. There is, however, a point at which the air in the tube will cease to vibrate with the reed, and consequently the sound will be that of the reed only. The degree of correspondence between the reed and the tube absolutely necessary for the production of a perfect and full musical sound, will depend on the diameter of the tube. In small tubes, the unison with the reed must be nearly perfect, or no sound can be obtained;

but in large organ-pipes a much greater latitude may be allowed.

The form of the pipe has a great influence on the quality of the sound that is produced; but we need not enter further into this subject: it will be sufficient to state, as an ascertained fact, that the variety arises from the mass of air contained in the cavity. The material of which the pipe and the reed are formed have also to be considered. In the construction and arrangement of the tongue great care is necessary, or by the contact of the vibrating plate with the edges of the orifice, a rough and far from pleasing tone will be produced. Supposing the tongue to be formed of metal, and to be so placed as to strike upon the edges of a metallic orifice, at every vibration the sound would of course be heard, and, blending with that obtained from the vibration of the enclosed atmosphere, give a harshness to the tone, approaching to a scream. But if the vibrating plate be so constructed and arranged as to have its motions without contact, though still obstructing the passage of the air, touching neither one side or the other of the orifice, and if at the same time attention be paid to the principle of resonance, a soft and rich tone will be obtained. These facts will enable the reader to explain the cause of that great variety in the quality of tone observed in instruments of the same kind, and perhaps be of some service in directing him to the choice of the best instruments. The quality of tone in many wind instruments is, however, much less generally observed than in those which act by the vibration of strings, although no reason can be given for the want of observation, except that they are less understood.

MM. Biot and Hamel, when examining the action of a vibrating reed, employed a glass tube, that they might have a better opportunity of examining the phenomena. Their arrangement is represented in figure 11. T T is a cork or

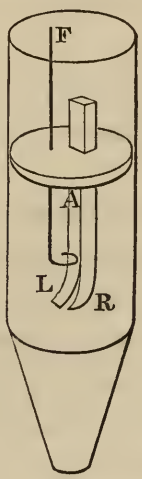

Fig. 11.

a disc of wood, in which the reed is fixed. L is the plate by whose vibrations the aperture in the reed is alternately opened and closed. F is a small metallic wire, which is capable of being moved upwards or downwards at pleasure, and bent at one end in a horizontal direction, so as to press upon the moveable plate and confine its vibrations. In using this instrument, the philosophers above named first drew the wire as far from the vibrating edge as possible, to the point A, for example. The tube was then supplied with a constant stream of air, and the wire was gradually pushed downwards. The lower the wire was forced down, the more acute was the sound, as might have been expected ; but there was a certain point at which the intensity of the sound decreased, and at

last failed altogether. But although no sound was produced, the tongue was still in rapid vibration; yet the vibrations were made without closing the aperture, and consequently without giving sound. As soon as the wire was pushed a little lower the sound was given out again, and of course of a higher pitch.

Before we close this chapter, a short description must be given of a few wind instruments; and first, of those which are blown with a reed.

The hautbois consists of four tubes, that to which the reed is affixed being the narrowest; and the last, being the largest, terminating in a wide opening like the trumpet. The bassoon is its natural bass, and is also constructed of four pieces, and is played by blowing through a crook or mouth-piece to which the reed is attached. The instrument would be eight feet in length, and consequently most inconvenient in use, but it is always bent back, and is therefore only four feet in length. The hautbois and its companion instrument have apertures and keys resembling those of the flute. Where they were invented, and by whom they were brought into this country, we have not been able to discover, but in the time of Shakspeare they were certainly favourites with the public. San Martini and his pupils are said to have been the best players ever before a British public. "The concertos which Vincent used to play fifty years ago, which were known to be Martini's, were admirable, full of fire, taste, and genius." This passage was written nearly twenty years since, and we still have to regret that it is not known what became of these compositions.

The trumpet is a very ancient instrument, and has been

long employed in military music. It is not, however, confined to this one use, as every one must know who has been accustomed to attend the modern performance of oratorios. The rich, clear, and thrilling tones obtained by Mr. Harper from the trumpet, and especially when accompanying Braham in Luther's hymn, must he heard before any idea can be formed of the power and richness of the instrument.

In the Book of Numbers, of the Old Testament, we are informed that Moses made two silver trumpets to be used by the priests ; and Josephus informs us that Solomon provided two hundred, constructed in the same manner for the use of the Levites in the Temple. If we consider the pastoral habits of the Israelites when they first settled in the land of Goshen, under the protection of Pharaoh, it will appear very unlikely that they introduced the instrument into Egypt; the probability is, that it was invented and used by the Egyptians, and the Jews were made acquainted with it by them. There are representations of this instrument on the arch of Titus.

The Greeks had several kinds of trumpets ; but without entering into a description of the varieties, it will be merely necessary to state, that the instrument was known in the time of Homer ; and in the year 396 before Christ, prizes were given to the best performers at the Olympic games. Timæus, of Elis, was the first who obtained a prize, and may therefore be considered as the best performer of his day. Herodotus, of Megara, who lived nearly a hundred years after, gained ten prizes at the different Grecian games.

The trumpet has long been used on the field of battle to give the signals of onset or retreat. Lighted torches were first

employed for this purpose ; and afterwards shells, which were the first trumpets. But although the instrument is admirably adapted for this purpose by its bold and full tone, it is well calculated, when judiciously introduced, for the performance of other music.

The trumpet has a great compass, but is by no means a perfect instrument, and can only sound a certain number of notes, called by musicians trumpet-notes. In the Philosophical Transactions for 1692* there is a paper by the Honourable Francis Roberts, called, "A Discourse concerning the Musical Notes of the Trumpet and Trumpet-Marine, and of the Defects of the same." To this paper we would direct the attention of those who are curious to investigate with more minuteness the advantages and defects of this instrument.

To conclude the chapter it will be necessary to give the reader a short account of the organ ; the instrument, par excellence, the one that excels all others in the richness and power of its tones, and at the same time may be said to include all others. To describe this complicated instrument is not our intention, for it would need a detail unsuited to our work, and perhaps be of little interest or advantage to those for whom our pages are principally designed. Its history, and the principles of its construction, are all that we can attempt to give.

The organ is an ancient instrument ; but although many were made at different times, it did not come into what may be called general use until the eighth century. St. Jerom

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* Vol. xvii. p. 559.

says, that there was one at Jerusalem which could be heard as far as the Mount of Olives. The first organ that was brought into France was sent from Constantinople in the year 757, by the Emperor Constantine Copronymus as a present to King Pepin.

There can be little doubt that the organ was known to the Romans, from the testimony of Vitruvius, and the epigram in its praise by the Emperor Julian. Mersennus says, that "the Sieur Naude sent him, from the Matthei Gardens at Rome, the form of a little cabinet of an organ, with bellows like those made use of to kindle a fire, and a representation of a man placed behind the cabinet blowing the bellows, and of a woman touching the keys." On the bottom of the cabinet was the following inscription: C. F. Scaptia Capitolinus ex Testamento Fiero Monumen. Jussit Arbitratu Heredum Meorum sibi et suis.

Luscinius, a Benedictine monk, and a native of Strasburg, who wrote a treatise on music called "Musurgia," gives a description of all the most important instruments of his own day. After speaking of those which consist of vibrating strings, he introduces the wind instruments, which he says, as they are more costly than others, so they excel all others in harmony; the former are made for the use and pleasure of man, but the latter are generally dedicated to the service of God. The organ is then mentioned as the most important. In his day there were two kinds, one he calls the portative, because it could be carried like many other instruments, from one place to another; and the other the positive, for it was usually fixed in churches.

Authors are by no means agreed as to the time when the

organ was first introduced into the church service. It is generally supposed to have been done by Pope Vitalianus, who was raised to the pontifical chair in the year 663. Previous to this time, however, instruments were used in divine service, as appears from the united testimony of Justin Martyr, and Eusebius. St. Ambrose, who lived about fifty years after Eusebius, caused them to be employed in the cathedral church of Milan. Some authors have maintained, that the organ was introduced in the year 1290 by Marinus Sanatus, and to support their opinions assure us, that musical instruments were not known in churches at the time of Thomas Aquinas. But they are met by the statement, that Gervas, a monk of Canterbury, mentions an organ in his description of Lanfranc's church, before the fire in 1174. From these conflicting statements it may be fairly concluded, that the precise time when the organ was first introduced into churches cannot be fixed with certainty; nor indeed is it a matter of great importance, except to those who have an objection to instrumental music in divine service, and are anxious to find some plea from the state of the Christian church at that period.

It is scarcely necessary to remark, that the organ consists of a series of pipes which are supplied with air by a pair of bellows. Some of these tubes are closed, some of them are open, and the modes of vibration are consequently different. By the means of certain stops, the communication may be opened between different sets of tubes, and the quality of the tones greatly varied.

From the statements made in the last three chapters, it will be evident, there are three classes of musical instruments,

those which produce musical sounds from strings, those which are formed of elastic plates and bars, and those enclosing a column of air capable of independent vibration. The laws governing the production of sound in these three instances, so far at least as they could be explained in a popular manner, have been stated; and lest the reader should find a continued philosophical discussion tedious or uninteresting, a short history of some of the most important musical instruments has been introduced.

CHAPTER VIII.

THE ELEMENTS OF MUSIC.

A NOTE, that is a single musical sound, is called a unison; whether this is a word which conveys the meaning intended by those who use it, is not now to be considered. There are many terms in art and in science, sanctioned by custom, but having little claim to general use from any other circumstance. In the organ and pianoforte, commonly distinguished as keyed instruments, there are in each octave twelve notes, seven of which are produced by white, and five by black keys.

It is generally supposed, that the musical scale was invented by Guido, of Arezzo; or, according to others, that it was an improvement upon the Grecian scale, and called the gamut from the Greek letter gamma, as an acknowledgment of the assistance he derived from the scale of that celebrated nation. In musical composition sounds are represented by marks of different kinds, which are distinguished from each other by being placed either on or between, above or below, five parallel lines, which are together called a staff, as represented in figure 12. The names given to the several notes are as

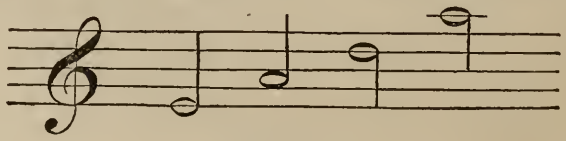


FIG. 12.

follows—do, re, mi, fa, sol, la, si, do; or according to the modern system they may be distinguished by the first seven letters of the alphahet, A, B, C, D, E, F, G.

The same note has not always the same name, for that depends on the clef which is distinguished by a mark at the beginning of a musical composition. There are three clefs—the treble, or highest; the tenor, or mean; and the bass, or lowest. The method of representing these, and the names given to the several notes, may be learned from the following figure. The treble is called the G clef; the tenor, the C

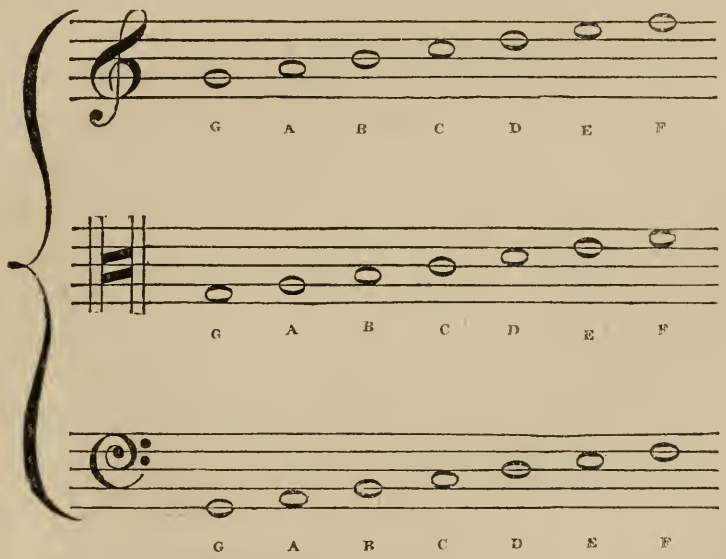


Fig. 13.

clef; and the bass, the F clef; the reason of this will be evident from an examination of the figures which represent them; the treble being on the second, the tenor on the third, and the bass on the fourth line.

It may be here necessary to remark that the position of

the several clefs must be attended to in reading music. The treble clef is now always placed on the second line ; but in some old scores we find it occasionally on the first line, and in this case all the notes on that line will be G; so if the tenor clef be removed from the third to any other line, the notes on that line will be C. When the G clef is on the first line it is called high treble : when the C, or tenor clef, is on the first line, it is called the soprano clef ; when on the second, the mezzo soprano ; when on the third, the counter-tenor ; and when on the fourth, the tenor clef. In the old church music, the bass, or F clef, is frequently on the third line, and it is then called the barytone clef.

The reader will have some difficulty in obtaining a thorough acquaintance with the notation of music ; but it is the first step in the study of the science, and that without which no progress can be made. The object of the clefs is evidently to bring the notes within a certain range, for as in score the parts are placed one above the other, the notes of one part would interfere with those of another if they were allowed to run up or down to the extent above the staff otherwise required. Even now it is necessary that some notes should be above, and some beneath the staff, and separate lines are therefore added to the notes, as in the following figure.

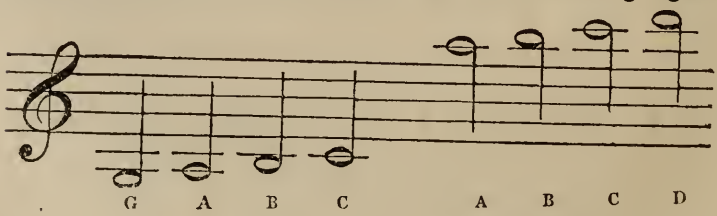


Fig. 14.

The lines which are here added are called ledger lines. A

little practice will give a facility in reading all modern music ; but with this the reader should not be satisfied, or he will be excluded from the study of the rich and imaginative music of the early schools.

Hitherto we have considered all notes, as though they were of an equal length or duration ; but it is evident that in the composition of music, there must be a variety in this particular ; some will be played slowly, others with great rapidity. To represent duration, notes of different forms are used ; they are all shown in the following table, and their relative durations are assigned them.


A Large is equal to two Longs.


A Long is equal to two Breves.


A Breve is equal to two Semibreves.

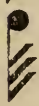

A Semibreve is equal to two Minims.


A Minim is equal to two Crotchets.


A Crotchet is equal to two Quavers.


A Quaver is equal to two Semiquavers.


A Semiquaver is equal to two Demisemiquavers.


A Demisemiquaver.

The quaver, and other notes of less duration, are frequently

grouped together by one or more broad connecting lines, as in the following figure.

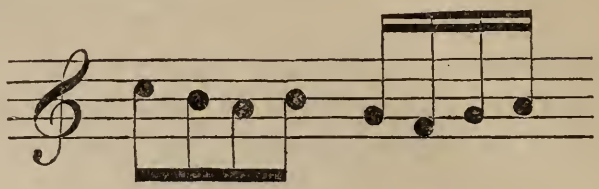


Fig. 15.

A dot is frequently placed on the right-hand side of a note, and adds to its duration one half.

From what has been already stated, it will appear, that the difference of tone usually called in ordinary language high or low, shrill or hoarse, is in music called pitch. There is then some difference between one tone and another, which may be considered as distance, space, or in musical language, an interval. To obtain an accurate idea of what is meant by this term is absolutely necessary.

The alteration from one tone to another may be made by sensible or insensible degrees. If for instance the fingers be pressed on the string of a violin, and gently drawn over it, the performer will become conscious of an alteration of tone; but one sound will so blend or run into another, that it will be impossible to detect any sudden or very evident change at any moment. But let the experiment be performed in another way. First take the sound of the open string, and afterwards that obtained in the former experiment, when the finger was pressed on the highest point to which it was carried. In this case there is a sudden start from what would be called a low to a high note; or in other words, a perceptible interval between the pitch of the two sounds.

When a man and woman are singing together the same note, it might be supposed that they were singing at the same pitch. This is not however the case, for the interval between the two is made up of seven distinct steps, as may be proved by the former raising his voice from one tone to another; by which means he will find, that the female voice is an octave above his own. Now the whole scale of music is confined to one octave, and the notes or tones which compose the octave are, as already stated, designated by the syllables—do, re, mi, fa, sol, la, si, do.

