much lampblack as will be found necessary to make the compound of the required degree of blackness. Instead of the lampblack, any other suitable coloring matter may be used, according to the colored pencil it is desired to produce.

From this time the Patent Office records appear to show no patent in this line, until the English patent No. 4,090, of 1874, was issued to J. L. Petit, for a copying pencil compound of aniline dyes, mixed with powdered plumbago or colored chalks, cemented together by gum water, dextrine, or other adhesive matter soluble in water. If preferred, the adhesive matter may be omitted and the compound united by pressure in dies suitable to form it into sticks of the necessary form for pencils.

The next patent granted for a copying pencil was No. 4,473, of 1874, issued to Jensen (for Dr. Jacobson of Bavaria), which describes a compound of two classes of substances, one insoluble in water and the other soluble. The first may be as follows: Sulphuret of antimony, graphite, metallic powder, or other suitable base, 10 parts; tannic acid, 7 parts; peroxide of iron, 2 parts; and dextrine, 1 part. The second may be made of graphite, 5 parts; violet of aniline, 4 parts; and dextrine, 1 part. These ingredients may be mixed with as much acidulated alcohol as will dissolve the soluble part of the mixture, then steamed off until dried, next pulverized, and finally pressed in hot moulds to form suitable sticks for pencils.

During the year 1875, we find four English patents relating to this subject, Nos. 178, 440, 460, and 1,236; but the first three of these have only provisional specifications and are rather meagre as to details. The first (J. L. Von Faber's) describes the use of four compositions of various degrees of hardness, ranging from 52 parts of aniline, 39 of graphite, and 9 of kaolin, for a soft pencil, to 25 parts of aniline, 25 of graphite, and 50 of kaolin, for a hard one. The second provisional specification (J. Flackfield's) gives a compound of wax, aniline, clay, and white of egg or albumen. The third (H. Volmer's) mentions "chemicals and black lead," without further description. The fourth on the list is the patent of F. Wirth, a communication from G. Schwanhausser, who obtained an American patent October 26, 1875, for the same invention. The following is the mode of preparing pencil compounds given in this patent: Simmer 10 lbs. of logwood chips in 100 lbs. of water until one tenth has evaporated. Strain and heat again to boiling point; then add small quantities of the nitrate of oxide of chromium until the bronze precipitate that first appears has again dissolved with a deep bluish-black color. The liquid should be next evaporated to the consistency of syrup. To six or seven parts of this add two parts of finest elutriated fat clay and a small quantity of slime of gum tragacanth. Other coloring matter may be substituted for the logwood.

The next patent is that issued to C. Walpuski, above referred to, who, in the course of his litigation before the Patent Office, proved his invention to antedate all of the above patents on copying pencils. His compound consists of 100 parts of aniline dissolved in alcohol and water, 50 parts of white clay, and 10 parts of a solution of gum tragacanth. It is stated that any other suitable coloring matter that will give a copy may be substituted for the aniline.

For the benefit of those of our readers who are not familiar with the subject of pencils and their manufacture, we may state that the ordinary pencil is filled with a preparation of graphite, commonly called black lead or plumbago, both of which are misnomers, as there is no lead or plumbum in it. Until quite lately it has been considered by chemists as a carburet of iron, but it is now generally acknowledged that, although it shows traces of iron, this metal is only mechanically mixed with it—there being no chemical combination between the two.

Pencils were originally filled with square sticks cut from blocks of graphite found in the famous Borrowdale mine, in Cumberland, England, which contained the purest ever found, but on the exhaustion of that mine the impure materials to be found elsewhere were pressed into service, after proper purification. The process adopted by the Dixon Company at Jersey City, who use a graphite found at Ticonderoga, N. Y., is as follows: The graphite is first ground fine in water, treated with sulphuric and nitric acids, and, after washing clean, heated to a bright red. Then it is mixed with sufficient water to make it run freely and allowed to pass slowly through a series of tanks arranged in steps, until the water leaves the last one of the series almost clear, having left the graphite deposited and graded in the tanks—the deposit in that nearest the overflow, being the purest, is used for the finest pencils. The graphite after being taken from the tanks is dried, and then mixed with pipe clay obtained from Rotterdam, Holland, which has been purified in the same way as the graphite, only the very finest being used for pencils, as the coarse can be utilized in the manufacture of crucibles. Upon the amount of clay used depends the hardness of the pencil—the more clay the harder the grade—about 7 parts of clay to 10 parts of graphite, by weight, forming a medium. The clay and graphite is thoroughly mixed with water and ground like paint, but is passed repeatedly through the mills, as many as twenty-four times being considered as necessary for the finest grades. When ground sufficient the pasty mass is inclosed in a canvas bag, and the water is squeezed out by a powerful press, leaving the compound in the form of a stiff dough, which is placed into a cylinder of a forming machine, and, by means of a piston driven down by a powerful screw, is forced out at the bottom of the cylinder in the form of "leads" that, after being heated in a crucible to a red heat, are ready for insertion in the wooden blocks to cut into pencils.

