from predacious fishes by gluing to his sides small sticks, somewhat longer than his body, until he is encased in an irregular woodencylinder—a jagged and clumsy boat in which he alternately floats and crawls. This carpenter worm leaves an orifice for his head and legs, and his artificial shell seems a thorough shield.

The medusa or jelly fish of our seacoast is well known to all sea bathers; and its phosphorescence often reveals its whereabouts to steamboat travelers. It is as large as a tea plate, flat, gelatinous, and translucent; with the convex portion forward, it pushes its way through the water as if it were a small parasol—a white fringe a yard long, waving backward from the edge, assisting the resemblance. This creature has hardly any life; it seems to have only one organ, which receives and ejects food, and its movement through the water is by a series of convulsive jerks. Lift it out of the water and it drops through the fingers like thin jelly. But in its native element it has the power of sharply stinging with its fringe, from which it is called nettle fish. This fringe, when microscopically examined, is found to be filled with minute sacks, each of which contain a microscopic arrow ready to discharge. Friction bursts the cells and causes the discharge of myriads of arrows into any soft flesh that may be the cause of the disturbance. The harm is not great to any robust organism, but it must be sufficient to shock and paralyze some of the inferior fishes.—*Graphic.*

Correspondence.

How to Straighten a Shaft.

We frequently receive letters from our subscribers detailing some experiment they have made, or some new wrinkle in the detail of manufacture, or concerning a novel device they have found to answer for some particular purpose; for all such communications our correspondents have our thanks.

Although the large number of such communications precludes the possibility of our answering or publishing all, yet we convert as many as possible to the benefit of our readers. We are sometimes surprised to observe how completely the information forwarded to us on a given subject will answer an inquiry made on the same subject by some other correspondent. For example, A. F. writes: "You will do me a great favor if you will tell me how to straighten an iron shaft, 2½ inches in diameter, that is slightly bent, and will not work without binding in the bearings."

The same mail brought a letter from J. J. H., who writes:

To the Editor of the Scientific American:

"The following is a good way to straighten shafts that have been sprung by heat or otherwise. Lay the shaft on bearings at each end, with the arched side up, about 1 foot from the ground; then build a fire (wood will answer) under the part or parts to be straightened. When hot, chill the the top side, which is to be straightened, with water, which can be best done with a swab; continue the heating and chilling till the work is complete. Allow the heat to come back to the top side between each chilling, to quicken the process, and to ascertain when complete. After the shaft is hot, a very little fire will be required to continue the heat. I think that any kind or size of metal shafting can be straightened by this process. I made the experiment on a wrought iron shaft 5 inches in diameter and 12 feet long, that was sprung 3 inches by being burnt in a mill. It was was only 2 hours from the time I built the fire under it till it was perfectly straight. J. J. HILL.

Hayden's Ferry, Arizona, July 1, 1876.

[For the Scientific American.]

THE DEVELOPMENT OF SPEECH.

As the seventeenth century was preëminently one of revolutions, the present is one of evolution. Everything is supposed to have been evolved from something else, man from monkeys, articulate speech from inarticulate cries, writing from hieroglyphics, etc. A few weeks since the American Philological Society met in New York city, and among their discussions were some of much interest. Professor Harkness read a paper in which he stated that comparative philology had proved that all the known languages and dialects have been evolved from one parent tongue, whether by differentiation, natural selection, and survival of the fittest, or by other processes. Darwin, in his "Descent of Man," draws some of his most forcible arguments from the resemblance of the human fetus to the full grown ape and other animals. The unspoken language, the inarticulate cries of infants, has not, so far as we are aware, been carefully studied, and compared to the cries of birds and animals. H. Taine has recently directed attention to this subject by an article on "Lingual Development in Babyhood," published in the *Revue Philosophique.* But M. Taine passes over the multitude of different cries and exclamations, consisting, as he says, exclusively of vowel sounds, and expects articulate speech. Some of his observations are, however, valuable and interesting, as being the first that have been accurately made and intelligently recorded. We hope that these observations will be repeated by others, so that in time the mass of facts will be large enough to enable us to generalize upon them, and eliminate the personal factors which vitiate the conclusions drawn from too limited a number of facts. Idiosyncrasies in children are probably as common as elsewhere; abnormal development must not be mistaken for a normal condition; one child will differ so greatly from some other child that we shall at first incline to think there is no common ground between them; but as observations increase, the facts will gradually fall into system, and order come out of chaos.

