THE ALVAN CLARK ESTABLISHMENT.

The home and workshop of the sons of the world-famous Alvan Clark is situated in Cambridgeport, just in the environs of Boston, Mass. Leaving the city by the Cambridge road, crossing the waters of the Charles River and turning to the left before the University of Harvard appears, the place is soon reached. It is easily recognized by a telescope tube raised on a high pier that towers above the surrounding objects. A piece of ground of about an acre in extent contains the buildings. In front are three dwelling houses, the homes of George B. Clark, of his brother Alvan G., and of the widow of Alvan Clark, the father. The grounds are very prettily kept as a luxuriant lawn with flower beds and paths. In the rear of the residences is a lofty and now disused observatory, the great rusty telescope tube already alluded to, and a low brick building. The latter, as unpretentious as a structure well can be, is the factory. In it the great Pultowa, Washington, and Lick objectives were made. The least imaginative visitor cannot but feel a sense of inspiration as he treads the truly classic spot that has furnished astronomy with its most efficient weapons. The story of the foundation of the business has already been briefly told in the sketch of the life of Alvan Clark.* George B. Clark, when a student, made a reflecting telescope. It was so successful that it was the first inducement that caused him to take up the occupation of telescope making permanently. His brother Alvan G., when sixteen years old, entered a machine shop in order to learn the machinist's trade, intending, ultimately, to join his brother. When twenty-one years old he entered his brother's factory. Up to this period the father had only worked upon lenses in the evenings, painting portraits and miniatures by day. But a few years later he gave up his studio and devoted himself entirely to his favorite occupation. Thirty years ago the factory was removed to its present location. The father is dead. His two sons, including the founder of the establishment, now conduct the work personally. When they abandon it, it is hard to say where a successor can be found.

The demand for large lenses is so slight in this country that the glass disks for their manufacture are generally procured abroad. This is always the case with the large sizes. They may be made in different ways, but one typical method of preparation may be described. A lump of glass of any shape is selected in the glass house, and its specific gravity is determined. If this factor is high enough and the piece appears clear and good, it is melted down into a disk. The lump is placed on a slab of fire clay within a ring and exposed to heat, when it slowly flattens down into the desired shape. This furnishes the blank. If it proves clear and free from striæ, it is ground into shape and polished.

Sometimes the glass plate is delivered in the shape of rectangles. A sheet iron tube, fed with abrading material, is used as an annular saw to cut out suitable disks from such pieces for lenses. The plate is first polished and tested optically with the utmost care for striæ. Small bubbles do little harm, and are contained in some of the best objectives. Such portions of the piece as stand the test are used. Often a lens is cut from the center, while the corners have to be rejected.

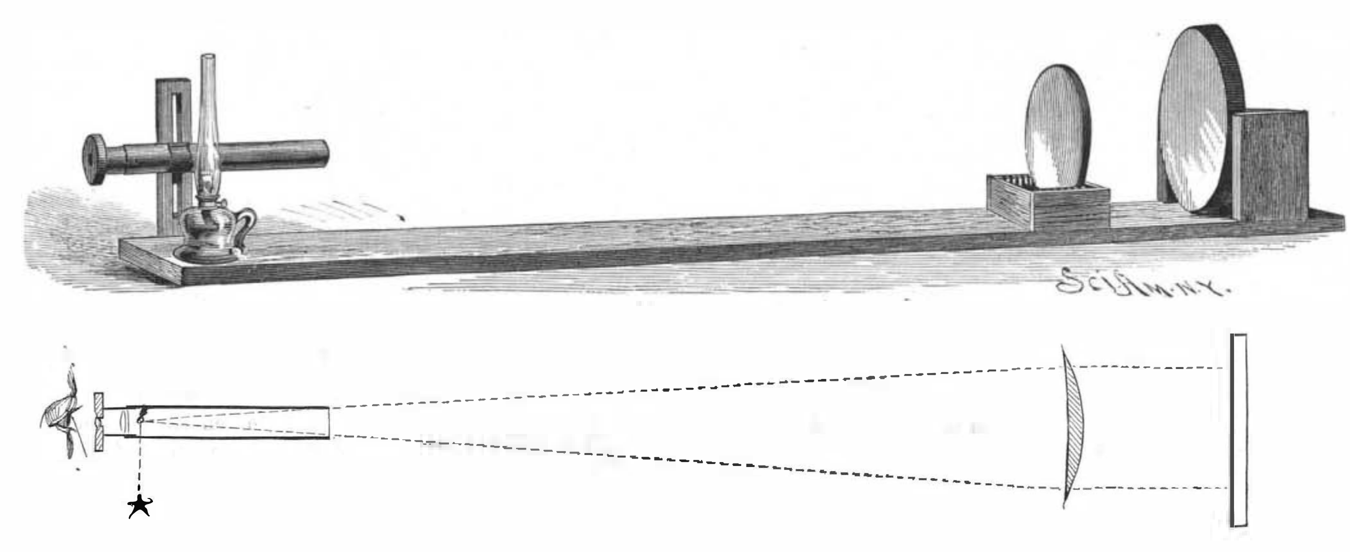
The manufacture of the objective properly begins with the circular disk. This possesses approximately parallel sides, which have been more or less completely polished for the purpose of testing. The processes it is subjected to may be divided into cutting and polishing. The former brings it very nearly into shape, with a rough surface. The latter polishes and imparts the last minute corrections.