The blocks are formed by sawing the wood into pieces as long as a pencil, six times as wide, and half the thickness, which are afterwards run through a planing machine that not only smooths them but cuts in each block six grooves half the thickness of the "leads." In the grooves in one block the leads are laid, a second block previously coated with glue is laid on the first, and a pile of these compound blocks are placed in a press, where they remain until dry. The blocks are next cut apart into six pencils each by passing through a machine like a moulding machine, having two sets of cutters operating on opposite sides of the blocks, each of which cuts half way through the wood. The cutters in these machines are so accurately arranged and run so true that when the pencils leave the machine there is no mark to show the line of separation from the block other than the joint of the two pieces of wood inclosing the lead, and are said to be so smooth that sand papering would roughen them. The shaping machine turns out about 72 per minute, or over 43,000 per day. The pencils are then varnished or colored by another machine, at the rate of 120 per minute, or 72,000 per day; and then polished in another machine at the rate of 106 per minute, or over 63,000 per day—all by unskilled labor.

## SOME NEW INVENTIONS NECESSARY FOR FUTURE ASTRONOMICAL OBSERVATIONS.

Persons who have never seen a first-class astronomical observatory, nor read a detailed description of the same, can have no idea of the peculiar difficulties which are encountered and have to be overcome at any cost. One of these is that when a telescope magnifies the size of any object, it magnifies also its motion, whether real or apparent, in the same proportion. Any one who ever looked through a spyglass knows that it must be held perfectly still, and that any motion communicated to the same, causes an apparent motion of the object observed, and that this motion is larger in proportion to the power of the glass. So in an opera glass, which never magnifies beyond 3, 4, or 5 diameters, the motion of the hand in which it is held is of not much consequence; but when using a long marine spyglass, it is necessary to hold it quite still, and some improvised support is necessary, among which one of the most convenient is the shoulder of a person standing in front of the observer. For large spyglasses or small telescopes a footpiece is necessary, and this must have more stability in proportion to the power of the glass, as the least tremulous motion in the instrument causes a strong vibration of the objects seen, so much, indeed, that observations are often interfered with from this cause.

This is the reason that it has become no longer customary to establish observatories on the top of buildings, as was done in olden times, but on the ground floor. So the old observatory of the University of Leyden, situated on the top of a high building, possessed a large Newtonian telescope constructed nearly a century ago by a maker who had attained a great reputation in this line, but the instrument was rendered perfectly useless by the continued vibratory motion, either by wind, passing carriages, movement of persons in the building, etc. The objects observed were almost always seen in a condition as if tossed by waves. Some two years ago this telescope was still in existence, and shown as a curiosity, when the writer of this article could not help but admire the useless ingenuity with which it was mounted, and which, for an instrument of that power, was entirely out of place.

By the general revival of astronomical science, which became very active at that period, it was superseded by a modern refractor, mounted equatorially on a solid base, placed at a lesser height.

And here we must explain what is meant by equatorial mounting. The apparent motion of the heavenly bodies caused by the earth's rotation around its axis, and which increases along the celestial equator, which is the principal region for observation, to about a quarter of a degree for every minute of time, is of course magnified in proportion to the power of the instrument; so for a telescope magnifying say 120 diameters, it will be 120 times as much, or 30 degrees for a minute, or half a degree for a second of time. It is evident that in such a case no object would remain in the field of the telescope long enough to be seen or studied, but stars and planets would move through the field at too rapid a rate. The equatorial mounting thus is intended to cause the telescope to follow that motion, and is accomplished in this way: in place of mounting the joints by which the free motion of the instrument is obtained, to a vertical solid pillar, they are attached to an axis placed parallel to the earth's axis, and this axis is rotated by clockwork at the rate of once in 24 hours, in an opposite direction to that in which the earth is revolving, so that these two movements neutralize one another, and the telescope, if left to itself, is rendered immovable in space, except following the earth's yearly orbit, which, however, does not influence the direction of the instrument to any perceptible degree.

The apparent motion of the sun is slower than that of the fixed stars, for one day per year, or nearly one degree for every 24 hours; the apparent motion of the moon is again slower to an amount of nearly thirteen degrees for every 24 hours. The clockwork regulating the rotation of the telescopic axis has to be set in accordance to the intention to use the telescope to observe the fixed stars, sun, or moon, and this movement must be more minutely regulated in proportion to the power of the instrument.