If the reader should know sufficient of music to sing the scale of notes, or gamut, to the syllables above enumerated, he may soon become conscious that it is divided into two parts or phrases, and this will be more observable if he be first told to make a short rest at the syllable fa. By singing these notes in their order several times, he will probably notice, that there is a great similarity between the intervals of the several notes in each phrase; and the question may be suggested, what relation have the several intervals of each succeeding note to each other? If the ear be left to judge on this question, it will detect that the interval between do and re is greater than that between mi and fa, which seem to gradually slide into each other instead of having that decided step so evident in passing from do to re; he will also become conscious of a longer interval between sol and la, than si and do. But by what means can the relative proportion between the longer and shorter intervals be measured? There are no means by which this can be done; but it is customary to estimate the interval between mi and fa, and si and do, as half that from do to re, or re to mi. It will then now

be evident, that the scale may be greatly extended, for if the intervals mi to fa, and si to do, are only half notes, half notes may be introduced between the whole tones, and the musical scale will consist of twelve equal steps, or thirteen notes, instead of seven unequal steps, or eight notes.

It will now be understood, that to extend the scale of natural notes, a semitone is introduced between every interval that separates whole tones. The note introduced above any natural note is represented by the following character ♯, and is called a sharp; while the figure ♭, called a flat, is attached to that below. Hence then it will appear, that a sharp is a semitone higher than the natural of the same name, and the flat is a semitone lower. Thus A sharp, which in the pianoforte or organ is a black key between A and B natural, is a semitone higher than A natural. So also A flat is a black note between A and G natural. From these particulars it will be easy to understand why D sharp and E flat are produced from the same key, or in other words are the same note. The white keys represent the natural, or as they are sometimes called, diatonic notes; and the black ones the sharps and flats, or in other words, the artificial notes.

A double sharp is a whole tone above a natural note, and a double flat a whole tone below. Thus A double sharp is B natural, and A double flat is G natural.

A scale is a regular succession of notes which may be repeated to any number of octaves higher and lower, only limited by the compass of the instrument and the capability of hearing.

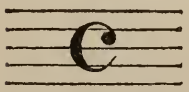
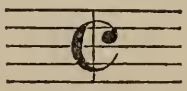
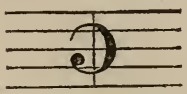
The diatonic scale, which is that already spoken of, consists of five tones and two semitones.

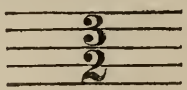
It is not easy to determine why the term chromatic has been applied to a scale of music. Some persons imagine that it has been adopted because the Greeks were accustomed to distinguish the notes by different coloured characters; and others think that it may have been employed, because the scale is intermediate between the diatonic and enharmonic scales, as colours are between white and black. There are other writers who maintain, that the term chromatic was adopted because its semitones embellish and give a richness to the diatonic scale, as a variety of colour does to a painting. These remarks will almost render it unnecessary to state that a scale in which the semitones are inserted between the natural tones is a chromatic.

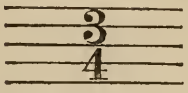
The enharmonic scale has intervals smaller than the semitones, such as quarter tones and commas. "It is formed," says Mr. Gwilt, "by uniting the ascending with the descending scale of the chromatic genus, by the use of an interval created between the sharpened note of the preceding and the flattened note of the succeeding one. These, though not exactly equal to half a semitone, are, from their approximation to that quantity, called dieses, or quarter tones."

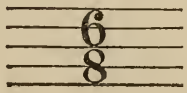
As our remarks on the elements of music are entirely confined to the one object of removing the difficulty many young persons experience at the commencement of their studies, it will not be necessary to enlarge this part of our work further than may be required for the explanation of those characters by which time is represented. Musicians are accustomed to distinguish between the duration to be occupied in performing the notes of a bar, by considering time to be of two sorts, common and triple.

In common or double time, every bar has a measure equal in duration to either a minim or a semibreve ; in the former there will be two crotchets, or four quavers ; and in the latter, four crotchets, or eight quavers. But what, we may be asked, is to be the duration of the minim or semibreve ? The relative duration of the several kinds of notes is known, what is to be the standard of comparison ? If the minim, or crotchet, or any other note, be taken as the standard, how is its duration to be determined ?

The movements in common time are various, and at best are only relative ; one is slow, another rather quicker, and a third very fast. The slowest is represented by a large C  placed immediately after the clef. The intermediate time is represented by the same figure, but a vertical line is drawn through it thus  . When the quick time is to be employed, the curved part of the letter is reversed, and a vertical bar introduced, as in the alla-breve, a name by which the middle time is often known : thus  .

Triple time is so called because when it is used the bars may be divided into three parts. It is represented by figures placed as a fraction after the clef; the denominator, or lower one, showing into how many notes the semibreve is divided, and the upper one how many such notes are contained in a bar. Thus  shows that the upper figure repre-

sents three minims in a bar, for there are two minims in a semibreve, and two is the denominator. 

signifies three crotchets in the bar;  six crotchets.

CHAPTER IX.

THE HISTORY OF MUSIC.

The history of music, among the ancient nations, and even until some time after the Christian era, is so imperfect, that a very casual notice will be all that can be required by the reader. To investigate those laborious criticisms and curious theories which have taken the attention of some writers would be now an unprofitable task.

The art of combining sounds so as to produce an agreeable impression on the ear must have been studied at an early period in the history of man. The music of nature delighting the ear, would suggest to him the combination of sounds, and imitation, if no other principle were active, prompt the trial. This is the explanation given by Lucretius of the origin of music :—

> " Through all the woods they heard the charming noise
> Of chirping birds, and tried to frame their voice
> And imitate. Thus birds instructed man,
> And taught them songs before their art began ;
> And whilst soft evening gales blew o'er the plains,
> And shook the sounding reeds, they taught the swains ;
> And thus the pipe was framed, and tuneful reed."

It may be fairly imagined, and has been stated by all writers, that vocal music preceded instrumental, but the introduction of a system and a method of notation cannot be

attributed to an early age. Long after the power and compass of the human voice had been discovered, and certain combinations of sounds which we call songs or tunes had been introduced, instruments must have been invented, rude at first in their construction, and imperfect, but by degrees improved until they were fit to accompany the singer. Wind instruments may be supposed to have preceded all others, but the sounds obtained from vibrating strings were not long unknown.

The power of music is not only acknowledged by all the ancient writers, but also greatly exaggerated. We acknowledge it has a strange influence over the feelings; but there are few of those persons who are intent on the civilization of the barbarous tribes in foreign countries who would consider the introduction of music effective for their purpose. But according to Polybius, the Arcadians, who inhabited a cold and inhospitable country, could be tamed by no other means, and the inhabitants of Cynetus, who neglected the study, were more cruel than any other Grecian tribe. This favourite theory, that music has an influence in softening the disposition and exciting a tenderness of feeling, was not proved in the case of Nero, who played on his flute when Rome was burning. On the other hand, it is not our intention to deny that music may have an influence on national character, and it is certain our recollections are intimately connected with favourite songs, of which there is a pleasing example in the fact that the Swiss mercenaries were forbidden to sing or play, under the penalty of death, the "Rans des Vaches," as it always produced a melancholy feeling among them.

EGYPTIAN MUSIC.

The antiquity of the Egyptians, the early establishment of a regular system of government, and the remarkable progress of the arts and sciences, direct our attention to the state of music among them. When Abraham visited Egypt, in consequence of a famine, this people must have made some advance towards a civilized state, for they had not only established a system of civil policy, but were regulated by principles of justice and hospitality. The Scripture history also bears testimony that the Egyptians were a powerful and learned people when the family of Jacob, seventy persons in number, settled among them.

Nearly all the information we have concerning the state of music among the Egyptians is derived from the Greek writers. Herodotus, who travelled in Egypt, says, that it was used in all their religious ceremonies and festivals; and Strabo informs us the children were taught music as well as letters. The evidence of Diodorus Siculus on this subject can scarcely be credited, for after stating that music was prohibited, he ascribes to the Egyptian deities the invention of music and musical instruments, and admits all the principal Grecian poets and musicians to have travelled in Egypt to improve themselves in those arts.

In other parts of this work we have had occasion to mention some of the Egyptian instruments, and it may be further stated that in the sepulchres of the kings of Thebes there are representations of four different kinds of harp, one of which has four and another thirty-eight strings.

The Egyptians are believed to be the inventors of the

monaulos or single flute, which in form resembled a bull's horn, and is so represented in their ancient sculpture. Apuleius informs us that a crooked flute was employed in celebrating the mysteries of Isis. Many other instruments are exhibited on the ancient sculptures, and from these as well as the testimony of the Greeks, who derived the elements of all their knowledge from the Egyptians, we know this people had made great advances in the practice of the pleasing art. After the conquest of the country by Cambyses, 525 years before Christ, music, as well as other sciences, was patronized and flourished, but the Egyptian character was now merged in that of the foreigners who possessed the soil. The learned from Greece were welcomed to Alexandria, and the musical talent of the inhabitants during the reign of the seventh Ptolemy, according to Athenæus, was so great, that there was scarcely a labourer near the capital who was not a master of the lyre and the flute.

HEBREW MUSIC.

The deep interest which has been felt in every age of the Christian era in the history, habits, and opinions of the Hebrews, has drawn the attention of many learned men to the state of musical science among them; and although their researches have not been attended with any great success, we cannot pass over this interesting portion of history without some notice. But little information can be gathered from the Holy Scriptures, either in reference to the character of their music, or the instruments they employed.

The first and only allusion to music in the age preceding the Deluge we find in a short account of Tubal, the sixth

descendant from Cain, who is said to have been "the father of all such as handle the harp and the organ*." Jubal lived only a short time before the Flood, which happened in the year 1656, A.M., and we may therefore conclude that the early inhabitants of the earth were almost if not entirely unacquainted with musical instruments. It must not be supposed by the term organ is meant the perfect but complicated instrument so called by way of pre-eminence in the present day, for all commentators are of opinion it was nothing more than a series of tubes closed at one end and formed of reeds in the same manner as the Pandean pipe.

No further allusion to music or musical instruments can be found in the Scriptures till about six hundred years after the Deluge. "And Laban said to Jacob, Wherefore didst thou flee away secretly and steal away from me, and didst not tell me, that I might have sent thee away with mirth and with songs, with tabret and with harp†?" The word here translated "tabret" is in some places called "the timbrel," but what was the nature of the instrument commentators are by no means agreed. We may, however, conclude that as Laban was a Syrian, both the tabret and the harp may be classed amongst the Assyrian instruments.

The attention is next called to the very beautiful song of Moses, after the passage of the Red Sea, when the Israelites had just escaped from bondage in Egypt. "Then sang Moses and the children of Israel this song unto the Lord, and spake, saying, I will sing unto the Lord, for he hath triumphed gloriously; the horse and his rider hath he thrown

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* Genesis, iv. 21. † Genesis, xxxi. 27.

into the sea . . . . And Miriam, the prophetess, the sister of Aaron, took a timbrel in her hand, and all the women went out after her with timbrels and with dances. And Miriam answered them, Sing ye to the Lord, for he hath triumphed gloriously; the horse and his rider hath he thrown into the sea*." The passage here referred to is interesting, not only as the first recorded instance of an address to Deity in a song or psalm of praise, but as a sublime expression of triumphant and pious feeling. It is also an instance which, even in this early age of the church, gives a sanction to the introduction of musical instruments in the performance of religious worship. Dancing may, perhaps, be accounted for from the circumstance that Miriam was an Egyptian, and it is well known that in her own country the people were accustomed to blend both music and dancing in their addresses to their gods. This practice seems to have been afterwards common among the Hebrews, for when they compelled Aaron to make them a golden calf, said to have been in imitation of the Egyptian Apis, Moses found them, on his return from Sinai, singing and dancing around it. The daughter of Jephtha welcomed her father with timbrels and with dances, and David, on his return after slaying Goliath, was met by the women of Israel, "singing and dancing, with tabrets, with joy, and with instruments of music."

The next sacred song inserted in the Scriptures is that sung by Deborah and Barak, which was apparently in the form of a dialogue, and unaccompanied by instruments. We have no account, until the time of David, of any other

* Exodus, xv. 1—21.

instruments, or music of any description, excepting the trumpets, of which there are two kinds, the trumpet of the jubilee, and the trumpet of rams-horns used on warlike expeditions, such as the siege of Jericho.

We have seen that poetry and music were united among the Hebrews ; and it is evident from many passages of Scripture, that the prophets were accustomed to deliver their inspired messages in the same manner. After Samuel had anointed Saul king of Israel, he tells him, " It shalt come to pass, when thou art come to the city, that thou shalt meet a company of prophets coming down from the high place with a psaltry, a tabret, and a pipe, and a harp before them, and they shall prophesy. And the spirit of the Lord will come upon thee and thou shalt prophesy with them." In another place it is said, " David, with the captains of the host, separated to the service of the sons of Asaph, and of Heman, and of Jeduthan, who should prophesy with harps, with psaltries, and with cymbals." And again, Elisha, when the armies of Israel, Judah, and Edom, were near perishing from thirst in the wilderness, commanded a minstrel to be brought to him, " and it came to pass when the minstrel played, that the hand of the Lord came upon him. And he said, thus saith the Lord."

The influence of music upon the mind at this early age, is very remarkably shown in its power over the troubled spirit of Saul. " And it came to pass, when the evil spirit from God was upon Saul, that David took a harp and played with his hand, so Saul was refreshed, and was well, and the evil spirit departed from him."

The association of music and poetry is more remarkably

evinced in the history of David than in any other portion of the sacred writings. All the compositions in the Book of Psalms were undoubtedly written for singing or chanting, some being intended for private and personal devotion, and others for public services. In the first Book of Chronicles, we have an account of the musicians employed by David in religious services; and in the same book we find the following remarkable passage, "God gave to Heman fourteen sons and three daughters, and all these were under their father for song in the house of the Lord, with cymbals, psaltries, and harps*." And in the same chapter it is said, "So the number of them with their brethren that were instructed in the songs of the Lord, even all that were cunning, was two hundred four score and eight†." Four thousand Levites also were appointed for the same purpose. In another part of the holy Scriptures‡, a description is given of the construction of some of the Jewish instruments; "And David and all the house of Israel played before the Lord upon all manner of instruments made of fir-wood, even on harps, and on psaltries, and on timbrels, and cornets, and cymbals."

In the reign of Solomon, during which the Hebrew nation appears to have been in a state of the greatest prosperity, music was not disregarded; one passage only need be quoted in proof of this statement: "Solomon appointed, according to the order of David his father, the courses of the priests to their service, and the Levites to their charges, to praise and minister before the priests as every day required§."

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* 1 Chron. xxv. 5. † Ibid. 7. ‡ 2 Sam. vi. 5.
§ 2 Chron. viii. 14.

Josephus states, that when David had established the tranquillity of his country, he employed himself in composing psalms, and preparing instruments on which he taught the Levites to perform ; and among others he enumerates a ten-stringed harp, and a psaltry with twelve chords. The practice of sacred music in public devotions is evident from many passages, but we shall only quote one other in proof of the statement: " And the sons of Aaron the priest shall blow with the trumpets, and they shall be to you for an ordinance for ever throughout your generations."

After the destruction of Jerusalem by the Babylonians, and the consequent captivity of the Jews for a term of seventy years, music, both as a sacred ordinance and a source of personal gratification, was in all probability entirely neglected. " By the rivers of Babylon there we sat down, yea we wept when we remembered Zion. We hanged our harps upon the willows in the midst thereof, for there they that carried us away captive required of us a song, and they that wasted us required of us mirth, saying, Sing to us one of the songs of Zion : How shall we sing the Lord's song in a strange land*?"

In the year 536 B.C., Cyrus permitted the Jews to rebuild their temple, and re-establish their ancient form of worship ; the spirit of their ancestors was however lost, their dependence upon Divine Providence and the God of their forefathers was shaken by the introduction of a vain-glorious spirit ; and the rejection of the Messiah completed their overthrow, without leaving one honourable momento in this concluding page of their history. Titus Vespasian, by the

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* Psalm 137.

destruction of their city, terminated their existence as an independent people. The mean and pusillanimous spirit which they exhibited previous to and at the time of the Saviour's advent, and their proud pharisaical boasting when he dwelt among them, foretold the sudden and utter fall they soon after experienced, which has so literally fulfilled the warnings frequently uttered in their hearing.

