and afterwards cooled and crystalized, but with extreme slowness and under conditions different from those bodies cooling in the open air; they differ from volcanic rocks not alone by their crystaline structure but by the absence of tufa and breccias, which are the products of eruptions on the earth's surface or beneath seas of little and inconsiderable depth.

The metamorphic or stratified crystaline rocks form the fourth and last great division of rocks, comprising the gneiss, mica schist, clay slate. chloritic schist, marble and the like, the origin of which is more doubtful than that of the other three classes They contain no pebbles or sand or scoriæ, and no traces of organic bodies, and are often as crystaline as granite, yet divided into beds corresponding to sedimentary formations, and may be called stratified. The materials of these strata were originally deposited from water in the usual form of sediment, but were subsequently so altered by subterranean heat as to assume a new texture. It may be proved that fossiliferous strata have exchanged an earthy for a highly crystaline structure, even at some distance from their contact with granite; hard clays containing vegetable or other remains have been turned into slate, called the mica schist or hornblende schist, and every vestige of the organic bodies has been obliterated.

All the crystaline rocks are of very different ages, sometimes newer than the strata called secondary, and we must infer that some peculiarity must exist which is equally attributable to granite and gneiss, or in other words to the plutonic and altered rocks, which are distinguished from the volcanic and the unaltered sedimentary rocks; and that the granite and gneiss and the other crystaline formations are hypoaqueous, or rocks which have not assumed their fossil forms and structure at the surface, and occupy the lowest place in the order of superposition.

The composition of granite, as already stated, being quartz, mica and feldspar, the two last named ingredients contain the alumina in the form of silicate of alumina in nearly equal proportions, and some contain also some alkaline ingredients; likewise mica consists of a silicate of alumina and another alkali, differing somewhat from those contained in the felspar; we have, for instance, the anorthite, a lime felspar, the labradorite, a lime and soda felspar, the oligoclase, a soda lime felspar, the albite, a soda felspar, the orthoclase, a potash felspar; while the mica group, such as the phlogopite, biotite, muscovite, lepidolite, and others contain about twenty per cent of alumina, and about thirty per cent magnesia in their compositions. Felspar, like adularia, amazonstone and labradorite, when polished, form ornamental minerals; the garnet, likewise a silicate of alumina, when cut and polished, forms a gem; so is the lapis lazuli a silicate of alumina, an ornamental stone furnishing the natural ultramarine blue colors. The turquoise, one of the genus, is of blue color, but is a phosphate instead of a silicate of alumina, while another interesting mineral, called wavellite, contains this alumina. The beryl and emerald are silicates of alumina oxygenated, the latter colored with oxide of chrome; and the first, when cut and polished, has the name of aqua marina, and is a fine gem.

A vast number of minerals composed of alumina and silica are found in nature, which find much useful application in the arts and manufactures; the mineral cryolite from Greenland, which is an aluminate but not combined with silica, is a fluoride of aluminum and sodium, is exported to many parts of the world and furnishes the material for alumina compounds.

Common slate, fuller's earth, pumicestone, marl, loam, ocher, umber, and sienna are more or less clays or silicates of aluminum, the three latter being colored by oxides of iron and manganese.

The topaz, a beautiful gem, is a silicate and fluoride of alumina. The great family of zeolites, which are composed of hydrous silicates and represent a very interesting class of minerals, are all chemical compounds of alumina with silica; most of them contain also a considerable portion of water, and lime, soda and potash.

Clay, which is found in nature in very extensive deposits, and if of very fine quality and texture is called kaolin: and the other varieties, such as common pipe clay, fine clay, Stourbridge, marl, or loam clay, and claystone: is of the same chemical composition as regards the silicate of alumina; some contain more iron, and some contain lime and the alkalies soda and potash; all, however, owe their existence to the decomposition of the granitic rock which, through many causes, either chemical or mechanical, or through the action of atmospheric air for many ages, has gradually become disintegrated; and as Brogniard found in France the granitic rock in such a condition, he called it "*la maladie du granite.*" The rock may gradually wear down either by variation of temperature or glacial action, or by congelation of water within the rock, gradually producing a split and expansion. In a chemical point, water itself may produce a powerful metamorphosis; as it contains carbonic acid, it would probably act upon the alkalies in the felspar of the decomposing granitic rock, while the silicate of alumina and the free silex would subsequently be separated by the action of water; the former, being so much lighter, would soon be washed away from the heavier silex, and after separation the clay is deposited. Very striking demonstrations of the decomposing granitic rocks may be seen in New York city, particularly in the upper part; there is a ledge of granitic rock extending from east to west, beginning at 31st street west to 60th street north; the Croton aqueduct in 42d street and Fifth avenue has been built from a granite quarried near 48th street and Tenth avenue; while on the east side, above 50th street, the gneiss rock caps the granite.