From a study of the speech of babyhood we shall learn not only how language is formed, but shall see in it the gradual unfolding of the intellect. Babies' selections of words are instructive to the biologist; the order in which they acquire the power of pronouncing the consonants is an interesting study for the phonetic scholar. Why, for instance, can every infant pronounce the word no, for several months before it can say yes? That the English sounds of th are difficult for our children is not surprising; but why are our sounds of j and ch, which few foreigners ever succeed in uttering correctly, easier for a child to pronounce than w, or f, or g? Yet we have heard a boy of three years say jay for way, chun for fun, and jajy for wagon. Again, an American child, who has heard no language but English, will sometimes introduce into our words the most difficult vowel sounds of other languages, such as the unpronounceable German ö and ü, or French eu and u, which he has never heard.

M. Taine says that the little girl on whom his observations were made began to attach a meaning to certain words before she pronounced any word to which she attached any meaning. This will, we think, agree with the experience of most parents, and is not strange, for animals learn to understand our language which they can never speak. The first word pronounced by her was papa, but for a time she did not comprehend its meaning. At the age of fourteen months and three weeks, he says, she could pronounce mama, tété (nurse), oua-oua (dog), koko (hen, cock), dada (horse wagon), mia (cat), kaka, and tem. To the latter word she gave a very extensive signification, such as give, take, see, look; it seemed to be a word coined to express her principal desires. Another child, observed by the writer, began with the word no, which was spoken very emphatically in reply to any question, and without a definite idea attaching to it. The same may be said of another common expression used by her, "don't do it;" she soon after learned to say mama, bow-wow (dog), and dink (drink). At the age of fifteen months she began to imitate, repeating almost everything she was told to, and here the habit of generalization was again apparent. She was told, on seeing an ice wagon pass, to say ice. She can pronounce it nicely, and says it every time she sees a horse and wagon, showing that she has extended its meaning to all wagons, and probably to horses also. Another curious case came under our notice sometime since of a little boy who applied the term dady to every man he saw, and also to chickens, dogs, horses, etc., much to the annoyance of his mother.

In a paper read at the Bristol meeting of the British Association, D. A. Spalding advanced the idea that the progress of the infant is but the unfolding of inherited powers. He makes no application of this principle to the power of speech, although he might have done so, and we are inclined to believe that, just as a child learns to walk as soon as his limbs are strong enough to safely support him, so he will learn to talk as soon as the brain is sufficiently developed to evolve ideas requiring expression, subject, of course, to the law that perfection is only gained by practice. E. J. H.

[For the Scientific American.]

THE FIRST CHINESE RAILWAY.

The Japanese have readily taken to the mechanical, scientific, and other improvements to which intercourse with the rest of the world has introduced them. For ages they were more exclusive than the Chinese; but now that the barrier is broken down, the Japanese make the most of their opportunity; and they really seemed to have learned and adopted more foreign notions in a few decades than the Chinese have acquired in centuries.

But the iron horse has at last been domesticated in China; and if the old conservatives of the Celestial Empire ever read anything but Chinese classics, they would class the locomotive with that wooden horse which stands as the representative of treacherous gifts. If the locomotive does not revolutionize China in the end, its power has certainly been overrated. The trial trip was taken on a short road out of Shanghai, on June 30 last, and on July 3 regular travel commenced, six trains running each way daily, and the receipts being highly satisfactory. Six daily trains over a road only five miles long is not a very heavy day's work; but with the Chinese, in making innovations, it is wise to make haste slowly.