The cutting is executed by cast iron laps. These rotate in a horizontal plane. They are cast of the general curvature of the lens, but reversed. They are fed with water and with a cast iron sand. The latter is made by flowing air into melted iron. This blast drives out a cloud of minute vesicles of metal, that are chilled instantly by the air. This material is very fine and is rust colored. On treatment with hydrochloric acid, hydrogen is evolved, thus proving the presence of the metal. It is used principally by granite polishers, and has been adopted by the Clarks for their work.

The lens is pressed upon the rapidly rotating lap, being held to one side of the center and slowly moved about to insure regular grinding. Were it held motionless, the part over the center of the lap would not be cut, and a prominence would soon be created there. The iron sand is the only cutting agent. It possesses a great advantage over emery, in not "breaking down." The grains, owing to their metallic nature, are very tough, and possess great cutting power. In this way the faces of the lens are brought to the proper curvature, and the lens is finally shaped in the rough. It has next to be polished.

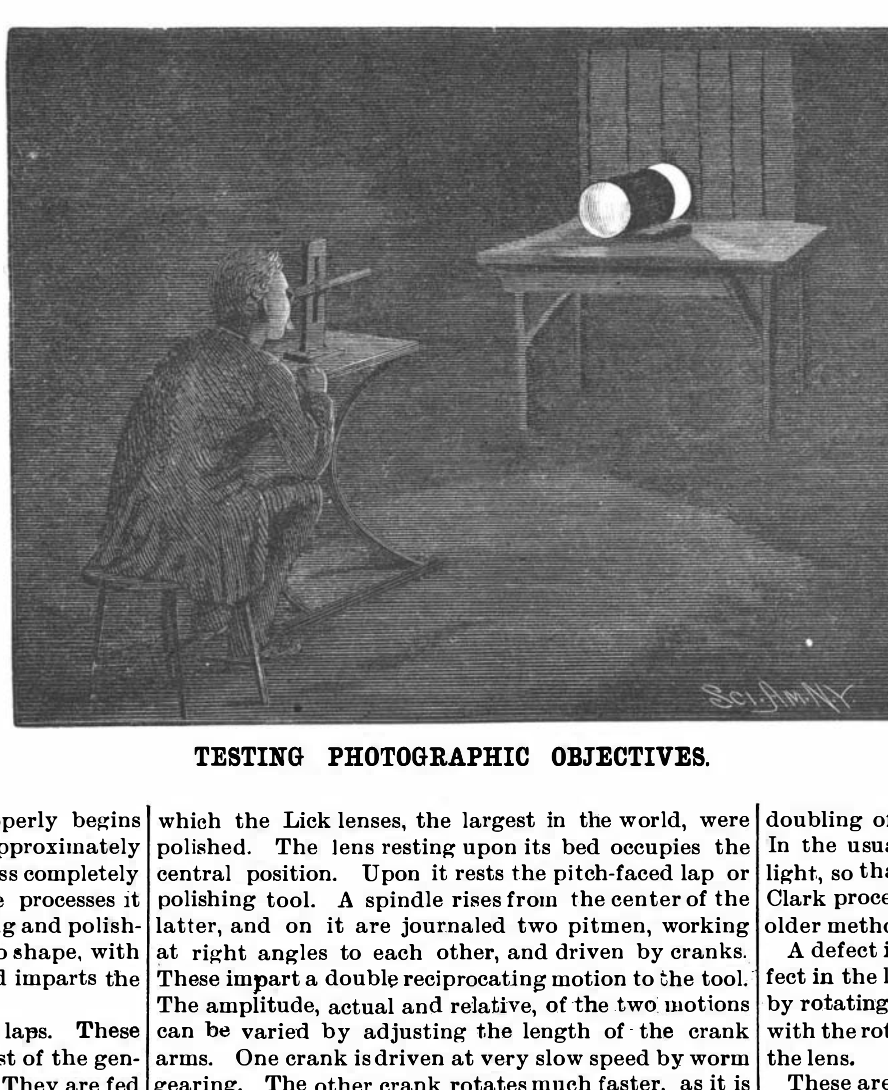
For this purpose a pitch lap used as below or above the glass is employed. For the smaller class of lenses the pitch lap is rotated precisely as is the metal lap, and is fed with water and rouge. Upon it the lens is pressed and moved about by hand. The pitch contains holes or grooves to prevent suction and sticking. The pitch is slightly or rather slowly yielding. It soon assumes the shape and contour of the lens, and polishes it without altering materially its shape. This operation is reversed for the larger lenses. These are rotated in a horizontal plane while the lap, composed of a metal backing and front of pitch, is moved about over the face. The bed upon which the lens rests consists of its original metal lap. Upon this a piece of Brussels carpet is cemented, and the lens is placed thereon. The illustration shows the machine in operation upon which the Lick lenses, the largest in the world, were polished. The lens resting upon its bed occupies the central position. Upon it rests the pitch-faced lap or polishing tool. A spindle rises from the center of the latter, and on it are journaled two pitmen, working at right angles to each other, and driven by cranks. These impart a double reciprocating motion to the tool. The amplitude, actual and relative, of the two motions can be varied by adjusting the length of the crank arms. One crank is driven at very slow speed by worm gearing. The other crank rotates much faster, as it is driven by tooth gearing. The effect of this is that the tool follows an endless variety of paths, never repeating its course over the face of the lens. The driving gear is seen under the bench, and the face of the pitch-faced lap divided by grooves into squares is also shown. Rouge and water is the polishing agent.