The Jews had no regular series of musical characters, unless we can believe that the vowel points have answered this purpose. Dr. Burney informs us, he was assured by a learned Jew, that "in reading the prophets they merely mark accentuation; but in singing them, they regulate the melody not only as to long and short, but high and low notes."

GRECIAN MUSIC.

The early history of the ancient Greeks is so enveloped in fable, that there is much difficulty in forming any accurate opinion of the state of society, or of the arts, from the descriptions which have been left us by their historians. We shall, however, endeavour to give a brief account of a few of the fables, which are connected with the history of music. The Greeks were accustomed to consider music as the foundation of all the sciences, as well as the principal source of gratification. On this account they paid much attention to the laws of harmony, for in fact they imagined all the dispositions of physical existence to have been made in reference to a particular system of concords.

Jupiter, who is called the father of gods and men, was born in the island of Crete, and brought up in a cave of Mount Ida. Immediately after his birth, the Idæi Dactyli

danced around him in armour, clashing their swords : a rude kind of music, and, perhaps, the only one known at this period. Cadmus, the son of Agenor, was a contemporary with the Cretan Jupiter, and introduced into Greece a race of Phœnicians called Curetes, who brought with them the arts and sciences of their native country. This people settled in Phrygia and Crete ; in the former they were called Corybantes, and in the latter Dactyli. Cadmus is said to have espoused Harmonia, who was so skilled in music, that the art itself was called after her name. Diodorus Siculus has described the marriage ceremony, which was attended by the gods ; Mercury with his lyre and Minerva with her flute ; Apollo also was present, and his lyre was accompanied by the flutes of the Muses.

In a former part of this work we have stated, that the ancients attributed the flute to Minerva and the lyre to Mercury ; but Apollo was the first who played upon the lyre, and accompanied it with his voice ; for Mercury having stolen his oxen, presented him with his instrument as a peace-offering.

> "To Phœbus, Maia's son presents the lyre,
> A gift intended to appease his ire ;
> The god receives it gladly, and assays
> The novel instrument a thousand ways.
> With dexterous skill the plectrum wields, and sings
> With voice accordant to the trembling strings ;
> Such strains as men and gods approved, from whence
> The sweet alliance sprang of sound and sense."

Mercury, the son of Jupiter and Maia, was supposed to be the patron of learning and all the ornamental arts, which may in some degree account for the invention of the lyre being

attributed to him, but he is also noted for his thefts. Horace has given a very vivid description of his propensities in one of his odes, which has been prettily translated by Francis :—

" Thou god of wit, from Atlas sprung,
Who, by persuasive power of tongue,
And graceful exercise, refined
The savage race of human kind.
Hail ! winged messenger of love
And all th' immortal powers above,
Sweet parent of the bending lyre,
Thy praise shall all its sounds inspire.
Artful and cunning to conceal
Whate'er in sportive theft you steal,
When from the god who gilds the pole,
E'en yet a boy, his herds you stole ;
With angry voice the threat'ning power
Bade thee thy fraudful prey restore,
But of his quiver too beguiled,
Pleased with the theft, Apollo smiled."

The Muses, who must be especially mentioned in a history of music, are supposed to have been a company of singers engaged in the worship of Osiris, the Egyptian Bacchus. But the Greeks consider them the daughters of Jupiter and Mnemosyne, or Memory. The attributes of these ladies have been described by Callimachus ; Calliope sang the praises of heroes ; Clio recorded in her song the deeds of past ages ; Melpomene's songs were plaintive, and Thalia's were full of mirth and gaiety ; each had her own especial province, and can only be considered as the representative of a particular style.

Bacchus is said to have invented theatrical representations and established schools of music, in which those who

distinguished themselves were exempted from all military service, and in after ages enjoyed many especial privileges. This circumstance will account for the splendid exhibitions which were always prepared in honour of this god; and the term "servants of Bacchus," is not applicable to those who indulged to excess in wine, but to actors, and especially to such as performed in those pieces in which music and dancing were introduced. The exhibitions in honour of Bacchus were at last attended by such extreme licentiousness, that in the year 186 before Christ, they were abolished throughout the Roman empire by the senate.

In the catalogue of musical gods, we must not omit the merry Pan, the inventor of the pipes called after his name, who, although inferior in his divinity, must be placed among the most celebrated of the musicians. He was the constant companion and counsellor of Bacchus, and aided at all his carousings with the melody of his pipes.

We shall only mention the Sirens in addition to the immortals already enumerated. These three celebrated singers resided on the coast of Sicily, and were terrestrial divinities half women and half fish. Homer introduces them in the twelfth book of the Odyssey, where he gives a very vivid description of their fascinating power. The following is a part of Circe's warning to Ulysses, as translated by Pope :—

"Next where the Sirens dwell you plough the seas,
Their song is death, and makes destruction please.
Unblest the man whom music wins to stay
Near the curst shore, and listen to the lay;
No more that wretch shall view the joys of life,
His blooming offspring, or his beauteous wife.

Flee swift the dangerous coast! let every ear
Be stopt against the song! 'tis death to hear!
Firm to the mast thyself with chains be bound,
Nor trust thy virtue to the enchanting sound."

From this short account of the fabulous age, it will be evident that music was one of the principal amusements of the ancient Greeks, and was so highly esteemed, that those who excelled in the practice or science were considered worthy of being raised to the rank of divinity. The simplest state of society is that in which a people are chiefly devoted to pastoral pursuits. Such was, in all probability, the condition of those who first settled in Greece; but an heroic age succeeded, and both poetry and music, kindred arts, were employed in celebrating the warlike exploits and valorous enterprises of contending chiefs.

The history of the Grecian heroic age is not much less intermixed with fable than the period which immediately preceded it; but amid the confused representations and conflicting characteristics of those individuals whose names and talents have been recorded, we may collect some information that may probably lead us to a knowledge of the state of musical science. Amphion, Chiron, Linus, and Orpheus, are the most remarkable early Grecian musicians.

The musical reputation of Amphion is not supported by any very conclusive evidence in the Greek authors. It was he who dethroned Laius, and, to secure his conquest, built a wall with strong towers and seven gates round Thebes. He married Niobe, the daughter of Tantalus; and Pausanias is of opinion that his musical reputation arises from this circumstance. He is not mentioned by Homer as a musician; yet

other writers are of opinion that he acquired the art in Lydia and introduced it into Greece.

Chiron, who is styled by Plutarch " the wise centaur," was born in Thessaly. He is said to have lived in a cavern, at the foot of Mount Pelion, and was the inventor of botany, medicine, and surgery : he was also renowned as a practical astronomer, having grouped the constellations for the use of the Argonauts. Attracted by his knowledge of the sciences, the Grecian youths from all parts of the country attended on his instructions, and among the most celebrated of his pupils we may mention Achilles, to whom he taught, as Apollodorus informs us, the science of music, as an incitement to virtuous actions, and a bridle to the impetuosity of his temper. From the ruins of Herculaneum a painting was obtained which represents Chiron teaching Achilles the use of the lyre. He was accidentally killed by a poisoned arrow from the bow of Hercules, one of his pupils. Some of the ancient writers, however, consider Hercules as the pupil of Linus, and by them we are informed that the musician finding his pupil obstinately stupid, was once provoked to strike him, which so enraged the young hero, that he seized the lyre from the hands of his master, and killed him by a blow on the head.

Orpheus has the highest reputation among the Greeks for his musical talent. He embarked in the Argonautic expedition, and not only excited the courage of his companions with the tones of his lyre, but silenced the Sirens by the sweeter music of his voice and instrument. He has also the fame of inventing the science of magic ; but the fable which is told of his attempting to restore to earth his wife, Eurydice, by a visit to the infernal regions, his power of silencing Cer-

berus, suspending the torments of Tartarus, and drawing iron tears down the cheeks of Pluto, are well known to the reader. Such was the sweetness of his music, that the infernal god consented to restore him Eurydice, upon condition that he should not look back upon her until he had quitted his regions; but unable to perform on his part the contract, or forgetful of the injunction, he forfeited the prize which his lyre had won. Whatever explanation may be offered of this fable, we may place some credit upon the descriptions that have been given of his extraordinary musical powers; but his genius was the cause of his death—the Thracian women, jealous of his influence over their husbands, waylaid and murdered him.

The Trojan war was commenced, according to Archbishop Usher, eleven hundred and eighty-five years, and according to Sir Isaac Newton, nine hundred and four years before Christ. Homer is the poet and historian of this remarkable epoch, and has left us an account of some of the most celebrated musicians and poets, a short description of whom may be interesting to the reader. Teiresias was a blind bard, and the first person who united music, poetry, and prophecy with the priestly office. It was he whom Ulysses consulted in the shades, by the command of Circe. Thamyris, who is distinguished by Homer as one who sung to his lyre, was born in Thrace and was the pupil of Linus. Plutarch informs us that his voice exceeded in sweetness all the poets of his age; but having dared to challenge the Muses, he was punished for his presumption with a loss of voice, an inability to touch his lyre, and blindness. In the eighth book of the Odyssey, Homer gives us a very full account of Demodocus, who was received at the palace of Alcinous with the

highest honours. It is supposed that the poet here refers to himself, and although he has been most lavish in his own praise, his fame has far exceeded that which the poet himself gave to his own representative. The following passage from the Odyssey will show how closely the account of Demodocus is applicable to Homer :—

> " The herald now arrives, and guides along
> The sacred master of celestial song ;
> Dear to the Muse ! who gave his days to flow
> With mighty blessings mixed with mighty woe ;
> With clouds of darkness quenched his visual ray,
> But gave him skill to raise the lofty lay.
> High on a radiant throne, sublime in state,
> Encircled by high multitudes he sate :
> With silver shone the throne : his lyre, well strung,
> To rapt'rous sounds at hand Protonous hung."

Phemius is the only other poet mentioned by Homer, and he is supposed to have been his particular friend, or instructor, and to this alone he is indebted for the preservation of his name to the present age.

> " To Phemius was consigned the chorded lyre,
> Whose hand reluctant touched the warbling wire :
> Phemius, whose voice divine could sweetest sing
> High strains responsive to the vocal string."

It will be here proper to take a more general view of the state of musical science in Greece during the time of Homer, before we proceed to another period. From the works of the great poet we may fairly conclude that all the arts were in high estimation, but none were held in such reverence as poetry and music, which were always united. The bard appears to have constantly accompanied his songs with the

lyre, and mere instrumental music was altogether unknown. At all public feasts music was invariably introduced, and the gods themselves are frequently described as attentive listeners to the inspirations of the poet. In public worship also music was employed, and we know not a single religious rite that could be performed without its assistance. The greatest heroes of antiquity were not insensible to its charms, and frequently stirred their valorous enthusiasm by chaunting to the lyre the immortal deeds of heroes and of kings. Both Achilles and Paris were musicians; but while the one checked his unbounded rage and thirst for glory with the soothing tones of the harp, the other employed the same instrument for the indulgence of his effeminate habits.

Of the poets and musicians who lived subsequent to Homer and previous to the establishment of the Grecian games, a very brief notice will be sufficient; nor indeed is it possible to obtain much information concerning them, as all their works have been destroyed, excepting a few fragments. From the time of Homer to Sappho, from Sappho to Anacreon, and from Anacreon to Pindar, we have nothing to direct us, except a few casual notices.

There is some doubt as to the time in which Olympus lived; most persons imagine that it was before Homer; but, without pretending to settle this question, we will here attempt to give a short notice of him. He was a Phrygian by birth, and is celebrated by Plato, Aristotle and Plutarch, for his poetical as well as musical talent. It is said that Alexander, when he heard his Curule song performed by Antigenides, was so excited with it that he seized his arms and was ready for combat. Thaletas lived about three hun-

dred years after the Trojan war, and was so celebrated for his philosophical and political genius as well as his knowledge of music, that Lycurgus, the Spartan legislator, travelled into Crete for the purpose of obtaining his assistance in completing and establishing that form of government which had in after ages so singular an effect upon the character of his countrymen. Herodotus says that Archilochus was born at Paros, one of the Cyclades, and fixes the period of his celebrity at about the year seven hundred and twenty-four before Christ; but there is abundant evidence to prove that he lived at a much later period. When a young man he attached himself to the army, but in his first engagement lost his buckler and fled from the field, from which cause he was brought into great disgrace, and lost the lady of his affections. His life after this period was characterised by a bitter resentment, so much so that his satires were proverbial throughout Greece. He was highly esteemed by his countrymen, by whom he was ranked with Homer and has the honour of inventing lyric poetry. Archilochus was one of the first victors at the Pythic games, and a hymn that he wrote in praise of Hercules was so much admired, that he not only received the crown, but it was afterwards always sung at the Olympic games in honour of those victors who had not a poet to celebrate their success.

Tyrtæus was a celebrated Athenian general, said to have been the inventor of a military trumpet, and considered one of the first performers in his day. During the second Mesinian war, about 684 years B.C., the Lacedæmonians were commanded by the oracle to obtain the assistance of an Athenian general. Tyrtæus was sent, and to the energy and

heroic character of his music, historians have attributed in a great degree the success of the party with whom he was connected ; and so highly was his music esteemed by this singular people, that when the Spartans were in arms, they were summoned to the king's tent, that they might be encouraged to brave all dangers by the exciting influence of his songs.

Terpander must have lived about the time of Tyrtæus, but the precise period of his birth is not known. Plutarch speaks of him as a composer of great power, and informs us that he gained four successive prizes at the Pythian games. It was he who added three strings to the lyre, and thus excited the anger of the Spartan senate: he has also the honour of introducing a system of musical notation.

Having thus far traced the history of Grecian music among dark or fabulous ages, we come now to the period of authentic history, which may be supposed to commence with the establishment of the games. For what purpose these periodical festivals were originally intended, we do not pretend to determine ; it is sufficient for our present purpose, that in the year 776 before Christ, the Olympic Games began to be regularly celebrated every fourth year, which afterwards became a fixed Grecian epoch. At these games there were not only horse races, gymnastic exercises, manly feats and trials of physical strength, but also poetical and musical contests ; which brought together nearly all the philosophers and men of highest renown throughout the country. The musical and poetical exhibitions were never prominent in the Olympian games, but that they were not unfrequent, there is abundant evidence. Pythocritus, of Sicyon, played four times on his flute during one festival ; and so greatly was his

music admired, that a pillar and statue was erected—" To the memory of Pythocritus, surnamed Callinicus, the flute-player." In the ninety-first Olympiad, Euripides and Xenocles entered into competition for the prize of dramatic poetry, the recitation of which was always accompanied by music. In the ninety-seventh Olympiad, a prize was established for the best performance on the trumpet.

The Nemæan games, so called from Nemæa, a village in Arcadia, or, as others suppose, established in honour of Hercules, after he had slain the Nemæan lion, were of great antiquity. The exercises here were very similar to those at the Olympic games, as will appear from Pindar's odes. Musical performances, however, were evidently admitted; for it is told by Plutarch, in his life of Philopœmen, that he entered the theatre at the Nemæan games, after the victory of Mantinea, while Pylades was singing to the lyre a song composed by Timotheus, the application of which to the celebrated general was so striking, that the music was drowned in the acclamations of the people. It may be here mentioned, that this Timotheus was the musician who was expelled from Sparta, on account of his adding several additional strings to the lyre.

The Isthmian games were established in honour of Neptune by Theseus, and received their name from the circumstance of being celebrated on the Isthmus of Corinth. The contest for the musical and poetical prizes, formed a principal part of the exhibition, although a garland of pine leaves was the only reward received by the victor.

An interesting account is related by Livy of the celebration of the Isthmian games, immediately after the defeat of Philip

of Macedon by the Romans. A great concourse of people had been assembled together from all parts of Greece to witness the contests; but all, at the same time, anxious and fearful for the liberties of their provinces. The Romans having taken their seats, the herald advanced into the centre of the area, with his trumpet as usual, and when silence was commanded, proclaimed, not the opening of the games, but the following decree: "The Roman senate and people, and Titus Quintius Flaminius their general, having vanquished Philip and his Macedonians, declare Corinth, and all the other states which have been subject to Philip independent, free, and amenable only to their own laws." Such was the joy that this proclamation diffused throughout the audience, that they recalled the herald to hear again the joyful tidings and to see the messenger of their liberty.