The first railroad in China, from Shanghai to Woosung, is ten miles long; but the road was only completed to Kangwan, half the distance, when it was opened with much ceremony, the pleasantest part of the programme being on the second day, when the natives were allowed to travel free, and appear to have received that proposition as heartily as any dead heads among the outside barbarians could have done. It is three years or more since the British and continental ironmasters, in session at Liége, took China into their calculations as a possible market for iron, locomotives, cars, and all the mechanical paraphernalia of railways. The first idea was to present the Emperor of China with a small specimen railway; but Chinese red tape—as much more complicated as a Chinese puzzle is more puzzling than any other—prevented the plan from being successful. The next movement, and it would seem a feasible one, was for the foreign residents to buy ground for a carriage road, from Shanghai to Woosung. Englishmen must have their drives, and there could be no harm in that. Then railroad estimates were made; but the first were at too high a figure. It would not do to risk much on an enterprise upon which the Chinese dragon might pounce, and, with a whisk of his tail, demolish. So the estimates were cut down to a single track, of very narrow gage, 2 feet 6 inches, very light rail, 27 lbs.; a toy locomotive, weighing only 1½ tuns, running at a maximum speed of only 15 miles per hour. The road was commenced in January, and in the months which have elapsed the projectors have gained in confidence. They have built for the road two engines, the "Flowery Land" and the "Celestial Empire," weighing each 9 tuns; they have eight inch cylinders and ten inches stroke, have each six wheels, and side tanks.

With a sagacious eye to the consequences of an explosion upon the Chinese temperament, the boilers were tested to 200 lbs. to the square inch. And, for a little while at any rate, the speed will be kept down, and the chances of collision or track jumping will be studiously guarded against. Even to cut off a Chinaman's queue would be fatal to the enterprise; and at this late day in the history of railroads, the problem of safety is made prominent above that of speed. It were much to be wished, for the sake of the public, that Britons and Americans were so far Chinese that to kill one would be a disaster worth consideration, as well financially as morally. If we learn safety in railway traffic from the first Chinese railway, it will be a first class investment for the traveling world. And if, from this small beginning, the iron interests should receive a much needed impetus, that, too, would be a welcome event. *

THE IMPACT OF LIGHT.

ABSTRACT OF A LECTURE BY CAPTAIN ABNEY, R. E., F. R. S., AT THE LOAN COLLECTION, SOUTH KENSINGTON.

Astronomy was the religion of the world's infancy, and it can hardly be a matter of surprise that untutored yet inquiring minds, unaided by any distinct revelation, should have attributed to the glorious orb, the center of our solar system, the possession of divine attributes, and, as they gazed upon the wondrous effects of his magical painting, that they should have offered to him their adoration and worship, and carefully noted any phenomena due to him. Thus probably

THE FIRST PHOTOGRAPHIC ACTION

noticed would be at a very early period of human existence, when the exposure of the epidermis to his rays caused what is known to us as tan, whilst the parts of the body covered would remain of their pristine whiteness. A photographic action which would be remarked at a later date would be the fading of colors in the sunlight. Ribbons, silks, curtains, and similar fabrics of a colored nature undergo a change in tint when exposed to it.

RIBBONS CHANGED BY LIGHT.

I have here a specimen of a pink trimming used by the fair sex, and the lady who presented me with it informed me that it was "a most abominable take-in," as the color "goes" after two days' wear. Her ideas on the subject and my own somewhat differed, for to me it presented a capital opportunity of using the material as a means for obtaining a photographic print in a moderate time I have here two results of the exposure of this stuff to the sunlight. One was exposed beneath a negative of an anatomical subject, and we have the image represented as white upon a pink ground. The other subject is a map. An ordinary map was superposed over a square piece of the stuff, and placed in sunlight whilst in contact. We have in this case the lines of the map represented as pink on a white ground, from which the color had faded.

CHEMICAL CHANGES CAUSED BY LIGHT.