The lens thus shaped and polished has next to be tested. Two methods are used for this work. In one a prism is mounted in a tube attached to a lamp chimney of metal. A flame is maintained within the chimney. This prism is so screened as to furnish a minute source of light reflected outward. The lens to be tested is held in a generally vertical plane. Directly back of it a plane mirror, silvered on its anterior face, is placed. The lamp and prism are so placed that the beam of rays from the prism falls upon the face of the lens, passing through it, and returning again after reflection from the mirror, the prism occupying about the focal position. The eye of the observer is held as near the back of the prism as possible. The lens then appears brightly illuminated, because the eye so nearly coincides in position with the focus. The work is done in a dark room. If the lens is perfect, the field is of uniform brightness, presenting, however, the prismatic colors of the spectrum in broad areas. If the smallest irregularity exists, it appears as a spot or ring or other area upon the glass. To illustrate the sensitiveness of the test, Mr. Alvan G. Clark held his finger for a few seconds upon the face of a nearly perfect lens that was subjected to the writer's inspection by this test. On removing the finger, a strongly defined spot was seen, due to the heat thus imparted to the glass, and several minutes elapsed before it passed away. This was a proof of the extraordinary sensitiveness and perfection of the test. As a further illustration of the effects of atmospheric perturbation, a half dollar which had been held in the hand was laid in front of the lens. With the eye in position a perfect stream of heated air striæ appeared crossing the disk, and resembling in the spectral illumination a cloud of flame. The hand held in front of the glass seemed a source of conflagration, as the same effect on a larger scale was produced. All these changes appeared pictured upon or in front of the face of the lens.



TESTING VISUAL OBJECTIVES.

In the other method, which is shown in the illustration, the source of light is a minute bead or convex surface of glass, carried in the center of a sight-ing tube, about six inches long. The light from a lamp is received on this and dispersed. All is arranged otherwise as before. The pencil of light from this source, representing almost a mathematical point, is received and transmitted by the lens as before, is reflected from the mirror and again transmitted. The eye, held a few inches from the back of the reflecting bead, and hence out of focus if the bead is in focus, sees only a small disk of light, about a quarter of an inch in diameter. This image appears, of course, a little to one side of the reflecting bead. If the bead is in the focus of the lens, the spot should appear uniformly illuminated. If the lens is imperfect, the spot will appear unevenly lighted. In general, a dark or light spot appears in the center. By slowly moving the eye, a disk of light can be carried slowly across the field of view, and in this way a still more sensitive effect is obtained.



TESTING PHOTOGRAPHIC OBJECTIVES.