INSIDE A CHURCH ORGAN.

It is questionable whether any more magnificent specimen of human mechanical skill exists than the grand organ. The builder must unite, in his single person, the three capacities of artist, of scientist, and of workman: of the first, in order that he may possess the delicacy of ear to appreciate minute shades or variations of musical sound; of the second, that he may know and investigate the principles of acoustics which govern the productions of melodious vibrations, and the theories to be followed in constructing the apparatus from which the same may be elicited; and lastly of the skilled artificer, in order that he may contrive and invent devices for rendering the harmonies, latent in his assemblage of pipes, levers, and keys, responsive to the touch of the musician. It may seem almost a shattering of one's favorite mental idols to break down the divinity which, as the king of instruments, hedges around the organ: indeed, the dry details of levers, springs, and bellows, seem inappropriate and incongruous in connection with those grand tones which peal forth in the solemn chords which excite our reverential feelings as we kneel in the sanctuary; but Science is utterly destitute of sentiment. With imperturbable calmness she mercilessly resolves the daintiest melodies of Mendelssohn or Schumann, or the most majestic of choruses of Handel or Beethoven, into mere vibrations of the air, prolonged through certain intervals and in certain tubes, or leads us off from the reverie into which we fall over some exquisite harmony of the great tone masters into abstruse calculations as to the percentage of power due to the food absorbed by the organist *plus* the blower, which, converted into heat, is reconverted into motion by muscular action, which is again communicated to levers, etc., and which ultimately reappears in the shape of sound, and is again converted into motion when vibrating the auditory nerves

We recently spent a pleasant half hour inside an organ. We climbed ladders and mounted platforms, and enjoyed the novel sensation of standing in a small grove of tubes, where big pipes were the large trees, and the little ones, the under brush; and looking back it seems as if we investigated enough levers, springs, and rods to establish a moderate sized piano manufactory. We puzzled over the arrangement of pedals, couplers, and stops, and became hugely impressed with the skill which enables a single mortal of ordinary construction to play on so many things at once; and finally discovering some novel and really ingenious appliances which, the builder informed us, were not furnished to organs in general, we obtained through the kindness and courtesy of that gentleman the following interesting particulars:

Let us premise by observing that the instrument which formed the object of our visit is located in the church of the Holy Communion, corner of 20th street and Sixth avenue, and that it has just been completed by Mr. Hilborne L. Roosevelt, of No. 40 West 18th street, in this city. Mr. Roosevelt is one of the youngest of American organ builders; but if we may judge from the magnificent tone and almost perfect mechanism, coupled with devices of no mean inventive skill, which we find in his latest production, we may fairly assume that he has reached a foremost place in his arduous profession. His plan is to combine the best points of all schools, English, German, and French; and hence the brief sketch which we give of the arrangement of the organ in question may perhaps be considered as including many of the latest improvements of the manufacture.

Everyone knows that if power be communicated indirectly, the necessary mechanism for turning corners, etc., necessitates a certain amount of frictional loss and resistance, greater, of course, than if the force was applied directly from the motor. Add to this the fact that the latter is weak, and, moreover, acts at a disadvantage, and an outline may be gleaned of the difficulty of actuating the multitudinous valves and levers of an organ, by compound levers connecting with key boards, say forty feet off, governed by the fingers of the organist. There is both a strong resistance to digital pressure, necessitating great exertion on the part of the performer, and also there exists an appreciable lapse of time between the touching of the key and the evolution of sound. The improvement which avoids this trouble is called the "pneumatic lever," and its effect is such that the keys are as easily manipulated, even with the full power of the instrument in action, as those of an ordinary pianoforte, while the interval of time between touch and sound, is barely ½ second, which is of course practically inappreciable. In the church above noted, the organist's seat is on the ground floor, while the instrument is in a gallery. The levers from the inner extremities of the keys pass down under the flooring to a box directly beneath the loft. Here, arranged in framework, is a series of little bellows, one for each key of the organ; and in one end of each of which is a valve. operated by a lever leading from the key board. This is so adjusted that, on pressing down a key, compressed air enters the corresponding small bellows and inflates it. As the bellows enlarges, it pulls upon a lever that opens the valve connecting with the proper pipe. It will be noted that no pressure is needed on the key, except such as is necessary to lift the small bellows valve, which is of course a very inconsiderable amount.

This set, or rather these sets, of bellows, for there are two, one belonging to each bank of keys, must not be confounded with the main bellows which supplies the air blast. This apparatus is situated in the loft near the organ, and is operated by man power, forcing a powerful current of air, not directly to the pipes, but into another bellows which serves as a regulator, securing a constant, instead of an intermittent, blast, and thus preventing the disagreeable, wheezy, and unequal tooting sound often noticeable in old and imperfect instruments. The blast is finally driven into a reservoir, whence it emerges into the pipes in the manner presently to be described.