The general opinion is, I believe, that the color is given off somewhat similarly to the scent from a rose. Were this entirely the case, the light would not act as it does, but, beneath the negative or map, the color would bleach uniformly. The bleaching seems to be a really chemical change in the dye, due to the impact of light. There are many other bodies besides dyes which change in light, and some of them are of the most unlikely nature. I had intended to show you to-night the change that takes place in glass by exposure to light for long periods. My friend, Mr. Dallmeyer, has in his possession specimens of brown and flint glass, which have markedly changed color in those halves of the prisms purposely exposed to solar influences. In some cases there is a "yellowing" of the body, and in others a decided "purpling."

WHAT LIGHT IS.

It is, however, only those bodies which change rapidly in the light that are utilized in photography. The most common amongst these are various compounds of silver, for they are peculiarly sensitive to the action of light. Nearly every silver compound is more or less changed by it, and when I say changed I mean altered in chemical composition When we reflect what light is we can better understand its action. Light, as experiment, confirmed by mathematical investigation, tells us, is caused by a series of waves issuing from the luminous source, not, indeed, trembling in our tangible atmosphere, but in a subtler and infinitely less dense medium, which pervades all space, and which exists even in the interior of the densest solids and liquids. These waves of ether, as this medium is called, batter against and try to insinuate themselves amongst the molecules of any body exposed to their action, a good many millions of millions of them impinging every second against it. Surely it is not surprising to think, small though the lengths of these waves be, that this persistent battering should in some instances be able to drive away from each of the molecules some one of the atoms of which they are composed.

HOW LIGHT ACTS UPON SILVER CHLORIDE

Take as a type that salt of silver which was, perhaps, the first known to change in the presence of light-silver chloride. For our purpose we may represent each of its molecules as made up of two atoms of silver locked up with two atoms of chlorine. Let us consider the action of the light on only one molecule. The waves strike against it energetically and persistently; the swing that the molecule can take up is not in accord with the swing of the ether. It is shaken and battered till it finally gives up one atom of chlorine; the vibration of the remaining two atoms of silver and one of chlorine are of a different period, and are not sufficiently in discord to cause a further elimination of an atom. The molecule which contains the two atoms of silver and one of chlorine is called a sub-chloride of silver or argentous chloride, and is of a gray violet color. If, then, I place silver chloride (held in position by a piece of paper) beneath a body, part of which is opaque and part transparent, and expose it to sunlight, I shall find that, where the opaque parts cover it, there the white chloride will remain unchanged, whilst on the portions beneath the transparent parts, the dark silver sub-chloride will have been formed. Of course were the paper, after removal of the body, to be further exposed to light, the image obtained would disappear, as a blackening over the whole surface would ensue. In this state, then, the print is not permanent. Fortunately for photography, a steady solvent of silver chloride was found by Sir John Herschel in sodium hyposulphite. On applying this salt to the ima e, it was removed, and also one atom of silver and one of chlorine from the sub-chloride molecule, leaving the atom of metallic silver behind. The chemical change that takes place on the silver chloride can be very distinctly shown by exposing it perfectly pure beneath water. The presence of the sub-chloride is shown by the color, and that of the chlorine can be exhibited by the usual chemical tests.

ACTION OF LIGHT ON ALBUMINATE OF SILVER.