In these methods the rays of light pass twice through the lens, so that a doubling of the effect due to a misshape is obtained. In the usual methods a star is used as the source of light, so that a single transmission only is had. The Clark process, therefore, is of twice the delicacy of the older methods.

A defect in the mirror might be interpreted as a defect in the lens, but this is very easily provided against by rotating the mirror. If the supposed defect moves with the rotation, it is due to the mirror; otherwise, to the lens.

These are visual tests. For photographic telescope lenses they are not applicable. In these the focusing

* See SCIENTIFIC AMERICAN, vol. 57, No. 10.

must have reference to the actinic portions of the spectrum, and such objectives can only be tested photographically. Two methods of doing this are in use by the Clark brothers.

In one the spectrum of a bright spot is photographed. A bulb of glass is set up in the sunlight, four or five hundred feet from the station. The lens and tube projects through an aperture in the shutter of a dark room. The ray of sunlight reflected from the bulb passes through the lens and is decomposed by a prism into a spectrum about three-quarters inch long as regards its actinic portion. It is received upon a photographic dry plate. If all the actinic portions are in focus, the spectrum will be photographed as a thin streak of uniform width; but if the lens is not correct, the spectrum will taper off at one end or the other, indicating an erroneous shape.

In the other method a star is photographed. The lens is directed toward Polaris, and a number of exposures at slightly varying adjustments are made upon a dry plate. The exposures are made upon both sides of the focus. If the lens is perfect, the spots produced when the plate is out of focus are of even illumination. If the lens is imperfect, a dark spot can be discerned in the center of some of them. The image of the star when in focus is, of course, a mere point; the unfocused image may be nearly an eighth of an inch in diameter.

Great skill is required in applying the results of these tests, whether visual or photographic. Upon them are based the corrections which impart to the lens its final character of perfection.

ALVAN G. CLARK. THE LATE ALVAN CLARK. GEORGE B. CLARK.

The tendency of the inequalities in an objective is to form circles. The location of these is determined by the visual or photographic tests, according to the class of lens under treatment. The lens is removed and placed upon a horizontal stand, whose surface under the lens is ruled in circles. The proper one is selected as the guide, and the operator rubs the protuberant area with his fingers, using, as before, rouge and water. A few minutes or upward may be devoted to this. The lens is next, for a very short time, placed upon or under the pitch lap, and polished, and is then cleaned and retested. The testing requires more time than the rubbing. This process, repeated over and over again, extending, it may be, through many months, gradually brings the lens into shape.

The plane mirror used in the tests needs to be very perfect. They are much harder to grind than lenses, and are made by the Clark brothers for their own use. Such mirrors are also required in some astronomical work. As an illustration of the extraordinary degree of perfection to which their manufacture has been brought, the case of some manufactured for the government by the Clark establishment may be instanced. These were to be used in the observations of the transit of Venus. They were made with the guarantee that they were to be of eight miles radius of curvature as a minimum, and of the lot all exceeded this standard.

Although their objectives are what the reputation of the firm has been built upon, they also make the other portions of telescopes, furnishing them complete with all adjuncts, clock motion, and circles of graduation.

Although the thirty-six inch objective of the Lick telescope would seem a sufficient triumph, the brothers hope to be engaged to construct a still larger objective. They believe that they can make a forty inch objective of as good quality and as perfect as those of the Washington or Lick telescope. The work exercises a sort of fascination or excitement upon the operators, and to hear the story of their work from themselves upon the ground of their achievements is inspiring to the listener.

We also present an interesting group of the three coworkers. In the center, Alvan Clark, the father, appears. On the right of the picture, on his father's left, is George B. Clark, now the senior member of the firm. On the other side Alvan G. Clark is sitting. Two years ago death removed Alvan, the son of Alvan G. Clark, at the early age of fourteen years. With him the male line of the family was extinguished. His portrait, painted by the grandfather, shows strongly the Clark features.

Many of the paintings of Alvan Clark are still preserved in his old home. They include miniatures on ivory and portraits on canvas. They show that the lens maker was a skillful painter, his miniatures being especially beautiful. In the upper story of the factory he had a sort of a studio, where, within a few years of his death, he still handled the palette.

The Analysis of the Air.