Lately a great pressure has been brought to bear on those having the power or means of managing or founding astronomical observatories, so as to induce them to have large powerful telescopes constructed. Million dollar telescopes have been spoken of, but the difficulty of their mounting and the absolute necessity of regulating their proper motion to follow the objects observed appears not to have been thought of, while it is one of the most important mechanical problems with which the utility of such instruments will stand or fall.

Suppose a telescope could be constructed which would bring the surface of the planet Jupiter to within an apparent distance of ten miles. Then not only the motion of the earth herself, but also that of the planet in his yearly orbit, and the immense velocity of rotation around his axis in ten hours, would have to be compensated for by the clockwork attached to the telescope, as without it the objects would fly across the field with the velocity of a railroad train. To realize the truth of this assertion we have only to consider that the circumference of that planet amounts to a quarter of a million miles, so that every point of its equator moves through that distance in a little less than ten hours, equivalent to a velocity of about 29,000 miles per hour. Seeing objects moving with such a velocity at a distance of ten miles is equal to seeing objects move with $\frac{1}{500}$th part of that velocity at a distance of $\frac{1}{500}$th part of ten miles, which corresponds to observing a velocity of 50 miles per hour, at a distance of 34 feet. Looking therefore with a telescope bringing the surface of Jupiter to an apparent distance of ten miles would be equivalent to looking at a distance of only 34 feet at a railroad train moving at a velocity of 50 miles per hour. Of course nothing could be distinguished. The problem is therefore not alone to make the lenses and the tube of a gigantic telescope, but an equally important problem is the mounting and clockwork required to make observation possible. And this becomes an interesting problem because with such high powers the earth's yearly and daily motion, not alone but also the velocity in orbit and rotation of planets must be taken in account, as well as the inclination of the axis, of planes of orbits, and of rotation.

## HEREDITARY AS A FACTOR IN PAUPERISM AND CRIME.

Dr. Edward H. Parker recently read a paper of the above title before the Medical Society of the State of New York, at Albany, in which he reviewed the question of hereditary as an element in the production of crime and pauperism. He claimed to do this simply as a physiologist and with no sentimental, biasing notions. The elements for his line of argument he obtained from the Report of the Prison Association and the Report of the State Board of Charities of New York. He does not deny that anatomical, physiological, mental and pathological peculiarities of parents *may* be transmitted, but that they *will be* is not so absolutely certain. Strength, pluck, and skill may all be inherited, which when turned in one direction makes the skillful mechanic, and when by circumstances diverted from their legitimate channel, produces the expert criminal. He declares the mental characteristics of the two to be much the same, except that the criminal—a burglar, for instance—needs physical strength and reckless audacity, all of which may be inherited by both, but which the former can do without. The qualities that may be attributed to hereditary do not make the one more a criminal than the other an expert mechanic.

In reply to the question if there is not a certain base propensity, a lowness of character, which may be transmitted, he replies that physiology knows no such peculiarity in the human animal. He advocates that the cure for unbalanced lives is training, and that the general phenomena of crime is due to surroundings, or, to use his own words, to environment. Let the pure and moral mind come in contact with and become enveloped by morbid and immoral tendencies, and the result will be immoral. Environment makes generation after generation of thieves, burglars, prostitutes, criminals, etc., and a different environment makes generations of learned persons, mechanics, tradesmen, etc. Observation, he says, teaches that environment determines for the most part how capacity shall be trained and how used.

He denies that the evil tendency to crime is corrected by correcting physiological tendencies, nor has he any confidence in the training of a bare morality. Men can only be restrained from crime by deep, profound religious training, a feeling that goes down into the depths of the soul, which makes it a part of one's self to know that certain things must not be done because they are sins.

Mr. Parker says, as a physiologist, he is unable to see any heredity as a factor in pauperism, with the exception of feeble mind and body, and these are rather indirect factors. The State must be made to change this radically, rather than to lament the impossibility of making physiological changes over which the State can, from the nature of things, have no control.

## KEELY MOTOR STOCK AT A DISCOUNT.

A well-known circus man named James Kelley has failed, and the public are favored with a schedule of his debts and assets. The former amount to nearly a quarter of a million dollars. Among the latter are seventeen cages of wild animals, one hundred and twenty performing horses, five royal tigers, an intelligent zebra, a double-humped camel, five elephants, and, bigger show than all, forty shares of Keely Motor Stock. The bankrupt alleges that the latter is worthless; but only a few months ago the financiers of the motor concern claimed that that number of shares was worth at least four millions of dollars.