In making an ordinary silver print on paper, we have, however, something more present than silver chloride; we have an organic salt known as the albuminate of silver, that is, a combination between albumen and silver. I have in this test tube a little dilute albumen—the solid constituent of the white of an egg. Into it I drop a little silver nitrate: a flocculent precipitate is at once apparent. The silver from the nitrate has combined with the albumen, and on burning a piece of magnesium wire before it the outer surface shows a darkening; evidently, then, the albuminate of silver is decomposed by light. For silver printing purposes, paper is coated on one surface with a solution of albumen and sodium chloride, and the production of the silver chloride and albuminate is effected by floating that surface on a solution of silver nitrate. When dry, the paper, which is now sensitive to light, is ready for exposure beneath a negative. Here we have two prints produced on paper so prepared. If now I take one of them and dissolve away the insoluble salts in sodium hyposulphite, you see that the color is of a disagreeable foxy red tint. To show you how this want of a pleasing tone may be overcome, the other print is immersed in a weak solution of gold, and by a well known chemical action the metallic gold is deposited on the darkened portions of the picture. Now when gold is precipitated, it has not the well known yellow color, but is a bluish purple; thus the deposited gold mixes its peculiar tint with that of the silver, and after immersion in the hyposulphite we obtain a print whose beauty cannot be surpassed.

THE MAGIC PHOTOGRAPH

I daresay that many of you may have been charmed with the production of magic photographs, as they were called. Some few years ago the sale of such was enormous, but now the curiosity of the public seems to be satiated. The magic, as you may be aware, consisted in being able to produce on a white piece of paper a photograph of some unknown object. These mysterious pieces of paper were generally supplied in packets, containing with them a piece of blotting paper. The directions stated that the blotting paper was to be damped, and while moist, to be applied to the surface of one of the accompanying pieces of blank paper, and then a photograph would shoot out. I will endeavor to show you one method of their production. Here I have an ordinary photographic print which has not been treated with gold, but merely immersed in sodium hyposulphite and then washed. I immerse it in a solution of mercurous chloride which I have in this dish, and immediately a bleaching action is set up. The action continues, and the paper is apparently blank. What has happened? Simply a white compound of silver and mercury has been formed, which is indistinguishable from the paper. If I wash the paper and dry it, it is in the state of the paper supplied in the packets. I have one here washed and dried, and I immerse it in the sodium hyposulphite. The image immediately reappears, a combination has taken place between the constituents of the hyposulphite, the mercury, and the silver

Need I say that the blotting paper supplied is impregnated with the same sodium salt? In damping it the molecules of the latter are so separated and mobile that they are free to combine with the white image. By similar treatment the picture may be made to again disappear and once more reappear

LIGHT AND FERRIC CHLORIDE.

Besides silver there are various other metals which will give a photographic image. This paper, which has a slightly yellow tint, has been brushed over with ferric chloride, more commonly known as perchloride of iron, in which we have the maximum number of colors of chlorine combined with metallic iron. Allowing ordinary white light to act upon it, the waves cause a disturbance between the iron and the chlorine atoms, and one of the latter is shaken off, leaving ordinary ferrous chloride, or muriate of iron, behind. A piece of paper, similarly prepared, has been exposed beneath a negative, and the reduction of the ferric chloride to the ferrous state can be demonstrated by floating it on a solution of potassium ferricyanide. The combination between the lowest type of the iron salt and this salt results in the formation of a deep blue precipitate, known as Turnbull's blue. You see, after applying it, we have the lines of this map, of which this is the negative, of an intense blue. Instead of demonstrating the change of the iron salt by this means, I may float it on a weak solution of silver nitrate. The ferrous salt of iron will reduce the silver, while the ferric salts are wholly inoperative to produce the same effect. Here we have such a print.

The principal investigator of the action of light on iron compounds was Sir John Herschel, and he employed a variety of different combinations. Perhaps one of the most interesting exhibits in the photographic section is that old list of Fellows of the Royal Society, on which were pasted, by the hand of that distinguished philosopher, the actual solar spectrum prints made during his researches on these and other metallic salts.

URANIUM LIGHT-SENSITIVE SALTS.

Uranium salts are also capable of being reduced to less complex forms by the action of light. I will not enter into a detailed description of the decomposition, but will simply exhibit the method of producing a print with the salt. The paper has been coated with uranic nitrate and exposed to light, beneath the same negative before shown to you. The image is made visible by a solution of potassium ferricyanide as in the case of the iron salt.