The editor of the *Engineering and Mining Journal* thinks there are few, if any, branches of scientific inquiry that have done so much for the "greatest good of the greatest number" as those which have unfolded and developed the principles of hygiene and sanitation, and taught us that the preservation of good health and the prolongation of life both chiefly depend upon a supply of pure air and pure water. It has over and over again been proved that in such crowded cities as our own the most malignant forms of infection are chiefly propagated by spores or germs floating in the air, or carried into our drinking water by the infiltration of sewage matter; and although a great deal of attention has undoubtedly been devoted to the analysis of both these elements, there is still a great deal of room for the simplification of processes and the popularization of easy and reliable methods of investigation. Our first knowledge of the air and its composition was in a very large measure due to the labors of Dumas and Boussingault, but it has been greatly amplified of recent years, and we now know that the dust or minute particles of solid matter which are constantly suspended in space by the action of the currents contain various germs which disseminate disease, and an immense variety of minute seeds, which, when deposited in certain liquid or moist substances, immediately germinate and induce mould, mildew, and fermentation. From the standpoint of hygiene it is extremely difficult to determine whether it is more desirable to have a thorough knowledge of the air we take into our lungs or of the water we drink, each being so important; and the only reason why the latter has hitherto received a greater share of attention is probably to be found in the fact that its analysis is much less tiresome, comparatively devoid of complications, and therefore more easily comprehensible to the ordinary mind than that of the former. The recently published and highly interesting results that have lately been obtained in England by a group of experimenters promise to create a revolution in this state of affairs by drawing more attention to air analysis, and it will be interesting to briefly glance at the newly suggested method by which to arrive at an accurate determination of the various atmospheric constituents.

The test for carbonic acid consists in placing several two gallon glass bottles side by side and filling them with air, withdrawn from different parts of the room by means of India rubber tubing. Into each bottle is then poured a small quantity of weak baryta water, which, acting upon the carbonic acid, gives rise to a dense white precipitate of barium carbonate, easily separated by filtration, and weighed.

The germ test is made by means of a glass tube, some two feet long by three inches in diameter, lined inside with a coating of transparent gelatine. A certain quantity of air is made to pass through the tube, and the germs deposit themselves upon the gelatine, where they can live and multiply, and where they may be distinguished and identified under the microscope.

For the detection of organic matter, six large glass bottles are filled with distilled water, and are connected with each other by glass tubes. The air, made to pass through the whole series in a continuous stream by means of an aspirator, communicates to the liquid all the organic impurities with which it was charged, and, without visibly affecting its color, causes it to acquire a disagreeable smell. The *ensemble* of this simple process recommends and entitles it to the serious consideration of all those who are intrusted with the care of the public health, and we should be glad to see all public buildings and apartments in which large bodies of persons daily congregate for business or for pleasure provided with the necessary and inexpensive apparatus. It might be presided over by some intelligent person (not necessarily a scientist), its frequent use would insure the immediate detection of noxious elements, and we might thus constantly maintain or restore pure air by applying such preventive or remedial agents as are well known and always at hand.

Newspaper Advertisements.

An advertisement of the present day, as a rule, is a model of clearness, precision, and compactness.

In fact, quite a degree of pleasure can be derived from the perusal of it, aside from the important information which it oftentimes conveys.

In ingenuity the modern advertisement is remarkable; in fact, it is frequently a work of art, both in a literary and typographical sense. The aim of some advertisers in many cases seems to be to draw the attention of the reader away from the fact that it is an advertisement. While not taking rank among what may be termed literary productions, it possesses many of their brightest features. In the hands of a master workman, be he advertiser, writer, or compositor, the matter becomes attractive to the most casual reader. The latter's attention is drawn toward it, and his interest in it aroused before he is fully aware of the fact. The old style of merely puffing one's merchandise has passed out of date. The reading and purchasing public of to-day demand something stronger and better. That this want is recognized and appreciated by the keen advertiser and equally alert public is apparent to almost every one. The fact is, advertising has become such an integral part of modern business methods that it is almost impossible to carry on any kind of trade or traffic without its aid. It is well known that many concerns pay large salaries to skilled writers whose only employment is the invention and the framing of attractive and telling advertisements.

Thousands of dollars are annually expended simply in putting the matter in shape, and many millions more for its publication in the press. The firm who can express in clear, strong, and concise language, set in attractive form of display, just what it has to offer, at once attracts the merchant as well as the consumer.

No merchant can now wholly depend for business upon the fact of his being well known to the trade. No matter how many years he may have been established, or how familiar his name is to the purchasing public, or how celebrated his wares are; if he does not advertise and keep doing so in some way, buyers and consumers will in time ignore him and visit and trade with his competitor who sounds his trumpet upon all occasions to the extent of thousands of dollars a year, and pays the same without murmur because it pays him to do so.—*Dry Goods Review.*

Magnesium Light for Photographic Purposes.