But of all the ancient games, none are so intimately connected as the Pythian with the history of music. They were established to commemorate the victory of Apollo over the serpent Python. At first they were intended for poetical and musical contests only, and the prize was awarded to him who wrote and sung the best song in honour of Apollo. Chrysothemis of Crete, who purified Apollo after the conquest, was the first who obtained a prize at these games. Homer consulted the Delphic oracle upon the propriety of his entering into competition, but was not considered qualified, on account of his blindness and inability to sing and accompany himself upon the lyre. Hesiod also was incompetent, because he was not master of the same instrument.

About five hundred and ninety-one years before Christ, some alteration was made in the arrangement of these games,

one prize being given to him who sang best to a flute accompaniment, and another to him who, without singing, played with the greatest precision and taste. This is the first instance that we meet with, in the history of Greek music, of the separation of that science and the art of poetry. In the eighth Pythiad, a prize, that is, a crown of laurel, was given to the best performer on the lyre. Strabo, speaking of the Pythian games, mentions a peculiar kind of hymn, called the Pythian Nome, invented by Sacadas, who performed it at Delphi. This poet was highly thought of by Pindar, but his works are lost. The piece to which we allude consisted of five parts; the first was a description of the preparation for combat, the second was the commencement of the contest, the third was the heat of the battle, the fourth the song of victory (composed of iambics and dactyls), or the taunts of Apollo over his enemy, and the fifth the hisses of the dying monster.

We must now proceed to speak, very briefly, of some of the most remarkable poets and musicians who flourished at the time of the regular celebration of the Pythian games.

Alcæus, who was born at Mitylene in the forty-fourth Olympiad, or six hundred and four years before Christ, having, like Archilocus, lost his shield in the field of battle, espoused the Muses, and was much celebrated in his day, not only for the plaintive, but also for the bold and energetic strain of his poetry. He was considered as one of the greatest lyric poets of antiquity, and is described by Quinctilian as a chaste, concise, eloquent, and sententious writer. He was the contemporary of Sappho, with whom he was deeply in love.

It will be sufficient to mention the names of Mimnermus, Stesichorus, and Simonides. The latter was celebrated for

the purity and sweetness of his style, and for the power which he exercised over the passions. Both Plato and Cicero speak of him in the highest terms, although in his old age he became so avaricious of money, as to warrant the supposition that he was not unwilling to sell his talent at a price ; for when asked by the queen of Hiero the tyrant of Syracuse, whether it was more desirable to be learned or rich, he replied, that the latter was much preferable, for he frequently found the learned waiting at the doors of the rich, but the rich men were never at the doors of the learned.

Pindar, the pupil of Simonides, was born at Thebes, in Bœotia, about five hundred and twenty years before Christ. His father was a flute-player, and after having instructed him in the elements of music, placed him under the tuition of Myrtis, where he met Corinna, to whom it is said he was more indebted than to her under whose instruction he was especially placed. This celebrated poet always distinguished himself in his contests, and frequently excelled Myrtis ; but Corinna at five successive contests obtained the prize against him. It is unfortunate that we have not a single fragment of this lady's poetry by which to judge of her power of composition ; but there can be no doubt, that Pindar was much indebted to her in restraining his luxuriant fancy. Having once shown to Corinna the exordium of his first essay, she replied, you should sow with the hand, and not empty the whole sack at once. So celebrated, however, did this poet become, that every hero was anxious to have his exploits recorded in his verse, and all Greece resounded with his fame. The highest honours were paid him during his life and after his death ; and when we consider the loftiness of thought, and the

purity of morality which so singularly distinguish all his poems, we feel the force of that now trite maxim in his first Pythian Ode, it is better to be envied than pitied. Plutarch informs us, that at his funeral was sung the short and simple dirge, " This man was pleasing to strangers and dear to his countrymen." When the Spartans ravaged Bœotia and burned Thebes, the following inscription was placed upon the door of the house in which he had resided, " Forbear to burn this house, it was the dwelling of Pindar ;" and the same command was given at another time by Alexander the Great.

We may now close our very brief history of Greek music by an account of the Panathenæan games, and of the most celebrated performers. There were two exhibitions at Athens under this name, both of them dedicated to Minerva, the patroness of that city, and said to have been established by Orpheus. The greater Panathenæa was held every five years, and the lesser every three. The latter has been attributed to Pericles ; but Plutarch, who examined the registers, found an account of exhibitions held long before his time.

The flute was always a favourite instrument at Athens, perhaps because it was invented by Minerva ; and contests on this instrument were always introduced at the Panathenæan games. The most celebrated poets and singers also frequented Athens at these times, to compete for the honours awarded those who excelled in their particular arts. Some of those who were successful at these games, and were held in high estimation by the people, may now be mentioned.

Damon, an Athenian, the disciple of Agathocles, instructed both Pericles and Socrates in the science of music. Plutarch

says, he was a profound politician as well as an excellent musician, and that he concealed his knowledge of the principles of government by an apparently entire devotion to music. By Socrates he is mentioned as his personal friend; and Pericles, who was particularly anxious to encourage the arts, no doubt frequently availed himself of Damon's assistance. There are few characters in the Grecian history who have so strong a claim for pre-eminent distinction as a patron of the arts, and especially of music, as Pericles. Plutarch, who has written his life, gives him the honour of attempting to introduce and recommend the arts in all the entertainments he proposed for the pleasure of the people. It was he who built the Odeum, a room in which the poets and musicians prepared themselves for exhibition in the theatre. He also invited Antigenides, of Thebes, the greatest flute-player of his day, to Athens; and intrusted to his care the tuition of Alcibiades, his cousin. Of this celebrated performer, and Dorion, his contemporary and rival, we have already spoken in another part of this work; and also of Ismenias and Lamia.

The flute-players who were engaged in the public religious services, were chosen at the same time as the state officers, and the appointment was held in as high estimation as that of the priests themselves. This will in a great measure account for the frequent mention of celebrated flute-players and musicians in the writings of the Greek historians. For many years, instrumental music was always employed to accompany the voice; and while thus associated with poetry, the power and genius of the composer must have been restricted. Clonas is said to have been the first who composed

nomes or airs for the flute. The instruments with which the simple airs adapted to the expression of poetry were performed, were not suited to the execution of those more complicated movements by which the player may have desired to exhibit his skill. This led to the improvement of the instruments; but in proportion as the performance was separated from poetry, the art itself declined, a result aided in a great measure by the conduct of those who professed it.

ROMAN MUSIC.

Little can be said concerning the introduction of musical science among the Romans, a people who were especially indebted to the Greeks for the elements of all their knowledge in the arts and sciences. It is however well known, that long before their connexion with Greece, they were in communication with Etruria, and both Strabo and Livy consider the early Roman music to be derived from the Etruscans. The first allusion to music in the annals of Rome, we find in the account that is given us of the conquest obtained by Romulus over the Cænicenses, when the army, divided into three sections, sang to the honour of the gods, and celebrated the valour of their commander in extemporary verses. The Roman prætors annually celebrated games in honour of Cybele, at which time the procession was accompanied by players on the cymbals and flute.

The importance attributed to martial music in the earliest ages of the Roman empire, is exhibited in the institution by Numa, of the Salii, who sang songs to the god of war. And in the law of the twelve tables, we find that it was considered equally necessary in funereal rites; for

the master of the ceremonies was instructed to provide ten flute-players to accompany the songs which were sung in honour of the deceased. There is also evidence in the Roman writers of the introduction of music in the marriage ceremony. All that we know of the Etruscan music is derived from very scanty notices, and from the representation of their instruments on fragments of antiquity; from these we may gather, that they were little inferior to the Greeks in their knowledge or practice of the art, and that the Romans in all probability did not long remain inexpert performers upon the instruments they introduced.

That music was connected with religious rites is evident from a tale that is told by Livy of the Roman musicians, who imagining themselves to be affronted at the capital, withdrew in a body to the city of Tibur. Many attempts were made to induce them to return, but they so obstinately refused, that a stratagem was laid to effect the object. On a high festival day, the Tiburtines persuaded them to assist in the ceremony, and supplied them with wine until they became so intoxicated as to be insensible of their situation. They were then placed on cars and carried back to Rome, where they passed the night in the open air, and in a public part of the city. In the morning they were surrounded by the citizens, who with much entreaty, and after allowing them the privilege of parading the city three days in every year, and indulging in every excess that they pleased, persuaded them to resume their duties in the religious services.

In Livy we have an interesting sketch of the Roman drama, of which we may give a short account. In the year 364 B.C., the plague raged in Rome, and carried off so many

of the inhabitants, that a public feast, called the Lectisternium, to assuage the anger of the gods, was held; but the disease having little abated, they adopted another and very singular method of appeasing the incensed deities. The Ludi Scenici, dramatical exhibitions, were established. At first these amusements were conducted by actors from Etruria; but the Roman youth, having seen these performers, greatly improved upon their method of acting, introducing rude verses with the dancing and music; and at length, the unpremeditated and coarse jests which were first employed, gave way to the recitation of written satirical dialogues recited with proper gesticulations. Some years after, Livius Andronicus abandoned the satire, and wrote plays with a regular plot, at which time acting became an art and profession. "These dramas," says Livy, "soon after obtained the name of Exodia, and were usually interwoven with the Atellane Comedies, compositions originally borrowed from the Osci, and always performed by the Roman youth, who did not allow them to be disgraced by professed actors. It was a rule that those who performed in such pieces were not disgraced in their tribes, but were as able to serve in the army as though they had not appeared on the stage."

During the time of the Cæsars, music was very highly esteemed at Rome, although it was less encouraged by Augustus than by his predecessor; but at his burial, the body was received without the gates of the city by the senate and citizens, who conducted it to the sepulchre, singing funereal verses. Tiberius banished the comedians and musicians; but Caligula recalled them. The infamous Nero also encouraged music; but more, it may be imagined, for the

gratification of his own personal vanity than from any sincere love of the humanising influence of the art. When he visited Naples, he entered the city dressed as Apollo, attended by all the celebrated musicians of the time and his officers of state, in a thousand chariots. At the theatre of that place he made his first appearance as a singer, and was, of course, received with great applause. Five thousand musicians he took into his own service and dressed in a particular uniform. At Rome also he was frequently seen on the stage, and even received money for his performances. At the Olympic games he contended for the musical prizes, which he obtained by bribing the competitors and judges. It is said he once entered Naples, and afterwards Rome, on his return from the Olympic games, with eight hundred prizes; and so jealous was he of those whom he supposed to excel him, that Britannicus was poisoned because he had a more agreeable voice. The character of Nero is marked by strange inconsistencies; but the governing motive of all his actions, was a pride resulting from an inordinate love of fame, and an extraordinary amount of self-esteem. Although passionately determined on the satisfaction of his caprice, and ready for the commission of the most revolting crimes to effect his object, he could submit to much self-denial in order to gain the forced shout of the populace in a crowded theatre. It is recorded of him, that he abstained from all fruit and food that could affect his voice, and slept on his back with a plate of lead on his stomach; and, according to Suetonius, to praise his voice, which was weak and indistinct, was the sure way of securing his favour.

From the time of Nero till the fall of the Roman empire,

music was in high estimation, especially in the reign of Hadrian, a prince who was educated at Athens, and was a great patron of all the arts. Commodus encouraged dramatic exhibitions, and like Nero, his fellow in inhuman vice, delighted to appear on the stage, but more frequently as a dancer and gladiator than as a singer. After the fall of the empire, all the arts in which the Romans had excelled as copyists, if not as inventors and designers, were for a time buried in the ruins of the mighty nation that cherished them; but destined to rise again on the same soil with more than a pristine splendour.

MUSIC AMONG THE EARLY CHRISTIANS.

Whatever interest we may feel in the history of music among nations whose habits and opinions we are accustomed to consider with veneration, it is much more important to trace the history of the science in the various ages of the Christian era, with all of which we seem to be more intimately connected. The simple and sacred ordinances of the Christian religion are not opposed to the introduction of music in worship, a fact sufficiently proved by the habits and opinions of the early Christians. That the music employed in the primitive churches was of the simplest kind there can be no doubt, but that it was customary to sing, may be proved from a variety of passages in the works of those who wrote in the first few centuries.

Origen says: "We (the Christians) sing hymns to none but to the Supreme Being and to his only Son, in the same manner as they (the Pagans) sing to the sun, moon, stars, and all the host of heaven."

In the writings of Clemens Alexandrinus there is the following curious passage: "This is the chosen mountain of the Lord, unlike Cithæron, which has furnished subjects to tragedy; it is dedicated to truth: a mountain of greater purity, overspread with chaste shades. It is inhabited by the daughters of God, the fair lambs who celebrate together the venerable orgies, collecting the chosen choir. The singers are holy men, their song is the hymn of the Almighty King; virgins chaunt, angels glorify, prophets discourse, while music sweetly sounding is heard."

Philo, also speaking of the Thearpeutæ, says: "After supper their sacred songs began; when all were arisen, they selected two choirs, one of men and one of women, in order to celebrate some festival, and from each of these a person of majestic form, and well skilled in music, was chosen to lead the band. They then chanted hymns in honour of God, composed in different measures and modulations, now singing together, and now alternately answering each other."

In the time of Constantine, when the Christian religion was first established by law, which was in the year 312 A.D., great care appears to have been taken to establish a convenient form of worship and suitable singing. Eusebius, the historian of the period, says: "There was one common consent in chanting forth the praises of God; the performance of the service was exact, the rites of the church decent and majestic; and there was a place appointed for those who sung psalms; youths and virgins, old men and young."

In the year 374, the chanting in divine service was so badly performed, and the music was so inferior, that St. Ambrose, archbishop of Milan, undertook the task of recom-

posing the chants, and reducing this important part of the service into an order and regularity more worthy of the sacred object. St. Augustin speaks of this circumstance, and of the pleasure he felt when he first heard the service performed in the cathedral of Milan: "The voices flowed in at my ears, truth was distilled in my heart, and the affection of piety overflowed in sweet tears of joy." In another place he says: "The church of Milan had not long before began to practise this way of mutual consolation and exhortation, with a joint harmony of voices and hearts."

Gregory, who is distinguished among his contemporaries as a man of extraordinary mental endowments, must here be mentioned as having greatly improved ecclesiastical music by the introduction of his chants. He was born at Rome in the year 550, and after having held the important office of præfect under the emperor Justin the Younger, retired to a monastery that he had founded in his house. In the year 582, Pope Pelagius the Second appointed him as one of his deacons, and sent him as nuncio to Constantinople. After being for some time engaged in public business under the immediate direction of the pope, he obtained permission to retire again to his own monastery, from which he was recalled by a sense of duty, when a violent contagious disease was raging at Rome. Pelagius himself fell a victim to the disorder, and Gregory was unanimously elected to the papal chair. Feeling little anxious for the dignity imposed on him, he secreted himself in a cave, where he was found and induced to return to Rome, to fill the high office to which he had been chosen. What credit can be given to this tale we do not pretend to determine, but in the year 590 he was

consecrated; assuming the modest title "Servus servorum Dei" (The [minister] of the servants of God). To this prelate we are indebted for the chants that are called by his name, still used in the churches of Italy. It was Gregory, also, who first introduced Christianity into Britain. He is said to have been a man of weak constitution, but possessing a strong and discriminating mind, piety and great learning, he filled the papal chair with an equanimity rarely equalled.

INTRODUCTION OF MUSIC WITH CHRISTIANITY INTO BRITAIN.

For the introduction of Christianity into Great Britain, in the year 596, we are indebted to Pope Gregory, commonly called Gregory the Great. The incident which led him to establish a mission in this country is related by Bede. Some merchants having arrived at Rome, brought their goods to the market-place to be sold, and Gregory, with many others, attended as purchasers. Some boys also were offered for sale as slaves, and Gregory, having observed them closely, inquired of the dealers from what country they had brought them, and was told, from the island of Britain. He again inquired whether the inhabitants were Christians, but being informed they were Pagans, he exclaimed "Alas! what a pity that the author of darkness should be in possession of men of such fair countenances, and that, being remarkable for such graceful aspects, their minds should be void of inward grace." Not being at this time raised to the pontifical chair, he entreated Pelagius to send some ministers to the English nation, that they might be converted to Christ.