In the cases of photographs are shown some interesting specimens of iron and uranium prints, made by Niepce de St. Victor. I believe they were presented to Sir Charles Wheatstone by that ardent experimentalist. The subdued brown tones of the latter were probably obtained by the admixture of a little iron with the uranium.

PLATINUM PICTURES.

Within the last couple of years the salts of iron have been put to practical photographic printing purposes by Mr. W. Willis, jr., of Birmingham, and a valuable process resulted from his labors. The sensitive salt employed is an organic salt of iron known as ferric oxalate, and Mr. Willis made the discovery that among other metals platinum could be reduced to the metallic state from a double chloride of potassium and platinum, by ferrous oxalate in the presence of a potassic oxalate. A piece of paper is floated on a weak solution of silver nitrate and dried; and over the surface is brushed a mixture of the platinum salt and the ferric oxalate. After exposure to light (which produces the ferrous salts) beneath a negative, the paper is floated on a solution of neutral potassium oxalate, when the image at once appears formed of platinum black, a substance at once durable and incapable of being acted upon by atmospheric influence. Such an exposed paper I have here; and floating it on oxalate solution, you see the image is immediately developed. The unreduced iron salt can be eliminated by soaking the print in the oxalate solution, and a rinse and hyposulphite removes all traces of silver nitrate. After a few changes of water, the print may be dried, and is permanent. I should explain that the paper is first coated with silver nitrate in order to cause the platinum to adhere firmly to the surface of the paper. When omitted, the fine black powder formed is apt to precipitate in the bath.

VANADIUM.

Before dwelling upon that metallic compound which in photography is next in importance to silver, I must call your attention to the first vanadium print ever produced. Professor Roscoe, who has already delighted an audience in this room with an admirable lecture on Dalton's apparatus and what he did with it, has made a classical investigation of the compounds of this metal, and among other interesting facts has noticed that the vanadium salts are reduced by light in a somewhat similar manner to uranium salts.

LIGHT AND POTASSIUM DICHROMATE.

We now have to consider the printing processes which are due to the action of light on the dichromates of the alkalies in the presence of organic matter. For our purpose to-night we may take as a type potassium dichromate, a salt which readily parts with its oxygen to those compounds that have an avidity for it, more especially to certain carbon compounds under the influence of the ether waves.

To show that this salt is thus easily reducible by light in the presence of organic matter, I have here a piece of paper which has been brushed over with it, and exposed beneath a print. For a moment I float it on a weak solution of silver nitrate. The brilliant crimson color of the part not exposed to light tells us that silver dichromate has been formed; but where the solar rays have acted, the color remains unchanged. A slight modification of this process now exhibited to you is known as the chromatype, the offspring of Mr. Robert Hunt, so well known in the scientific world for his researches on light.

THE WONDERFUL ANILINE PROCESS

While experimenting with the chromatype process, Mr. W. Willis, the father of the gentleman I have already mentioned, discovered what is known as the aniline process. It is based on the fact that an acid in the presence of potassium dichromate strikes a blackish green or red color when brought in contact with aniline. You will see the *modus operandi* when I say that paper is floated with potassium dichromate and a trace of phosphoric acid. Aniline is dissolved in spirits of wine, and the mixed vapors allowed to come in contact with the sensitive paper that has been exposed beneath a positive print, such as a map or plan. The impact of the light has so changed the potassium salt that the aniline vapor causes but little coloration, while, where the paper has been protected from it, the dark color indicates that the dichromate is unchanged. The formation of this black color is familiar to the manufacturers of aniline colors, being, I believe, similar in composition to the residue left after the formation of aniline purple by Mr. Perkin's method.

It should be noted that, for copying engineers' tracings and drawings this process is extremely valuable, as there is no occasion to take a negative on glass before obtaining a print. All that is requisite is that the original should be fairly penetrable by light. A piece of paper prepared as indicated, a sheet of glass to place over the plan, and a box in which to place the exposed print to the aniline vapor, are the only necessary plant for the reproduction of a design.

What is an Ingrain Carpet?