It is proposed that the magnesium be mixed in the state of fine powder with an oxidizing agent, such as a chlorate or nitrate, and a substance such as amorphous phosphorus, which would accelerate combustion. The mixtures suggested as most suitable are—12 parts of chlorate of potash, 6 parts of magnesium powder, and 1 part of prussiate of potash or 24 parts of chlorate of potash, 12 parts of magnesium powder, and 1 part of amorphous phosphorus. The light may be colored by the addition of salts of suitable metals to the above mixtures. The powder burns with a flash, lasting only from $\frac{1}{30}$ to $\frac{1}{50}$ of a second, and yields a more intense light than when wire or ribbon is used; and the shortness of its duration removes the difficulty hitherto experienced of getting the proper "exposure" with the magnesium light.—*By J. Gaedicke, Berlin, and A. Miethe, Potsdam, Germany.*

FURTHER information desired as to the elevated railway gate described in our last issue will be furnished by Mr. G. Civolari, Temple Court, room 107, No. 7 Beekman Street, New York City.

Poisonous Bakery Adulterations.

Concerning the use of poisonous adulterants in bakeries, the Philadelphia *Record* says:

Notwithstanding all that has been published relative to the poisonous character of chrome yellow as a coloring matter for buns, cakes, and pastry, President Amerling, of the Society for the Prevention of the Adulteration of Food, states that a large number of bakers are still using the stuff. Recently he visited five bakeries, each of which does a large business, and in every case chrome yellow was found in use. The proprietor of one of these, a prominent up-town baker, was exceedingly indignant at the appearance of President Amerling, and stoutly denied using the poison. "Well, what do you use?" asked the president. "Why, canary yellow, and that's not poison. I'm not afraid to eat it myself."

The matter, when shown, proved to be nothing else than chrome yellow. The baker was cautioned not to use it again under pain of prosecution. He had been reported to the society by a gentleman who stated in a letter that his own family and a number of neighbors had been made sick by eating buns purchased at his bakery. Letters are beginning to pour into the office of the society at No. 142 South Sixth Street, giving information as to bakeries that are using the poison, and President Amerling is accumulating a mass of evidence against offending parties. The aim of the society, however, is to improve and educate, not to prosecute, and the evidence will only be used against those who, after being warned, continue to use the poison. It is estimated by the coroner that fully 50 per cent of the bakeries in Philadelphia have been constantly using chrome yellow.

The following circular has been sent out by the Society for the Prevention of Adulteration of Food to the bakers and confectioners:

You are hereby notified that the enumerated colors herein are poisonous, and if you persist in the use of any of them after receipt of this notice, you will be prosecuted to the full extent of the present law:

COMMON AND POISONOUS COLORS.

Common Name.	Chemical Name.
YELLOW.	
King's yellow	Sulphide of arsenic.
Cadmium yellow	Sulphide of cadmium.
Turner's yellow	Oxychloride of lead.
Turpeth mineral	Basic sulphate of mercury.
Chrome yellow	Chromate of lead.
Chrome zinc	Chromate of zinc.
Citron yellow	Chromate of barium. Chromate of strontia.
Naples yellow	Oxides of lead and of antimony.
Yellow ocher	Clay and hydrated ferric oxide.
Mosaic gold	Sulphide of tin.
RED.	
Minium	Oxide of lead.
Vermilion	Sulphide of mercury.
Purple red.	Basic chromate of mercury.
Iodine scarlet	Mercuric oxide.
Realgar	Sulphide of arsenic.
Red ocher, Colcothar.	Ferric oxide.
GREEN.	
Chrome green	Chrome oxide.
Cobalt green (Rimmam)	Oxides of cobalt and of zinc.
Mountain green	Malachite green.
Scheele's green	Arsenite of copper.
Verdigris	Basic acetate of copper.
Emerald green	Acetate of arsenite of copper.
BLUE.	
Ultramarine	Silicate of alumina and soda with sulphide of sodium.
Mountain blue	Malachite blue.
Smalts	Silicate of cobalt and potassium.
Antwerp blue, Insoluble Prussian blue	Ferric ferrocyanide.
Soluble Prussian blue	Ferro potassic ferrocyanide.
Indigo	
BROWN.	
Manganese brown	Binoxide of manganese.
Vandyke brown	Ferric oxide.
Burned sienna, Burned umber	Clay colored with oxide of iron and manganese.
ORANGE.	
Chrome orange	Basic chromate of lead.