When the monk Austin arrived in England for the purpose

of converting our forefathers to the Christian faith, he was attended by singers, who were, perhaps, found useful in gaining him the attention of the people. About fifty years after, a singer of great celebrity was sent from Rome to correct such abuses as he might find in the manner of performing the service. The choral service was first introduced in the cathedral church of Canterbury, and soon extended to the other churches in Kent, to which county it was for some time confined. This fact is alluded to by Hollinshed, in his Chronicles: "Whereas beforetime there was in a manner no singing in the Englishe churches, except it were in Kent; now they began in every church to use singing of divine service, after the ryte of the church of Rome. The archbishop Theodore, finding the church of Rochester void by the death of the last bishop, named Damian, ordeyned one Putta, a simple man in worldly matters, but well instructed in ecclesiastical discipline, and mainly well seene in song and musicke to be used in the church, after the manner he had learned of Pope Gregory's disciples." In the year 677, Ethelred, king of Mercia, invaded Kent, destroyed the city of Rochester, defaced the cathedral, and drove Putta away.

St. Augustin, or Austin, was the first archbishop of Canterbury; and from history it appears that Gregory constantly impressed upon him the necessity of attending to the musical part of the service. It may, however, be doubted whether the art made much progress in this country until the arrival of John, præcentor of St. Peter's, who was sent in the year 680, to teach the monks of Weremouth the method of singing the ecclesiastical service according to the practice at Rome. This person was held in great estimation for his skill, and

opened several musical schools in different parts of Northumberland.

In the time of Pope Adrian and Charlemagne, there was a curious quarrel between the French and Italian musicians, as to their respective merits for taste and knowledge. It appears that Charles having visited Rome to celebrate Easter, the French singers pretended to have more agreeable voices, and to sing with better taste than the Italians; while the Italians, on the other hand, boasted that they were taught by St. Gregory himself, and that the French had altered and disfigured the true chant, "and, comparing the abilities of their great master with the ignorance and rusticity of their rivals, treated them as fools and barbarians.' The dispute was referred to King Charles, who, so far from deciding on behalf of the French, requested Pope Adrian to appoint singing, masters to correct the Gallican chant. Theodore and Benedict were chosen; one being sent to Metz, and the other to Soissons: the Pope also granted to the king St. Gregory's own copy of his choral books. Diaconus, in his life of St. Gregory, informs us that the French and Germans were quite unable to sing the Gregorian chant. "Their figures were gigantic, and when they sung, it was rather thunder than musical tones. Their rude throats, instead of the inflexions of pleasing melody, formed such rough sounds as resembled the noise of a cart jolting down a pair of stairs."

To return, however, to the history of music among our Saxon forefathers, it may be well to remark that the progress of ecclesiastical music must have been greatly aided by the establishment of a school at Canterbury. There are many incidents in the history of Alfred which prove that he excelled

as much in music as in general knowledge. The story of his entering the Danish camp in the disguise of a harper, and returning without being detected, is a sufficient evidence that he was well practised in the art of music, and the fact is stated by several of his contemporaries. In the year 886, Alfred established the chair of music in the university of Oxford.

St. Dunstan, a turbulent prelate, who was accused of the practice of magic, and died in the year 988, was well acquainted with all the arts, and is especially spoken of for his musical talents. It was he who gave an organ to the abbey of Abingdon, in the reign of King Edgar, and, according to some authors, introduced the same instrument into many other English churches and convents.

THE TROUBADOURS.

The history of music, from the commencement of the twelfth till nearly the middle of the fourteenth century, is included in that of the Troubadours, a class of wandering musicians who travelled through all the southern countries of Europe, composing and singing their songs in the palaces of kings, and castles of the nobles. The songs sung by the Troubadours, were composed in the Provençal language, supposed by Voltaire to have been formed in the ninth century, and to be a compound of Latin and Teutonic. It was spoken in its greatest purity in Dauphiné and Provence. In the eleventh century the rhyming Troubadours obtained the patronage of the Count de Poitou and many other powerful nobles. Received with great consideration and respect, they travelled from one castle to another, and sang their songs in celebration

of the heroic deeds of warriors, and the beauty of their ladies, encouraging that spirit of chivalry which had already made its appearance in Europe. The profession of the minstrel being again established, the numbers rapidly increased, and a spirit of emulation was excited. The influence of the Troubadours upon the manners of the people at this period, it is hardly possible to estimate; but that it lent its aid to the wild, imaginative, and superstitious opinions of the period, there can be no doubt. We have an interesting instance of the esteem in which music was held at the period of which we are speaking, in the history of Richard Cœur-de-Lion, and especially in the account of his deliverance from prison in the Tour Ténébreuse.

Richard having quarrelled with the Duke of Austria, when in Palestine, doubted the safety of passing through his dominions on his return home, and therefore assumed a disguise by which he hoped to pass unobserved. The duke, however, being informed of his arrival in his dominions, seized his person and confined him in a castle called the Black Tower. For a long time his imprisonment was unknown; nor would it, perhaps, have been discovered but for one Blondel, a minstrel who had been retained in his service, and was greatly attached to his master. This minstrel suspecting that he might be imprisoned by some rival monarch, travelled from place to place, apparently in the exercise of his profession, and coming to a city near the castle where Richard was confined, made such inquiries as made him suspect the fact. Having gained admission to the castle, but being at the same time unable to obtain a sight of the prisoner, he one day placed himself against a window and began to sing a French

song which they had formerly composed together. The king was at once certain that his minstrel had discovered his prison, and when the song was half sung finished it himself. Blondel immediately returned to England and informed the barons of his adventure.

In Walpole's "Catalogue of Royal and Noble Authors," we find a song written by Richard during his imprisonment; and Dr. Burney, in his "History of Music," has given a translation from a French version. The two concluding verses we may be permitted to quote :—

"Ye dear companions of my happy days,
Oh! Chail and Pensavil aloud declare
Throughout the earth, in everlasting lays,
My foes against me wage inglorious war.
O! tell them too that ne'er among my crimes
Did breach of faith, deceit, or fraud appear;
That infamy will brand to latest times
The insults I receive while captive here.

Know, all ye men of Anjou and Touraine,
And every bach'lor knight, robust and brave,
That duty now and love alike are vain
From bonds your sov'reign and your friend to save.
Remote from consolation here I lie,
The wretched captive of a powerful foe,
Who all your zeal and ardour can defy,
Nor leaves you aught but pity to bestow."

The licentiousness of the Troubadours, and the vices by which the order was characterised, led to their suppression, in the fifteenth century. It has more than once happened that favoured classes have, by their encroachments on the good feelings of the people, and by their excesses, fallen into disgrace and been the authors of their own ruin. But not-

withstanding the imperfect state of music and poetry among the Troubadours, and the follies into which they fell, the literature of Europe is greatly indebted to them for exciting that love of poesy which has never since been entirely banished from the public mind.

The expulsion of the Troubadours from France, by Philip Augustus, has been much blamed by many writers, not because there can be any doubt of their profligate habits, but because they exercised a much more despotic power over the rising literature of the country than he did over their privileges. Nor was the influence of the Troubadours altogether prejudicial to the habits of the French. "They banished," says a French writer, "scholastic quarrels and ill-breeding, polished the manners, established rules of politeness, enlivened conversation, and purified gallantry . . . . That urbanity which distinguishes us from other people, was the fruit of their songs: and if it is not from them we derive our virtues, they at least taught us how to render them amiable."

The minstrels who were banished by Philip Augustus were recalled by his successor, and granted many privileges. Their immoralities, however, and pandering to the vices of the times, again called down the displeasure of the government, for in the year 1395 they were strictly prohibited to speak or sing any indecent song, under a penalty of two months' imprisonment, during which period they were to live on bread and water.

The French lays of this period were amorous songs composed in the native language. The morality of the French, if their least blameable habits can receive such a title, was exceedingly lax; nor is it possible to entertain a very high

estimate of the character of a people who could invoke the Deity to grant success to their profligate intentions. But although the legitimate aim of music was thus thwarted, there was much in the social music of the period deserving the highest commendation.

Military songs also were sung by the army previous to an engagement. Charlemagne is said to have been very favourable to this method of exciting the valour of the troops. The celebrated song in praise of Roland, a translation of which has been given by Dr. Burney, is a specimen of this kind of poetry.

MUSIC IN ENGLAND BEFORE THE FIFTEENTH CENTURY.

The high esteem in which music was held by the ancient Britons, and by the Saxons, has been already alluded to, and we must now attempt to obtain some information concerning its progress among the Normans. The character of the music it is very difficult to determine, or the degree of taste exercised by the performer; but there is reason to believe that the monarch and the nobles retained a minstrel or bard in their households, and treated him with great honour. Henry the Third gave a pipe of wine and forty shillings to his harper, and another pipe of wine to Beatrice, his harper's wife. That the minstrel was about the person of his master, appears from several circumstances, and may be supposed from the tale that is told of prince Edward, afterwards Edward the First, when in the Holy Land. At Ptolemais, in 1271, he was attacked in his own chamber by an assassin with a poisoned knife, and was delivered by his minstrel.

In the works of Sir Walter Scott, much information con-

cerning the poetry and minstrels of the fourteenth and fifteenth centuries has been collected. Among the most celebrated of these personages must be mentioned Thomas of Erceldoun, otherwise known as The Rhymer, who united the power of prophecy with the art of versification. "I am inclined," says Sir Walter, "to place his death a little further back than Mr. Pinkerton, who supposes he was alive in 1300, which is hardly, I think, consistent with the charter by which his son in 1299, for himself and his heirs, conveys to the convent of the Trinity of Sotre, the tenement which he possessed by inheritance in Erceldoun, with all claims which he or his predecessors could pretend thereto. From this we may infer that the rhymer was now dead, since we find his son disposing of the family property. Still, however, the argument of the learned historian will remain unimpeached as to the time of the poet's birth; for if, as we learn from Barbour, his Prophecies were held in reputation as early as 1306, when Bruce slew the Red Cummin, the sanctity and the uncertainty of antiquity must have already involved his character and writings."

Sir Walter has also given us an old poem of Thomas the Rhymer's intrigue with the Queen of Faery, the commencement of which we will extract for the amusement of the reader, referring him to the collection of Sir Walter's works for the entire poem.

"In a lande as I was lent,
In the gryking of the day,
Ay alone as I went,
In Huntle bankys me for to play;
I say the throstyl, and the jay,
Ye mawes, movyde of her song,

Ye wodwale sange notes gay,
That al the wod about range.
In that longyng as I lay
Undir nethe a dern tre,
I was war of a lady gay,
Come rydyng ouyr a fair le ;
Zogh I suld sitt to domysday,
With my tong to wrabbe and wry,
Certenly all hyr aray,
Il beth neuyr discryuyd for me."

The following proclamation, issued by Edward the Second, in the year 1315, will better illustrate the habits of the minstrels, and perhaps the state of music, than any account we could give.

" Edward by the grace of God, &c. to sheriffes, &c. greeting. Forasmuch as many idle persons, under colour of minstrelsy and going in messages and other feigned business, have been and yet be received in other men's houses to meate and drynke, and be not therewith contented if they be not largely consydered with gifts of the lordes of the houses . . . we, willing to restrayne suche outrageous enterprises and idlenes have ordeyned, that to the houses of prelates, earles, and barons, none resort to meate and drynke unless he be a mynstrel, and of these mynstrels that there come none except it be three or four mynstrels of honour at the most in one day, unless he be desired of the lorde of the house. And to the houses of meaner men, that none come unless he be desired, and that such as shall come so, holde themselves contented with meate and drynke, and with such curtesie as the maister of the house wyl showe unto them of his owne good wyl, without their askyng any thyng. And yf any do against this ordinaunce, at the firste tyme he to lose his myn-

strelsie, and at the second tyme to forsweare his craft, and never to be receaved for a mynstrel in any house. Geven at Langley, the 6th day of August, in the 9th yere of our raigne."

There are many names associated with the history of poetry and music to which we cannot even briefly allude, but there is one author so intimately connected with the present state of English literature, and who gives us so excellent a description of the music of his day, that his works must receive some attention in a sketch of the history of music.

Chaucer was born in the year 1328, and died in 1400. Of his poems the critics of his own and succeeding ages have spoken in the highest terms, and he has received by common consent the title of the Father of English Poetry. "Chaucer," says Caxton, "for his ornate wrytyng in our tongue, maye well have the name of a laureat poete ; for to fore that he, by hys labour, embellyshyd, ornated, and made faire our Englyshe in thys royame was had rude speeche, and incongrue, as it yet appeareth by olde bookes whyche at thys day ought not to have place, ne be compared emong, ne to his beauteous volumes, and aournate wrytynges, of whom he made many bokes and treatyces, of many a noble historye, as well in metre and ryme, as in prose, and them so craftyly made, that he comprehended hys masters in short, quick, and hye sentences, eschewing prolygyte, castyng away the chaf of superfluyte and shewying the pyked grain of sentence, uttered by crafty and sugred eloquence."

Chaucer's "Canterbury Tales" are no doubt well known to our readers. Thirty persons, of whom the poet himself is one, set out from the Tarbarde Inn, in Southwark, on a pil-

grimage to the shrine of St. Thomas à Becket, in the cathedral church of Canterbury. To enliven the journey, the pilgrims relate tales, of which the work itself consists. In Chaucer's description of his fellow-travellers, forming the prologue of the work, and in various parts of the poems, there are interesting allusions to music. Among the company we find a mendicant friar, a monk, a knight and his squire, a prioress, an Oxford clerk, a poor scholar, a miller, and a parish clerk, and the musical talents of all are alluded to.

The mendicant friar was a happy soul, who had the art of pleasing every body;

> "And certainly he hadde a merry note,
> Wel coude he singe, and plaien on the rote."

The monk was a sportsman, and was best pleased with the music of the hounds;

> "And when he rode, men mighte his bridel here
> Ginge'ling in a whistling wind as clere,
> And eke as loud as doth the chapel belle."

The squire was a beau, and had all the qualifications of a gentleman:—

> "Singing he was, or floighting all the day."

We are also informed that

> "He coudè songes make, and well endite;
> Juste, and eke dance, and well pourtraye and write."

The lady prioress has a character from the poet not very unlike that now often given to a certain class of maiden ladies:—

> "And she was clepèd Madame Eglantine,
> Full wel she sangè the service divine,
> Entuned in hir nose ful swetely."

The Oxford clerk loved his books better than music; but the poor scholar was not unlearned in the art:—

"And all above there lay a gay sautrie,
On which he made on nightès melodie,
So sweetly, that all the chambre rong;
And 'Angelus ad Virginem' he song:
And after that he song the kinges note;
Full often blessed was his mery throte."

The miller also was a musician:—

"A baggèpipe wel couthe he blowe, and soun,
And therewithal he brought us out of town."

The parish clerk

"Could playen songès on a small ribible
And as well coud he play on a giterne."

In Chaucer's poem of "The Floure and the Leafe" there are many passages which may guide us to an accurate estimate of the state of music in his day. A few of these may be quoted.

"And as I sat the birdis herkening thus,
Methought that I herd voicis suddainly,
The most swetist and most delicious
That evir any wight I trow trewly
Herdin in ther life * * *
At the last out of a grove evin by
That was right godely and plesaunt to sight,
I se where there came singing lustily
A world of ladies * * *
There many were of them
That dauncid and eke song full sobirly,
But all they yede in manner of compace;
But one there yede in mid the company,
Sole by herself: but all followed the pace

That she kept * * * *
And she began a roundell lustily;
And then the company answered all
With voices swete entwined and so small,
That methought it the swetist melody
That evir I herd in my life sothly."

Many of Chaucer's songs were set to music, but none of the music has been preserved. Whether it would have any other interest than that of satisfying our curiosity, is scarcely a matter of doubt, for the only English song of this early date, composed in 1415, in honour of the battle of Agincourt, is not so remarkable as to excite any very anxious desire for a greater variety.

At the coronation of Henry the Fifth, in 1413, an incredible number of harpers were employed; but this monarch was either little pleased with the musical talents of his subjects, or had no taste for the art. When he entered the city of London, after the battle of Agincourt, he was received with much honour, and all the formalities were connected with either vocal or instrumental music. But Henry was not pleased with the music, for he afterwards issued a formal edict that no songs in honour of the victory should be again recited by harpers, or any others. From this incident it may be supposed that music did not receive much patronage at court during his reign, which was however so short, and attended with so many stirring incidents, that the art could have suffered but little permanent detriment from this cause.