Each key board, and there may be several, belongs to an entirely separate organ, so two or more instruments may, by ingenious inter-adjustment, be combined in one and the same case. In the organ in question, there are two key boards proper, though the pedals, worked by the feet, may be termed a third; and there is another called the electro-melody, so that in fact, with two key boards and one set of pedals, the player performs upon four separate and distinct organs at will, any combination of that number, or all together. The pedal organ is merely an assemblage of low pitched pipes; and on its mechanism, it is unnecessary to dwell. The great organ is the lowest bank of keys, which connect, as before noted, with pneumatic levers. Just above the receptacle for the wind is the wind chest, which may be likened to a long shallow box, divided by numerous longitudinal partitions, making troughs. In these partitions are set the pipes, each longitudinal row of which is called a register. The lower ends of each set communicate with a compartment of the chest, and the apertures are closed by spring valves. Now, if there were but one set of pipes, each key would through the pneumatic lever, communicate with one of those valves, and hence would necessarily sound but a single tube; but there are, as we have already stated, many rows of pipes, and hence one key not only works one valve, but several, ranged in a transverse line directly across the wind chest. That is, while a single key may sound first a fundamental note belonging to a chord which is found in one register, it may open simultaneously valves belonging to tubes in other registers parallel thereto, so as to admit air, and thus produce notes having certain harmonic relation to the key note; so that in fact by a single pressure of the finger, if we so desire, we may produce a chord or portion thereof. instead of a single note, as on a piano. Each trough in the wind chest of course belongs to one set of pipes, and has its own valve, so that the organist, by means of handles near his key board, called "stops," may admit the blast into one or any number of the channels, and thus sound any register or registers he may desire. The total compass of each register, in the great organ portion of the instrument we are describing, is 58 pipes, and there are twelve stops. allowing a selection of any of that number of registers. But these latter all differ in quality of tone; for instance, one is a harmonic flute, another a trumpet, a third a clarion; in fact each has its own voice, due to the construction of the pipes. The pedal stops are arranged in similar manner, and number five in all, while the swell organ, which is operated by the second or higher key board, has a similar number of pipes, with a set of eight stops peculiar to itself. The swell organ must here be explained, as used for *diminuendo* or *crescendo* effects. It consists in mechanism similar to that already described, but enclosed in a tight box, the sides of which are made like Venetian blinds. By opening these shutters, more or less, the organist can allow the whole sound to emerge, or can confine it, and so deaden it in the closed case. The electro-melody organ is an entirely novel invention of Mr. Roosevelt, of which it would be hardly possible to convey a clear idea without engravings. It is, as we have stated, a separate little organ by itself, and is designed to carry the notes of a melody or air, in a tone easily heard above the accompaniment, and so prove very useful in congregational singing. It is connected to the upper half of the key boards, and with a Leclanché battery. Each key, on being pressed, establishes a current which magnetizes an electro-magnet and so opens the valve of the proper pipe. The peculiar point, however, lies in devices which prevent any but the upper or melody note being heard. Thus, if we strike the chord C E G C, the upper C alone could be heard, if we allowed that note to rise, then only the G, and thus throw out any number of tones. This invention is highly ingenious, and though really very simple, quite difficult to solve at first sight.

There are many other appliances which we may briefly notice in conclusion. Among them are four couplers, by which the pedal great, and swell organs are connected, as may be desired, by a mere pressure of the finger of the organist on a button just above his key board. There are besides, five combination pedals, for drawing out the full power of the instrument, or full or part power of each integral portion. Then there is the usual tremolo arrangement, and various other refinements, which, though interesting to the musician, might fail to be appreciated by the general reader.

One of the most interesting applications of electro magnetism, it may be remarked, is to the church organ, and we are aware of instances of its use to much larger extent than in the electro melodic sub organ noted above. In fact, one of the principal churches in this city has two complete organs, one being on each side of the chancel, and entirely distinct from the other. A single keyboard communicates directly with one, but operates the other by the electric current and magnets acting on the valves; so that if desired, the choir may be divided, half on each side, and yet both parties be enabled to sing in correct unison with the instrument. There are other points relating to organ improvements and manufacture, which space prevents our here dwelling upon, and to which we shall allude at an early date.

The Balloon Advertising Dodge Rejected.

The Commissioner of Patents has rejected an application for a patent for the broad idea of attaching advertisements to balloons, for the reason that a balloon is a common object, upon which every person has the right to stick or paint advertisements if he wishes. In order to support a patent, the applicant must have invented something. It is not invention merely to put advertisements on balloons.