Odor of Arc Lights.

Complaint was recently made by the correspondent of a Rochester, N. Y., paper as to the bad odor of the electric lights on the streets. Mr. Redman, the manager of the Brush Company, endeavored to correct certain curious misconceptions on the subject, and said:

"The bad odor at this time of the year does not come from the electric fluid nor from the burning of the carbons. The explanation is very simple, and would be manifest to this correspondent if he had ever been present at the cleaning of a lamp after a warm night. The light attracts innumerable insects that kill themselves in contact with the lamp and collect there by the pintful. The mass of decaying animal matter gives out the offensive odor that the correspondent complained of. I do not wonder at his complaint, for the stench is particularly offensive. In certain situations we are obliged to protect the lamps with wire gauze to prevent the winged creatures from flying against them and interfering with the light. Ever since the introduction of electric lights here, the workmen at the various works have been wondering at the strange and varied visitants that come into the rooms at night. Our works at the lower falls are particularly well situated to attract all sorts of creatures that fly by night, and we have a very miscellaneous collection pinned on the walls, after the fashion of regular entomologists. The boys have had some monster moths come in at night, and all the specimens were duly pinned to the wall. It might interest a collector to call and examine our cabinet. Most of those we have seem to fly altogether by night, for they are of a kind that I never see by day. In former years we frequently caught a large green butterfly, but I have not seen one of them this year. Perhaps their season for skirmishing by night does not arrive until later in the year.

The Chinese Fan Palm (Livistona sinensis), and its Uses.

In the report of the superintendent of the Botanical and Afforestation Department of Hong Kong for 1886, the following interesting facts are given on the cultivation of the Chinese Fan palm (*Livistona sinensis*, Mart.) for the manufacture of fans.

The Rev. B. C. Henry, who has traveled much in the Kivangtung province, says in his book "Ling Nam" that the palm district extends about twenty miles from east to west and ten miles from north to south. It appears that fan palm cultivation is confined to the San Ui district. In reference to this, Mr. Henry says: "That the limitation of this industry is a matter of necessity and not of choice is proved by attempts made at various times to cultivate the palm in other places, attempts that have always resulted in failure."

Judging from the appearance of the country in traveling through the delta, the reputed failure of the palm when its cultivation has been attempted in other places than the San Ui district could scarcely be attributed to soil, as everywhere this had much the same appearance of richness and constituency. Knowing the immense influence which winds have on the growth and success of not only delicate plants, but also on the hardiest of trees, it is possible that the uninterrupted sweep of certain winds over the flat land of the delta, combined with some other minor uncongenial circumstances, may be the cause of the failure of the palm for commercial purposes. The San Ui district is protected by lofty hills to the north and westward, which possibly afford the conditions of shelter that the palm requires for the development of perfect leaves suitable for the manufacture of fans.

The palm plantations are situated on flat alluvial lands, about six to ten feet above the water of the rivers and creeks which run through the delta, and they are intersected with numerous open canals or ditches four feet wide or more, for carrying off the surplus water in the rainy season, and for retaining it, by means of wooden sluices fixed on the banks which surround the plantations or fields for purposes of irrigation.

The land is not wholly given up to palm cultivation, but other crops, as bananas, plantains, papays, oranges, peaches, ginger, betel-pepper plant, and various vegetables occupy shares of the ground.

The cultivation of the palm, and the manufacture of fans from its leaves, is a most important industry. According to Mr. Henry, the manufacture of the fans after the leaves have been cut gives employment to about one hundred firms and from ten to twenty thousand people. When the plantations are made, the young seedlings are placed at various distances apart, in order that different kinds of leaves, which are produced from plants growing at close and wider distances asunder, may be obtained for the manufacture of fans, for which thick or thin or large or small leaves are required.

"The most perfect plantation which I saw was about half a mile in length and about a quarter of a mile in width. It was drained by means of open canals as above described. The main body of plants were in perfectly straight rows, and they were exactly four feet four inches apart; the stems were from two feet to four feet high, and they bore about six fully developed and perfect leaves, the pellicles (stems) of which were five feet long, and the blade or leaf itself three feet long. Next to and surrounding the main body of palms, about one hundred feet wide of smaller palms, which were growing at only two feet from each other. The stems were but one foot high, they bore the same number of leaves (six) as the other plants, but, unlike them, half the number of leaves were bad. The leaves and their stems were each one foot shorter than those on the larger plants, and the pellicles were much more slender. Outside of this belt, and on the extreme margin of the plantation, there was a second belt, which, however, was very narrow. It consisted of only three rows of palms, the plants being very close together, only one foot four inches apart. None of the leaves on this belt appeared good enough for fan manufacture.