The reign of Henry the Sixth commenced in the year 1422, and may be said to have terminated in 1461. This weak and unfortunate prince, who studied only his own ease, was not likely to give a decided popular feeling either in favour

of or in opposition to the science of music. The minstrels led, as they had in former times, a wandering life, and no improvement of any importance was introduced.

The reign of Edward the Fourth terminated in the year 1482, and is distinguished by an almost uninterrupted series of wars. The king himself, however, delighted in splendour, and, if we may judge from his character, was likely to encourage the fascinating art of music. He entertained, as we are informed by history, a considerable number of musicians for the service of the chapel, and for his own amusement. To this appointment has been attributed the permanent musical establishments of the chapel royal, and the king's band; for in the year 1469 he did, by letters patent, "give and grant licence unto Walter Haliday Marshall, John Cuff, and Robert Marshall, Thomas Grane, Thomas Calthorne, William Cliff, William Christian, and William Eyneysham, then minstrels of the said king, that they by themselves should be, in deed and name, one body and cominality, perpetual and capable in the law, and should have perpetual succession: and that as well the minstrels of the said king, which then were, as other minstrels of the said king, and his heirs which should be afterwards, might at their pleasure name, choose, ordain, and successively constitute from among themselves, one marshall, able and fit to remain in that office during his life; and also two wardens every year, to govern the said fraternity and guild."

Towards the close of the fifteenth century, many noble inventions were proposed to the public, and the foundation was laid for a wonderful change of manners. Music also continued to advance, although in the reign of Elizabeth it

was not such as would please a modern, or as some would say, a fastidious ear.

Josquin des Pres, a musician of the Flemish school, was by far the most celebrated composer of his day. Adami calls him "Uomo insigne per l'inventione." He held the appointment of Maestro di Capello to Louis the Twelfth of France, and was promised a benefice by that monarch. The promise was, however, forgotten, and Josquin being commanded to compose a motet for the chapel royal, chose a verse from the 119th Psalm, "Memor esto verbi tui servo tuo." The music was greatly admired, and brought the promised gift; after which he composed a song of thanksgiving from the words, "Bonitatem fecisti cum servo tuo, Domine." Several of Josquin's compositions are still in being, some in a music-book that belonged to Prince Henry, afterwards Henry the Eighth, preserved in the Pepys collection at Cambridge, and some in a manuscript in the British Museum.

During the reign of Henry the Eighth, music, or we might, perhaps, rather say, ecclesiastical music, was in great estimation. The king himself is said to have possessed some knowledge of both the science and practice, for Hollingshed, in his "Chronicles," states, that he exercised himself daily in shooting, singing, dancing, wrestling, casting of the barre, plaieing at the recorders, flute, virginals, in setting of songs and making of ballades." According to Lord Herbert, the prince was, during the lifetime of his brother, intended for the archbishopric of Canterbury, and was educated accordingly. He is spoken of as an able Latinist, philosopher, divine, and musician. Two entire masses composed by him were often sung at his chapel.

Cavendish has described the magnificent arrangements in Cardinal Wolsey's chapel: "First he had there a dean, a great divine and a man of excellent learning, a sub-dean, a repeatour of the quire, a gospeller, and epistolor; of singing priests ten, a master of the children. The seculars of the chapell, being singing men twelve; singing children ten, with one servant to wait on them. In the vestry a yeoman and two grooms, over and besides other retainers that came thither at principal feasts."

But whatever may have been the excellency of ecclesiastical music at this time, domestic instrumental music must have been in a deplorably wretched condition, if it be true, as stated by Hollingshed, that the king when he attended a masque at the cardinal's palace, was entertained with "a concert of drums and fifes." The choral music was undoubtedly very superior to the instrumental. Henry is said to have composed two masses himself, and gave every encouragement to the musicians who most distinguished themselves. Even on his journeys he was attended by a part of his choir, as appears from the regulations given to the household by Cardinal Wolsey, in the year 1526: "When the king is on journeys or progresses, only six singing boys, and six gentlemen of the choir, shall make a part of the royal retinue: who daylie, in absence of the residue of the chapel, shall have a mass of our lady before noon, and on Sundais and holidaies, masse of the daie, beside our lady masse, and an anthempne in the afternoon; for which purpose no great carriage of either vestments or bookes shall require."

We are now almost confining our attention to the progress of music in England, but it may be worthy remark that the

Emperor Charles the Fifth was passionately fond of the study, and after the abdication of his throne, devoted much of his time to the improvement of the music in the religious service. "The emperor," says Sandoval, "understood music, felt and tasted its charms; the fryers often discovered him behind the door, as he sate in his own apartment near the high altar, beating time and singing in parts with the performers; and if any one was out, they could overhear him calling the offender names."

The violent religious discussions during the reign of Henry the Eighth had but little influence on the practice of music, for he was by no means inclined to reform to the extent desired by some of his subjects, who considered that "synging and saying of mass, matins, or even song, is but rorying, howling, whistelyng, mummying, conjuryng, and jogeling, and the playing at the organeys a foolish vanity."

The reign of Edward the Sixth commenced in the year 1547, and closed in the year 1553; but although so short, the names of many celebrated musicians have been recorded as the ornaments of the period. Dr. Christopher Tye seems to have been the principal composer of his day. Dr. Boyce has preserved one of his anthems, "I will exalt thee, O Lord!" in his collection of cathedral music by English masters. It was in the reign of Edward the Sixth that Sternhold and Hopkins wrote their version of the Psalms, so many years used in all our churches; a useful and proper composition at the time when written, but now evidently unfit for public use. Specimens of the music of Farrant, and several other composers of this period, have been preserved. The cathedral service was first set to music by John Marbeck, of Wind-

sor, in the year 1550 ; but many alterations were made during the reign of Edward.

When Mary assumed the reins of government, and commenced her cruel though short-lived sway over the affairs of this country, the Romish rites were restored ; but little alteration was made in the performance of ecclesiastical music, except that the Latin service was again employed.

We have now traced, as briefly as possible, the history of music through a series of dark ages, and at last we must admit, that but little information has been or can be gathered. The progress of music, as well as all other arts, is dependent on the advancement of the human mind ; and it is as impossible that a barbarous people should possess fine music, as that they should be acquainted with the noblest sciences that have engaged the attention of the learned. The genius of Mozart would have been lost in a state of society unprepared by previous practice and experience for the development of his peculiar powers. But we now advance to a period when all the arts began to rise in our native country, and give evidence of that greatness which they were destined to exhibit in later ages. The information has hitherto been scanty, but from the time of Elizabeth to the present day is so varied and extensive, that little more can be done, than mention the names and works of those who have excelled in the practice. This plan seems to be more consistent with the character and objects of this work than any other that could be adopted.

Elizabeth is spoken of by Camden and others, as a good practical musician, " being able to sing and play on the lute prettily and sweetly." If she was able to perform the pieces in that manuscript known as Queen Elizabeth's Virginal Book, she must in this respect have deserved the character that has been given her. It contains nearly three hundred pieces, many of them by Bird, Bull, and Farnabie, and most of them elaborate compositions.

The position in which Elizabeth was placed on her accession to the throne was by no means enviable, for the innovating spirit of the Puritans on the one hand, and the determination of the Papists to resist all change on the other, must have required more than ordinary discrimination to adopt a medium policy, without causing an out-burst of either party, and involving the country in the horrors of civil war. It is not, however, our object to trace the character of that Reformation she introduced, except as it may be connected with the progress of ecclesiastical music. Among the various requests of the Puritans, we find one, " That all cathedral churches may be put down, where the service of God is grievously abused by piping with organs, singing, ringing and trowling of psalms from one side of the choir to another, with the squeaking of chanting choristers, disguised (as are all the rest) in white surplices ; some in corner caps and silly copes, imitating the fashion and manner of antichrist, the pope, that man of sin and child of perdition, with his other rabble of miscreants and shavelings."

Such changes, however, were never contemplated by the

queen, nor did she offer the Puritans any inducement to believe she was in any way favourable to their opinions or tenets. Some alteration was necessary and enjoined by an injunction published in the year 1559, which provides for the maintenance of choral singing in some collegiate and parish churches, yet permits the introduction of "a hymn, or such like song to the praise of Almighty God, in the best melody and musick that may be conveniently devised, having respect that the sentence of the hymn may be properly understood and perceived."

In the year 1559, the Liturgy was printed under the following title: "The Boke of Common Prayer and Administration of the Sacraments and other Rites and Ceremonies of the Church of England." In the following year, Tallis and other celebrated musicians published "Certaine Notes, set forth in foure and three Partes, to be song at the Morning Communion and Evening Praier, very necessarie for the Church of Christe to be frequented and used: and unto them be added, divers Godly Praiers and Psalmes, in the like Form to the Honour and Praise of God. Imprinted at London, over Aldersgate, beneath St. Martin's, by John Davy, 1560." The same authors published in 1565 another and similar work, called "Morning and Evening Prayer and Communion, set forthe in foure Partes, to be sung in Churches, both for Men and Children, with dyvers other Godly Prayers and Anthems of sundry Men's doyings."

Among the most celebrated performers and composers of this reign, we must mention Robert White, Thomas Tallis, William Bird, Thomas Morley, and Dr. John Bull.

Very little is known of either the life or works of Robert

White. Many of his manuscripts have been preserved in the library of Christ Church, Oxford. His compositions are spoken of in the highest terms by writers on the history of music, but his works have never been published.

Tallis was a musician of no ordinary genius. Many of his works are still known and appreciated by those who study the old church music. Dr. Burney prefers his Latin motets and hymns, or Cantiones Sacræ, published in 1575, to any others of his pieces. In Dr. Tudway's collection of church music written for Lord Harley, and preserved among the Harleian manuscripts in the Museum Library (7337), the whole of the service by Tallis in D minor is inserted. In Christ Church, Oxford, there are manuscript copies of many others of his works.

Bird was a singing-boy in Edward the Sixth's chapel. In 1563 he was appointed organist of Lincoln cathedral, and in 1569 gentleman of the chapel royal. He was a voluminous composer, and many of his pieces are held in the highest estimation. Dr. Aldrich made a large collection of his works, and adapted many of his pieces to English words; all these were bequeathed to Christ Church, Oxford. In Dr. Tudway's collection * we find an entire service by Bird, in D major; and also several anthems, some of which were published by Dr. Boyce in his cathedral music. It is generally supposed that Bird is the author of that celebrated canon "Non Nobis Domine."

Nearly all that we know of Morley may be told in one sentence: he was a pupil of Bird's; a bachelor of music; a gentle-

* British Museum.

man of Queen Elizabeth's chapel; the author of "A plaine and easie Introduction to Practical Musicke," and composed much that is esteemed, though not altogether free from the charge of plagiarism. His burial service, still occasionally used in Westminster Abbey, is the most celebrated of his pieces.

John Bull was born in Somersetshire about the year 1563; was appointed organist of the chapel royal in 1591, and was the first professor of music in the Gresham College. The introductory lecture was published under the following title: "The Oration of Maister John Bull, Doctor of Musicke, and one of the Gentlemen of her Majestie's Royall Chapell, as he pronounced the same before divers worshipful Persons, the Aldermen and Commons of the Citie of London, with a great Multitude of other People, the 6th day of October, 1567, in the new-erected Colledge of Sir Thomas Gresham, Knt., deceased." In the year 1607, Bull resigned the professorship, and in 1613 left England and entered the service of the Archduke, in the Netherlands, and is supposed to have died at Lubeck in 1622.

There has never been a great public institution so grossly mismanaged as the Gresham College; but when we remember that in London every thing is done by interest, this is not surprising. Nor is there now any prospect of a better system: a short time since the chair of astronomy was vacant, and as a show of impartiality the candidates were requested to deliver trial lectures; but five members of the committee were ever in the room at the same time. The institution is worse than useless to the public, as now conducted.

Dr. Bull was one of the greatest performers ever known,

but his compositions have little if any interest ; his learning was great, his genius small.

Of secular music during the reign of Elizabeth we have not any extensive means of judging ; but certainly the talent of the period must be estimated by its church music and madrigals.

Having traced the history of music in England to the close of the sixteenth century, we shall direct the attention of the reader to the works of a few of the most celebrated composers on the Continent, and then close our brief and necessarily imperfect, yet it is hoped useful sketch, by a history of the musicians of the seventeenth and eighteenth centuries, without reference to their places of birth, or the countries in which their compositions had most influence on the public taste.

MUSIC ON THE CONTINENT IN THE SIXTEENTH CENTURY.

Giovanni Pierluigi da Palestrina was born in the year 1529 ; was admitted into the Pope's chapel at Rome, in 1555 ; was elected Maestro di Capella of Santa Maria Maggiore, in 1562 ; of Saint Peter's, in 1571 ; and died in 1594, being sixty-five years of age.

That Palestrina was by far the most eminent composer of the sixteenth century, is admitted both by his contemporaries and by posterity. Giovanni Guidetto, chaplain to Gregory the Thirteenth, being appointed to collect and regulate the choir service of St. Peter's, availed himself of this author's assistance, and acknowledges the advantage he derived from him in the following words : " If the compilation be found to have any merit, it must be chiefly ascribed to his kind

assistance." Palestrina's music is remarkable for the simplicity of style, and the cheerful character of his melody. He has been called the Homer of music, and with some reason, for all the ancient composers are forgotten when his name is mentioned. His works are numerous. Besides twelve books of masses, he published many motets, hymns, madrigals, magnificats, and other pieces. It is said that the Pope being offended with the manner in which the mass had been set and performed, had resolved to banish music in parts from the church, but Palestrina requested him first to hear one which he would compose. The celebrated composition called "Missa Papæ Marcelli" was written, and performed at Easter, 1555, before the pope and cardinals, who were so delighted with the music that it was instantly adopted in the celebration of the rites of the Romish church.

Luca Marenzio, called by his countrymen "Il piu dolce cigno," was born at Coccaglia, and stood unrivalled among his contemporaries for his madrigals. "He excelled," says Peacham, "all others whatsoever, having published more sets than anyauthor else, and hath not an ill song.

In France there were few composers of celebrity during the sixteenth century, and none whose works excite any interest in the present day. Francis Eustache Du Caurroy, born in the year 1549, was called by his contemporaries "Le Prince des Professeurs de Musique," and if this be a true character, there is little occasion to examine further into the records of the national music in this age.

Francis Salinas and Christofero Morales were the most celebrated Spanish musicians of the sixteenth century. Salinas was a native of Burgos, and being blind, his attention

was directed to music by his parents. By a female whom he taught to play on the organ he was instructed in the Latin language ; and became so enamoured with the study of literature, that he was sent to Salamanca, where he gained an acquaintance with Greek literature and philosophy. Here he was introduced to Peter Sarmentus, archbishop of Compostella, who took him under his protection. Many years after this, he was appointed professor of music at his own university. He is spoken of as an admirable performer on the organ, and better acquainted with the science of music and the works of his predecessors, than any other person.

Morales was celebrated throughout Europe previous to the introduction of Palestrina's works ; and his music has great merit, though most uninteresting to a modern ear.

Many musicians of note flourished in the Netherlands during the sixteenth century. Gombert, Jacket Berghem, Clemens non Papa, Cipriano de Rore, and Orlando di Lasso, may be named in particular.

CELEBRATED MUSICIANS OF THE SEVENTEENTH AND EIGHTEENTH CENTURIES.

There are many persons who, although attached to music as a source of pleasure, do not seem to be aware that there is any other means of exercising their skill than in the performance of the many light and generally trifling airs which are now in great numbers daily sent from the press. The object of these pages is to recall the attention to the old masters, not to create any fashionable dislike to the meritorious compositions of the present day. The history of music is, however, a subject too extensive to be adequately

discussed in the few pages we are devoting to it, and it is therefore necessary we should only speak of those masters whose works are most interesting to the modern performer.

The reign of James the First is not particularly distinguished as favourable to the progress of music; yet there were in his day several eminent composers. Among them we may mention Dr. Gyles, Tomkins, Edwin Bevin, whose works are distinguished by great harmony, and Orlando Gibbons.