The two-ply ingrain known to the trade is a fabric composed of two webs, or "plies" of cloth, made with different colored yarns—say one "ply" green, the other red—of equal consistence or texture, u nited at the edges or selvages of each by the selvage threads, and ingrained or united at different parts of the cloth, wherever called for by the design or pattern. If the red "ply" represents the ground color of the design, then the green will be the figure color; and whenever the green figuring "ply" appears over the red ground "ply," that is ingraining. The more general this ingraining or mixing up of the two webs or "plies," the better the fabric is ingrained, and the longer it will wear. The three-ply ingrain is made and ingrained after the same manner.

A two-ply carpet, woven on the same loom and "mounted" in the same manner as a two-ply ingrain, if woven plain, without any design or pattern, would be a seamless bag; a three-ply, under the same condition, a double bag, or two bags joined together by one side of each.

The old Scotch two-ply ingrain weighed about 24 ounces to the yard. The weft yarns were heavier than those now used, and the warp threads were three-cord worsted, and much stronger and heavier than the two-cord now in general use. Two things are gained by the substitution of the two-cord warp for the three-cord, though the fabric is rendered less durable. One is the saving of worsted, the most expensive of the two materials which compose the fabric; the other is that the warp being finer, it permits a wider scope in shading the weft colors. This will be understood even by the unskilled reader, if he will place an unequal number of coarse and fine black threads on two pieces of scarlet or white cloth or paper of equal width. The finer the black threads are, the brighter the colors underneath will appear.

Ingrain carpets are frequently called Scotch carpets, and by others Kidderminster. The difference in the nomenclature of this fabric, we presume, is due to the fact that, until 1821, Kidderminster had nearly a monopoly in making ingrain. In the memorable strike of that year, which commenced in March and continued into August, it lost nearly all its ingrain trade, which mostly fell into the hands of Scotch manufacturers.—*Textile Manufacturer.*

Glass Circle for the Measurement of Angles.

Mr. Lewis M. Rutherfurd, whose ruled diffraction plates, as substitutes for prisms in certain classes of spectroscopic work, have gained him a very extended reputation, in 1870, proposed a glass scale for the measurement of the angles of astronomical photographs. It was to be read by a micrometer microscope, and fitted with a gravity slide with one V and one flat slide. He has now carried out the idea by constructing a glass circle about 10 inches in diameter, divided to 10 minutes of arc, adapting it to a spectrometer similar to the one used by Mascart, and described in his paper on the measurement of wave lengths. The measurements were read by two microscopes each magnifying 75 diameters. This arrangement is one of the most delicate mechanical refinements that has come under our notice.

New Compensating Pendulum.

Professor J. Lawrence Smith has recently invented a new compensating pendulum, in which he avails himself of the great expansibility of ebonite, which, between 32° and 158° Fah., approaches that of mercury. The pendulum rod is of steel, with an adjusting screw at the lower end; and a round rod of vulcanite, with a hole in the center, is passed on to the steel rod fitting it loosely and being held in place by the adjusting screw. The bob of the pendulum consists of a heavy piece of brass, with a hole through the center large enough to admit the vulcanite, over which it passes, and, by a properly arranged stop, rests on the end of the vulcanite furthest from the lower end of the pendulum, so that any expansion of the vulcanite elevates the brass bob, thus compensating for the downward expansion of the steel rod and brass bob. Professor Smith says that four months' use of this pendulum on an astronomical clock has given very satisfactory results. It can be adapted, at a cost of 20 cents, to the ordinary mantlepiece clock, the pendulum of which usually beats in half seconds.

MADDER ORANGE.—Madder red, if exposed in a chest to the fumes of nitrous acid No. 3, yields a fine orange, which is not damaged by boiling soap lye. The red may be produced either by dyeing or steaming, and it is indifferent whether the cotton is oiled or not. The action of the fumes is to be continued for five minutes. If it is shorter the orange is converted into a brown by diluted alkalies or by soap.—*Reimann.*