The inner belt of plants was intended, by reason of thicker planting, to serve as a screen to protect the main plantation from the damaging effects of winds, while at the same time it affords finer leaves for smaller fans. The marginal and closely planted belt was placed on the river bank to serve as a fence to keep intruders out of the plantation. For this purpose the palm, while in a young state, and when planted together, is well adapted; the spines on the pellicles presenting a barrier sufficiently offensive to the bare, stockingless, and shoeless legs and feet of the Chinese coolie. The long, straight vistas, the regularity of the planting, and the canopy of the verdant leaves overhead, produce on the visitor a delightful impression which is worth traveling some distance to experience.

Other plantations contained palms of all ages. Some had trees upward of a hundred years old, according to the assertions of natives, but these plantations always contained trees of mixed ages, young plants having been constantly added to take the place of older ones as they died out or were blown down by winds. The old trees were always of a very stunted appearance—a condition which would naturally ensue from the continued lopping of their leaves. A parasitical fungus or lichen covered these old trunks, and gave them the appearance of having been whitewashed. The tallest trees seen were only about twelve feet high, but they were said to be upward of a hundred years old. The leaves on these old trees are larger and stouter than those on young plants, and the stems of the leaves are only about a foot long. The palm begins to yield leaves suitable for fans when it is about six years old. The first cutting of leaves takes place early in the year, and the leaves which are somewhat damaged by the winterly winds, and consequently of inferior quality, are used for thatch in the construction of the "matsheds" which are so extensively used for temporary purposes in China.

Leaves for fan making are obtained in April, one, two, or three leaves being taken from each plant, and the process is continued each month until November, when, I was informed, cutting is discontinued for a few months. The leaves are taken from the plantations to a clear space covered with short grass turf. Here each leaf has a thin piece of bamboo placed across the blade where it is joined on the stem. Each end of the bamboo is secured in its place by the loose end of a segment of the leaf being dexterously bound round it. The bamboo prevents the leaf curling up while it is drying. The leaves are then laid out singly on the turf to dry in the sun, and collected and stacked at night. The process is continued daily until the leaves are quite dry, when they are either sent off direct to the town to be made into fans or they are stacked for a time until the manufacturers are ready to receive them."

The manufacture of the fans is carried on chiefly in the town of San Ui, but there are also some establishments in the country where this is done. The dried leaves are subjected to a process of blanching by means of sulphur. They are then straightened and rendered shapely by being held and manipulated over a charcoal fire. The operator, as he finishes the fans, places them one by one on each other, making a heap on the floor; the heap is firmly pressed down by the weight of the operator, who stands on a board placed on top of the heap while he is working at succeeding fans. When a heap of twenty or thirty fans have been thus treated, they are removed, and another series is begun. The next process is sewing on the bindings at the edge of the fans. This is done by women and children, chiefly at their own homes, and the fans returned, when finished, to the manufacturer. The more expensive fitting of horn and bamboo handles is done at Canton. The portion of the stalk which is not required as a handle for the fan is not wasted; it is composed of fibrous material that is utilized in making short lengths of rope used as slings to suspend baskets from carrying poles. Around the stem, as bases of the leaf stalks, there is a quantity of fibrous substance, somewhat resembling coir fiber. This is carefully collected, and also used for making ropes.

Counterfeit Jewels.

Artificial precious stones have become an important article of trade. The products of some of the shops would almost deceive an expert, but the test of hardness is still infallible. The beautiful "French paste," from which imitation diamonds are made, is a kind of glass with a mixture of oxide of lead. The more of the latter the brighter the stone, but also the softer, and this is a serious defect. The imitation stones are now so perfectly made, and are so satisfactory to those who are not very particular, that their influence begins to be felt in the market for real stones. By careful selection of the ingredients, and skill and manipulation, the luster, color, fire, and water of the choicest stones are to the eyes of the layman fully reproduced. There are a few delicacies of color that cannot be perfectly given, for they depend on some undiscoverable peculiarities of molecular arrangement, and not on chemical composition; but the persons who buy the stones know nothing of that. Yet Sidot, a French chemist, has nearly reproduced these peculiarities, including the dichroism of the sapphire, with a composition of which the base is phosphate of lime. Two other French chemists, Fremy and Fell, have produced rubies and sapphires having the same composition with the genuine stones and nearly equal hardness.—*Popular Science Monthly.*