"The harmony of Gibbons's service in F, printed by Dr. Boyce," says Dr. Burney, "is pure, clear, and grateful; and the melody more accented and flowing than I have found in any choral music of equal antiquity. The two parts in one of the 'Gloria Patri,' though they may be the cause of some confusion in the words, discover no restraint or stiffness in the melody, which continues to move with the same freedom as if no canon had existed. And though the purists, on account of the confusion arising from all the parts singing different words at the same time, pronounce the style in which his full anthems are composed to be vicious; yet the admirers of fugue, ingenious contrivance, and rich, simple, and pleasing harmony, must regard them as exquisite productions, *alla Palestrina*, a style in which Tallis and Bird acquired so much renown."

Dr. Tudway, in his "Collection of the most celebrated Services and Anthems used in the Church of England," speaking of Tallis and Bird, says "None of the later composers could ever make appear so exalted a faculty in compositions for the church, except that most excellent artist, Orlando Gibbons, organist and servant to King Charles the

First, whose whole service, with several anthems, are the most perfect pieces of church compositions which have appeared since the time of Tallis and Bird; the air so solemn, the fugues and other embellishments so just and naturally taken, as must warm the heart of any one who is endued with a soul fitted for divine raptures." When attending officially the marriage of Charles the First with the Princess Henrietta of France, at Canterbury, he was attacked with the small-pox, died of the disease, and was buried in the cathedral.

Almost the only kind of secular music receiving any degree of attention during the reign of James the First, was that required in the performance of masques, which were sometimes introduced at the palace and in the residences of nobles. The first masque played in England was performed at Greenwich, in the year 1512; and in 1530, one at Whitehall, "consisting of music, dancing, and a banquet, with a display of grotesque personages and fantastical dresses." Public plays, however, preceded the introduction of masques, for in the year 1369, in the fourteenth year of Richard the Second, the parish clerks of London met "at Skinner's-well neere Clark's-well," to play interludes. The exhibition lasted three days, the king, queen, and nobles being present. All the dramatic poems of Ben Jonson, Beaumont and Fletcher, and of Milton, were written for private performance, and the music was adapted accordingly.

Dr. Child, who was the most celebrated musician of the reign of Charles the First, was a native of Bristol, and appointed to the office of organist of St. George's Chapel, Windsor, in 1634. He died in the year 1697, at the ad-

vanced age of ninety. His principal works are, psalms for three voices; catches, rounds, and canons; divine anthems; and above all, his services and full anthems, published in Boyce's collection. The style of this master is remarkable for its simplicity and easy harmony

In the year 1633 the four inns of court invited Charles and his queen to hear at Whitehall "The Triumphs of Peace," a masque written by James Shirley, who has given an interesting account of the performance, and to that we must refer the reader for particulars.

Henry Lawes was also a musician of some note, for to him was entrusted the work of setting Milton's "Comus" to music. This noble poem was written for the Earl of Bridgewater, and was first represented on Michaelmas night, 1634, at Ludlow Castle. Lawes performed the part of the Attending Spirit, and Milton has, perhaps, expressed his opinion of the musician's talent in a speech that he gave him.

—"But I must put off
These my sky robes, spun out of Iris' woof,
And take the weed and likeness of a swain
That to the service of this house belongs,
Who, with his soft pipe, and smooth-dittied song,
Well knows to still the wild woods when they roar,
And hush the waving woods."

From the short account here given of the secular music in the reigns of James the First and his successor, it will be evident that dramatic exhibitions were highly esteemed. It is said that seventeen playhouses were opened in the reign of James the First, six of which were continued by Charles; but none of these were, probably, better than the travelling exhibitions that now attend country wakes and fairs.

During the Protectorate, music and all the fine arts were banished from the kingdom. The work of the Puritans was that of destruction; not of either improvement or restoration. The period in which they held power is a dreary portion of our history, yet offers us a useful warning of the misfortunes which flow from intemperate zeal led on by artifice, cunning, hypocrisy, and pride, which together, constituted the character of Cromwell.

When Charles the Second came to the throne, the excesses of the court were, if possible, greater than the austerities of the protectorate. The gloomy tyranny of Cromwell had disgusted the people, and they drank deeply, as soon as an opportunity was afforded, of the intoxicating pleasures of life, with a zest they had never known if they had never borne the burden of puritanical austerity.

During the protectorate every opportunity was taken to destroy the very remembrance of ecclesiastical music. The organs were broken, the music books were burnt, and both singers and composers were compelled to find some new employment; many in an honourable old age becoming dependant on the charity of their patrons. There was, therefore, a great difficulty in re-establishing, at the time of the Restoration, the form of music previously adopted in churches. The most celebrated performers were recalled, and honours were bestowed on them according to their merits: Gibbons, Child, Rogers, and Wilson, received the degree of doctor of music; and the most talented artists were engaged to repair and rebuild the organs. Smith and Harris were the two most celebrated organ-builders of the period, and were so anxious for superiority, that in their competition for supplying the

Temple Church both were nearly ruined. The instrument constructed by the former was, however, chosen; and so successful was he in all his works, that a single stop, known to be his workmanship, is in the present day almost invaluable. Smith also built the organ in St. Paul's Cathedral, which is said to have a sweeter tone, excepting that in the Temple Church, than any other instrument in the kingdom, and the finest swell. The instrument by Harris, rejected at the Temple, was taken to pieces, and a part of it erected at St. Andrew's Holborn, and a part at Christ Church, Dublin.

Of the state of church music during the reign of Charles the Second, Dr. Tudway gives the following account: "The standard of church music begun by Mr. Tallis, Mr. Bird, and others, was continued for some years after the Restoration, and all composers conformed themselves to the pattern which was set them.

"His majesty, who was a brisk and airy prince, coming to the crown in the flower and vigour of his age, was soon, if I may so say, tired with the grave and solemn way which had been established by Tallis and Bird and others, ordered the composers of his chapel to add symphonies, &c. with instruments to their anthems; and thereupon established a select number of his private music to play the symphony and ritornellos which he had appointed. The old masters of music, Dr. Child, Dr. Gibbons, Mr. Lowe, &c., organists to his majesty, hardly knew how to comport themselves with these new-fangled ways, but proceeded in their compositions according to the old style, and therefore there are only some full anthems and services of theirs to be found.

"In about three or four years' time, some of the forwardest

and brightest children of the chapel, as Pelham, Humphrey, John Blow, &c., began to be masters of a faculty in composing; this his majesty greatly encouraged, by indulging their youthful fancies, so that every month at least they produced something new of this kind."

Humphrey wrote many choral compositions, some of which have been printed by Boyce and others, and may be found in the collections made by Aldrich and Tudway. He died in the year 1674, at the age of twenty-seven.

John Blow, who obtained his degree of doctor of music by the special grace of Archbishop Sancroft, wrote several anthems and services in a bold and pleasing style. His secular music was collected and published in 1700, eight years before his death, under the title of Amphion Anglicus, and although the work was not successful, it contains much excellent music.

Michael Wise was also an eminent composer, of the seventeenth century, and wrote some admirable church music. He composed a service in D minor, several anthems and some songs. Wise was killed in 1687, by a watchman, in a street fray at Salisbury.

Of all the English composers, Henry Purcell is by far the most eminent, for he occupies the same rank among British musicians as Shakspeare does among the poets. He was born in the year 1658, and received the elements of music from his father, who was a gentleman of the chapel royal. When his father died, which was in 1664, he was placed under the charge of Captain Cook, appointed, at the time of the Restoration, master of the children. By this excellent teacher he was fitted for the duties of a chorister;

and so rapid was his progress in the art of music, that he received the appointment of organist to Westminster Abbey when only eighteen years of age. When a singing boy, he composed many anthems, some of which are still sung in our cathedrals. In 1682, he was promoted to the situation of organist at the chapel royal, vacant by the death of Edward Low; and soon after this, his compositions were so celebrated through the country, that they were everywhere sought for with avidity. His attention, however, was not confined to church music; he was equally successful in his compositions for the theatre and the chamber. Some of his church music may be found in Boyce and Tudway's collections, and his secular compositions in the "Orpheus Britannicus," and "A Collection of Ayres composed for the Theatre, and on other Occasions," published two years after his death. To enumerate his various works, or even those which are still (and ever must be, as long as rich and impassioned music is appreciated) ranked among the finest compositions of any master, would occupy more space than can here be devoted to the subject. His "Te Deum," and "Jubilate," are inimitable compositions.

To speak of Purcell's music too highly is, in our estimation, almost impossible; he takes rank with the greatest composers of all nations, and in some respects surpasses all. His works, however, are not generally known to his countrymen, not even to many who employ their leisure in musical studies.

Thomas Tudway was a contemporary and fellow pupil with Purcell. He is chiefly celebrated for his valuable scores of church music now deposited in the British Museum, and

for his puns. He received his degree of doctor of music, at Cambridge, in 1705, for which honour he composed as his exercise the anthem, " Thou, O God, hast heard my vows."

Dr. Turner, Dr. Christopher Gibbons, and Benjamin Rogers, may also be mentioned among the eminent musicians of the seventeenth century.

Music was cultivated with great zeal in Italy, a country which produced many eminent composers; among whom we may mention Ludovico Viadana, the brothers Mazzochi, Gregorio Allegri, Orazio Benevoli, Frescobaldi, Ercole Bernabei and Agostino Steffani.

Viadana has the reputation of inventing *thorough-bass*. Drandius, in an enumeration of his works, speaks of his choral pieces " with a continued and general bass, adapted to the organ, according to a new invention, and useful to every singer as well as organist; to which are added short rules and explanations for accompanying a general bass, according to the new method." Allegri was the author of the " Miserere," still sung in the Roman Catholic chapels during Passion week.

In the year 1653, the great Corelli was born, at Fusignano, in the Bolognese, a master whose name will ever be held in reverence by those who delight in solemn, majestic, and sublime music. About the year 1683, he published his first twelve sonatas; in 1685, the second set, under the title of " Balletti da Camera;" in 1690, the third, and in 1694, the fourth. In 1700, he published his solos. Corelli was naturally of a timid and bashful mind, and is reported to have been of a mild disposition. His music has, no doubt, derived its character from the mind of the master, being chiefly distinguished for its sim-

plicity, grace, and elegance. "His merit," says Geminiani, one of his pupils, "was not depth of learning, like that of his contemporary, Alessandro Scarlatti; nor great fancy, or a rich invention in melody or harmony; but a nice ear and most delicate taste, which led him to select the most pleasing melodies and harmonies, and to construct the part so as to produce the most delightful effect upon the ear." We cannot, however, agree with the opinion expressed by Scarlatti, who said that "he found nothing greatly to admire in his compositions, but was extremely struck with the manner in which he played his concertos, and his nice management of his band, the uncommon accuracy of whose performance gave the concertos an amazing effect even to the eye as well as the ear."

One anecdote told of Corelli so strikingly illustrates his character, that we cannot omit its insertion. After the publication of his sonatas, by which his fame was carried to distant countries, he received an invitation from the king of Naples to visit his court, and to exhibit his musical talent. The natural timidity of the musician made him unwilling to accept the invitation; but the importunity of his friends prevailed, and taking with him the first violin and violoncello of his own band, fearing he should not be properly accompanied at Naples, he journeyed to the Neapolitan capital. When requested to play one of his concertos before the king, he excused himself on the plea that he had not his band with him. At last he consented, and was amazed to find that the Neapolitan musicians were able to perform at sight the music which his own band had to learn by repeated rehearsals.

On another occasion he was requested to lead in a masque

composed by Scarlatti, and in a difficult passage failed, though it was performed with ease by Petrillo, the leader of the Neapolitan band, and the other violins. Agitated and annoyed with this circumstance, he led off a song in C minor, in the major key. "Recomminciamo," said Scarlatti; but Corelli again commenced in the major key, and Scarlatti was obliged to show him his error. Dispirited and dejected he returned to Rome, imagining himself disgraced. Soon after this, Valentini, a man in every respect inferior to Corelli, rose into public favour; and this, with the misfortunes which had previously befallen him, acting on an extremely sensitive mind, hastened his death, which happened on the 18th of January, 1713; and he was buried in the Santa Maria della Rotonda. To such a mind as that of Corelli, nothing can be more afflictive than genius, drawing the unfortunate possessor into a publicity which excites with more than natural hilarity, from the very love of its pursuit, in the time of prosperity, and drives into melancholy or desperation when fortune or the public frown.

Of all the French musicians none are so celebrated as John Baptist Lulli. He was the son of a peasant, and was born near Florence, in 1633. In 1646, he was brought into France, and held the menial office of under-scullion in the residence of Mademoiselle de Guise. It was here he first exhibited his attachment to music by attempts to play on a miserable violin. Those who have had to submit to the torture of hearing a beginner on this instrument, may believe that his propensity was by no means agreeable to his fellow-servants; but his mistress hearing of his passion for music, allowed him to take lessons at her expense. So great was

now his progress, that he was soon admitted into the king's band. In 1652 he was appointed master of a new band of violins; but before this, he was in the habit of composing for the court ballets. He afterwards rose into great estimation through France, and wrote a great number of operas, by which he accumulated a very large sum of money. By Louis the Fourteenth he was highly esteemed, and from him received many honours. He was a man of unpolished manners, but had the art of equally pleasing and commanding. His death, which happened on the 22d of March, 1687, in the fifty-fourth year of his age, was occasioned by an accident. During the performance of a Te Deum, composed after the recovery of the king from a dangerous illness, he happened, in beating time with a cane, to strike his foot instead of the floor. Mortification followed, of which he died. He was at this time composing the opera of Achille et Polixène, and his confessor refused him absolution unless he burnt it. The love of music, however, prevailed and induced him to an act of duplicity. One of the princes calling on him when rather better, said, "Why, Baptiste, have you been such a fool as to burn your new opera to humour a gloomy priest?" "Hush! hush!" he replied, "I have another copy." Lulli's music is more suited to the taste of the French than the English people.

"When Lulli, the father of true French music," says Voltaire, "came into France, the dramatic music of Italy was of the same grave, noble, and simple kind as that which we still admire in the recitatives of Lulli; and nothing can more resemble those recitatives than Luigi's famous motet, composed and universally admired in Italy about the same time.

"After Lulli, Colasse, Campra, Destouches, and other musicians, have only been his imitators, till the time of Zameau, a man who surpassed them all in science, and whose theoretical writings have made music a new art."

It would be an interesting task to trace the history of music through all the European countries, from the middle of the seventeenth century to the present time; but to describe the styles and to record the characters of the most celebrated composers and performers, would require many volumes. To bring this short sketch to a close, we will merely refer to some of the music most celebrated in our own day, and to the English church music, without reference to the establishment of the opera; although we are chiefly indebted to that, as must be allowed by all persons, for the improved taste. Some limit, however, must now be drawn, and at a future time we may, perhaps, enter more fully into this most important subject.

George Frederic Handel was the son of an eminent physician and surgeon at Halle, and was born on the 24th February, 1684. It was his father's intention to have educated him for the profession of the law, but he evinced in his childhood so great a talent for music, that his parent prudently relinquished his own wishes, and placed him under the tuition of Zachau, the organist at the cathedral of Halle. When only nine years of age he was able to perform the services for his master, and commenced the study of composition. In the year 1698, when fourteen years old, he was taken to Berlin, at which court music was then greatly patronised. The elector of Brandenburg, afterwards king of Prussia, was greatly pleased with young Handel, and

offered to send him at his own expense into Italy to complete his studies, but his father refused the proposal. Shortly after his return to Berlin, the elder Handel died, and the son removed to Hamburgh, where he continued for some time to practice as an opera player. Matheson, a contemporary and friend of Handel's, has given an account of his habits during this period of his life. Matheson was a player on the harpsichord and Handel on the organ, and they appear to have had an agreement between them not to play in public on each other's instrument. "Handel," says his friend, "pretended ignorance in a manner peculiar to himself, by which he made the gravest people laugh. But his superior abilities were soon discovered, when upon occasion of the harpsichord-player at the opera being absent, he was persuaded to take his place; he then showed himself to be a great master, to the astonishment of every one except myself, who had frequently before heard him upon keyed instruments."

In December, 1704, Handel produced "Almira," his first opera; and on the 25th of February, 1705, another called "Nero."

Having obtained sufficient money to defray the expenses of a journey to Italy, he left Hamburgh in 1709. He first visited Florence, where he composed the opera of "Rodrigo." At Venice he remained some time, and there produced his "Agrippina," which was heard with great applause. At Rome he was received with attention by Cardinal Ottoboni, and during his stay had an opportunity of hearing the best music performed in the best manner under Scarlatti and Corelli. In 1710 he visited Hanover, and received the

patronage of the elector, afterwards George the First of England. Steffani was at this time Maestro di Capella, but resigned that office in his favour. He was, however, very anxious to visit England, from the representations made to him by the English nobility in the court of Hanover. This he was not only permitted to do, but his munificent patron also settled upon him a pension of fifteen hundred crowns, upon condition that he should return to his court.

In the same year Handel arrived in England, and although he probably intended to have made only a short stay, he was received with so much kindness and flattering attention, that he thought but little of his return, until reminded of his ingratitude to the elector by the arrival of George the First.

When Handel, whose fame was already established, arrived in this country, Hill, who was then a director of the Haymarket theatre, requested him to write an opera founded on Tasso's "Jerusalem." Rossi was engaged as "a gentleman excellently qualified to fill up the model he had drawn with words so sounding, and so rich in sense, that if his translation is in many places led to deviate, it is for want of power to reach the force of the original." The opera to which we refer is that called "Rinaldo," and was performed fifteen times without interruption, except as benefits occurred.

In the year 1715, Handel composed his "Amadigi," and probably in the house of the Earl of Burlington; for in his preface he says, "this opera more immediately claims your lordship's protection, as it was composed in your own family."

Of all Handel's compositions, none are so highly esteemed in England as his oratorios, of which the following is a chronological list:—

Esther	1720
Deborah, Athalia	1733
Acis and Galatea	1735
Alexander's Feast	1735
Ode, St. Cecilia's Day	1736
Israel in Egypt	1738
L'Allegro ed il Pensieroso	1739
Saul	1740
Messiah	1741
Samson	1742
Semele, Belshazzar, Susanna	1743
Hercules	1744
Choice of Hercules	1745
Judas Maccabæus	1746
Joshua	1747
Solomon	1749
Theodora	1750
Jephtha	1751

The difficulties which this great composer had to contend with during his residence in England, and his ultimate success, the peculiarity of his temper, the remarkable manner of his performances, and the touching magic of his compositions, are too well known to need any remark. His style is copious, dignified, and full of invention; and all his compositions are remarkable for the control they exercise over the passions.

Leonardo Vinci, a composer of the Neapolitan school, was very celebrated in his own day, and some of his operas are most worthy of esteem. It is said, that he was a runaway student from the Conservatorio at Naples. In the year 1724

he wrote the music for the opera of Farnace for the Aliberti theatre at Rome, which was so successful, that it established his fame, and for several years after he was constantly engaged in musical compositions. Vinci deserves mention not only for the pleasing harmony of his melodies, but also for the alteration he made in the character of dramatic music. Count Algarotti, speaking of the music set to Metastasio's "Didone Abandonata," says, "Virgil would himself have been pleased to hear a composition so animated and so terrible, in which the heart and soul were at once assailed by all the united powers of music."

The name of Pergolesi is well known to all our readers, and his merits cannot be passed over in silence. This celebrated musician was born at Casoria, about ten miles from Naples, in the year 1704. His musical talent being early discovered, he was sent to the Conservatorio at Naples, and when quite a child gave many specimens of his power in composition. In his own country he obtained but little patronage, for although he procured some employment by the assistance of the Prince of Stegliano, his operas were never successful at Naples. In 1735 he was engaged to compose an opera for the Tordinone theatre at Rome, to the poetry of Metastasio; all his efforts, however, were here unsuccessful, he was praised by none but professors and men of taste. So great was his mortification, that he does not seem to have resumed his pen until engaged by the Duke of Matelon to compose a mask to be performed at Rome. His success was now as great as his previous disappointment, every one was delighted, and his fame soon spread through neighbouring countries. But his life was drawing to a close. For several

years previously he had shown symptoms of consumption, which now assumed a more serious character, and was recommended to take a small house at Torre del Greco, by the sea-side near Mount Vesuvius. It was here that he composed his "Stabat Mater" and "Orpheus and Eurydice." He died in the thirty-third year of his age, esteemed in all countries as one of the greatest composers of his day.

Nicolo Jomelli must also be mentioned as an Italian musician of great genius; he was born in the year 1714, and died in the year 1774. He chiefly directed his attention to the composition of operas, but his admirable church music proves that he was equally capable of that style. The celebrated Mattei gives the following description of him in his account of the funereal ceremony: "Jomelli was my friend, he lived two years in my neighbourhood, and I had frequent opportunities of conversing with him, and of admiring his captivating manners, particularly his modesty in speaking of rival artists, whose compositions he readily praised, though their authors were not equally candid in speaking of him. The learning which appears in his works procured him the esteem of consummate musicians, but sometimes lost him that of the multitude. . . . . A learned and ingenious music like that of Jomelli, abounding in harmony and contrivance, which requires a careful execution and the utmost stillness and attention in the audience, could not satisfy the frivolous and depraved taste of the Italians; who used to say that the music of Gluck, Jomelli, Hasse, and Bach, was too rough and German, and pleased them less than the songs of the gondolieri!"

Joseph Haydn was born at Rhoraw, in Lower Austria, in

the year 1733. His father was a wheelwright, and the musical talents of his son were excited by his occasional performance on the harp. His musical genius being discovered, he was placed in the cathedral at Vienna, and having a powerful voice of great compass, was received into the choir, and taught both the art and science of music. When his voice broke he was dismissed from the cathedral, and supported himself by teaching and occasional performance. In 1759 he received the appointment of director of music in the service of Count Marzin. In 1761 he was promoted to the same office in the establishment of Prince Esterhasi.

Haydn's music, or at least his oratorio of "the Creation," is well-known in this country, and universally admired for its richness and pathos. His "Stabat Mater" and oratorio of "Il Ritorno di Tobia," are better known on the Continent than in this country; but the music in both is of the highest rank. The instrumental "Passione," which are founded on the seven last sentences of our Saviour, is one of his last and most perfect compositions, and, perhaps, unequalled in their peculiar style by anything that he or any other composer has written. This celebrated writer, who was called the father of modern music, died in May, 1809, at the age of seventy-six.

Piccini, Gluck, Sacchini, Bach, and many other musicians of high rank, might here be appropriately mentioned did our pages admit, but we must pass over them to give a short account of the great Mozart.

The name of Mozart is dear to every true lover of music; his style is peculiar, but his compositions have a much more powerful influence on the feelings than any other with which

we are acquainted. In all his operas he exercises a despotic influence over the passions of the auditor, agitating or composing the mind, and always adapting the style of his harmony to the full expression of the sentiments the words convey.

Many of the greatest musical composers have been remarkable for the precocity of their genius, but none have evinced their talents at so early an age as Mozart. He was scarcely three years old, when his father commenced teaching him the harpsichord, over which instrument he is said to have had a perfect control when only four years of age; but he was not, even then, satisfied with playing those pieces which were placed before him, but indulged himself in the composition of minuets and other light movements. He was scarcely five years old, when on his return from church he was found writing a concerto for the harpsichord which was composed according to the strictest rules of art, but so difficult in its execution, that his father, who was a musician of no ordinary rank, declared that no one would be able to play it. "It is a concerto," said the child, "and must be well studied before it can be played properly;" and sitting down at the piano said, "This is the style in which it ought to be executed," and attempted to give some idea of his conception.

This singular child was not less distinguished for the mildness of his disposition than for his extraordinary musical genius. To the warmth of his affections we may in a great measure attribute the touching sweetness of many of his compositions and the power which he afterwards exercised over the feelings of others. It is recorded of him that he would

frequently ask those about him "Do you love me!" and if answered in the negative, even in jest, he wept bitterly.

Before he was six years old (Jan. 1762), his father, who could not fail to perceive and value the extraordinary genius of his son, took a journey to Munich with his two children to perform before the elector and the royal family. Young Mozart was here received with every mark of attention, and excited the greatest surprise in the minds of all who heard him. In the following autumn he was taken to Vienna, where he gave concerts, and also in all the principal towns through which they passed. His father writing to a friend, says, "On Thursday we arrived at Spes, where two Minorites and a Benedictine who accompanied us, said mass, during which our little Wolfgang tumbled about upon the organ and played so well, that the Franciscan fathers, who were just sitting down to dinner with some friends, left the table and ran with all their company into the choir, where they were filled with wonder . . . The children are as merry as when they are at home. The boy is friendly with everybody, but particularly with military officers, as though he had known them all his life. He is the admiration of all."

At Vienna, the Mozart family was received with kindness by the emperor, Francis the First, who was accustomed to call him his little magician. The sweetness of his disposition, united with his extraordinary talent, brought him into great favour with all the members of the royal family; but so far was the attention of the noble and powerful from raising in his mind a spirit of pride, that it only developed the tenderness of his disposition. His love for music seems to have been

extended to the professors themselves, for he always preferred playing before them, performing with greater energy and care. Finding himself at one time surrounded only by the court, he turned to the emperor and asked with great simplicity, "Is not M. Wagenseil here? he understands these things." The musician was sent for, and, taking his place by the side of the piano, the child turned to him and said, "Sir, I am going to play one of your concertos; you must turn over the leaves for me."

The remarkable readiness with which Mozart made himself master of any musical instrument is proved by an incident which occurred soon after his return to Salzburg. During his residence at Vienna, a small violin was given him, upon which he frequently practised, and with what success, may be gathered from the following tale related by Schachtner, the archbishop's trumpeter, who was present on the occasion. Weulz, a celebrated violin-player, had called on the elder Mozart for his opinion of some trios which he had just written. "The father played the bass, Weulz the first violin, and I was to play the second. Mozart requested to take this part; but his father reproved him for this childish demand, observing that as he had never received any regular lessons on the violin, he could not possibly play it properly. The son replied, that it did not appear to him necessary to receive lessons in order to play the second violin. His father, half angry at this reply, told him to go away and not interrupt us. Wolfgang was so hurt at this that he began to cry bitterly. As he was going away with his little violin, I begged that he might be permitted to play with me, and the father, with a good deal of difficulty, consented. 'Well,' said he, 'you may

play with M. Schachtner, on condition that you play very softly, and do not let yourself be heard: otherwise I shall send you out directly.' We began the trio, little Mozart playing with me; but it was not long before I perceived, with the greatest astonishment, that I was perfectly useless. Without saying anything, I laid down my violin and looked at the father, who shed tears of affection at the sight. The child played all the trios in the same manner. The commendations we bestowed upon him made him pretend that he could play the first violin. To humour him we let him try, and could not forbear laughing on hearing him execute this part; very imperfectly, it is true, but still never to be set fast."

The exquisitely delicate sense of hearing possessed by the young Mozart, cannot be better described than by the mention of another anecdote. Wolfgang was very partial to an instrument that belonged to Schachtner, and often spoke of it as peculiar for the richness and softness of its tones. On one occasion he was amusing himself with his own little instrument, but turning round and addressing Schachtner, he said, "If you have left your violin tuned as it was when I last played on it, it must be at least half a quarter of a note sharper than mine." The remark, naturally enough, excited a laugh; but when the instrument was brought, it was found to be as he said.

In 1763 the Mozart family commenced a new expedition, beyond the boundaries of Germany, and the two children gave public concerts before princes and the nobility in all the principal towns through which they passed. An anecdote is told of Wolfgang, that remarkably shows the simplicity of

his mind at this period. When at Versailles, Madame de Pompadour had him placed upon a table, but as he approached her, she turned from him; on which he indignantly exclaimed, "I wonder who she is, that she will not kiss me,—the empress has kissed me." In 1764 he arrived in England, and was received with great attention by the king and royal family. After playing at sight before his majesty many pieces by the old masters, the king gave him the bass of one of Handel's airs, to which he instantly composed a beautiful melody. The father writing to a friend, says, "A week after, as we were walking in St. James's Park, the king and queen came by in their carriage, and although we were differently dressed, they knew us; and not only that, but the king opened the window, and putting his head out and laughing, greeted us with head and hands, particularly master Wolfgang."

In 1767 the family again visited Venice, and Mozart there wrote his first opera, "La Firta Semplia," by command of the emperor; but it was never performed, in consequence of the jealousy of the musicians. "The whole hell of music here," says his father, "has risen to prevent the talent of a child from being seen." When about fourteen years old, he received the order of the Cross, at Rome, from the pope. In December 1770 his opera of "Mitridate" was performed at Milan, with rapturous applause, and his great genius as a composer, as well as a performer, was established. His course, however, was not one of prosperity; for those who had admired and cherished him as a boy, seemed to forget him as a man, and he even failed to obtain the situation of music-master to the royal family, with a salary of forty pounds a year.

To give any description of the character of his music is

unnecessary. Haydn has spoken of him as "the most extraordinary, original, and comprehensive musical genius ever known in this or any age or nation." His celebrated "Requiem" was the last and not the least beautiful of his compositions. Of his death, the following account is given by his sister-in-law: "As I approached his bed, he called to me, 'I am glad to see you here; you must stay to-night, and see me die.' I tried to persuade him out of this, but he answered, 'I have already the taste of death upon my tongue; I can feel it: and who would be with Constance if you are not?' I only went away for a short time to give my mother some intelligence I had promised her, and when I came back to my disconsolate sister, Siissmaier was by Mozart's bed-side. Upon the counterpane lay the 'Requiem,' and Mozart was explaining his meaning to Siissmaier, that he might complete the work after his death." The great Mozart died in the thirty-sixth year of his age, leaving a wife and two sons totally unprovided for.

Since the time of Purcell, there have been many eminent composers for the church in England; and a short notice of some of them will, perhaps, be interesting to the reader.

Jeremiah Clarke, instructed by Dr. Blow, in the chapel royal, was a man of great talent; but an unfortunate attachment to a young lady far above him in rank, was the cause of his untimely end. Dr. Blow had so much regard for him, that in the year 1693 he resigned, in his favour, the situation of master of the children and almoner of St. Paul's. In 1700 Blow and Clarke were elected gentlemen extraordinary in the king s chapel, and in 1704, jointly to the situation of organist.

Clarke's compositions are not numerous. His style is remarkably pathetic and plaintive, and always pleasing to the cultivated ear as well as the crowd, for whom every composer must chiefly write. He occupies among musicians the same rank as the long to be remembered Otway does among poets.

Dr. Aldrich was dean of Christ Church, Oxford, and was in every respect an extraordinary man; for he was a profound theologian, an excellent architect, skilled in the physico-mathematical sciences, and thoroughly acquainted with the principles and practice of music. The catch, "Good! good! indeed;" and the beautiful round, "Hark, the bonny Christ-church Bells" are by him. Beside these and many other compositions of a similar kind, he wrote nearly forty services and anthems, many of which are still publicly performed. He died in the year 1710, leaving the whole of his musical collection to his college.

William Croft was born at Nether-Eatington, in Warwickshire, in 1677. After passing rapidly from one situation of honour to another, and enjoying a continued professional prosperity, he received, in 1715, the diploma of doctor of music in the university of Oxford. In 1724 he published in two volumes a collection of his choral music, in a work called "Musica Sacra; or, Select Anthems in Score, for two, three, four, five, six, seven, and eight voices, to which is added the Burial Service, as it is occasionally performed in Westminster Abbey." Croft died in 1727, in the fiftieth year of his age, and was buried in the north aisle of the abbey in which he so long and successfully officiated. His music is universally esteemed, and will long be so, for its pure harmony, skilful arrangement and pathos.

Dr. Boyce, whose name has been frequently mentioned in connection with the church music of this country, as having published an important collection of cathedral music in score, was educated by Dr. Greene, by whom the work was commenced. The compositions he has left us place him in a high rank among modern musicians. "Dr. Boyce," says a modern writer, "with all reverence for the abilities of Handel, was one of the few of our church composers who neither pillaged nor servilely imitated him. There is an original and sterling merit in his productions, founded as much on the study of the old masters as on the best models of other countries, which gives to all his works a peculiar stamp and character of his own, for strength, clearness, and facility, without any mixture of styles or extraneous and heterogeneous ornaments."

We have now presented the reader with a short sketch of the history of music, and have introduced to his notice the compositions of some of the most celebrated musicians of past times. We do not pretend to have even mentioned the names of all who deserve to be placed in the highest ranks of musical talent; nor has it been our object to give a consecutive account of all that has been done, but to refer those who may be interested in the study of music to the works of some few composers, and to give a sketch of the early progress of the science.

THE END.

LONDON:
BRADBURY AND EVANS, PRINTERS,
WHITEFRIARS.