The total lift is thus 60 ft. 6 in. The canal is divided into five levels, the length of which, respectively, is  $20\frac{1}{2}$ ,

71. 21. 3 and 2 miles.

The width of the canal at the top varies, of course, with the slopes of the sides; these are made ranging from I in | ing of all surfaces, where the paint itself is not only expect-6 through rock to 2 to 1 in clay and soft material. Except | ed to give the appropriate color that is desired, but also to when passing through rock, the slopes are pitched with | protect the surface against the weather. The other kind rough stone on a rubble backing to protect them from the wash of passing vessels.

The total amount of excavations in the canal is about 471 million cubic yards, one-sixth of which is in the rock. The walling of the various locks contains about 700,000 cubic yards of concrete, exclusive of brickwork and masonry; the walls of the Manchester and Salford Docks contain about 600,000 cubic yards of concrete. The weight of steel and ironwork in the fixed and swing bridges is about 15,000 tons.

The whole of the contract was let to the late Mr. T. A. Walker, who died in November last, and the work is now

it to be completed by December 31, 1891.

line have been built the whole distance from Eastham to Manchester.

## CONTRIBUTIONS TO PRACTICAL RAILROAD INFORMATION.\*

CHEMISTRY APPLIED XII.—THE WORKING QUALITIES OF PAINT.

By C. B. Dudley, Chemist, and F. N. Pease, Assist-ANT CHEMIST, OF THE PENNSYLVANIA RAILROAD.

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In our analyses of the requisites of a good paint in the last article, one point which has usually been regarded as of very great importance in paints, was overlooked, or at least not mentioned, and this is what is technically known as "covering power." This was not wholly unintentional, as we have always been somewhat skeptical of the common explanation of what is known as "covering power." There is unquestionably a difference in different pigments, as we ordinarily use them, in their ability to hide a surface, but we are not yet fully satisfied as to whether this is an inherent difference in pigments, or is a difference of physical condition. It may possibly be both, but we will treat this subject more at length later.

Meanwhile, for the sake of having the subject clearly before us, we will say that the requisites of a good paint are, first, durability, which has already been discussed; third, that it shall dry with sufficient rapidity, and fourth, that it shall have the proper covering power. This article will be more especially devoted to working qualities of

paint.

Before beginning the discussion of the working qualities of a paint, however, perhaps a little further analysis is necessary. Painting may be divided, according to the use

\* The above is one of a series of articles by Dr. C. B. Dudley, Chemist,

and F. N. Pease, Assistant Chemist, of the Pennsylvania Railroad, who are in

charge of the testing laboratory at Altoona. They will give summaries of original researches and of work done in testing materials in the laboratory referred to, and very complete specifications of the different kinds of material which are used on the road and which must be bought by the Company. These specifications have been prepared as the result of careful investigations, and will be given in full, with the reasons which have led to their adoption. The articles will contain information which cannot be found elsewhere. No. I, in the Journal for December, is on the Work of the Chemist on a Railroad; No. II, in the January number, is on Tallow, describing its impurities and adulterations, and their injurious effects on the machinery to which it is applied; No. III, in the February number, and No. IV, in the March number, are on Lard Oil; No. V, in the April number, and No. VI, in the May number, on Petroleum Products; No. VII, in the June number, on Lubricants and Burning Oils; No. VIII, in the July number, on the Method of Purchasing Oils; No. IX, also in the July number, on Hot Box and Lubricating Greases; No. X, in the August number, on Battery Materials; No. XI, in the September number, on Paints. These chapters will be followed by others on different kinds of railroad supplies. Managers, superintendents, purchasing agents and others will find these Contributions to Practical RAILROAD INFORMATION of special value in indicating the true character of the materials they must use and buy.

to which the paint is put, and especially according to whether it is expected to protect a surface or not, into two classes. The first of these classes is generally known under the head of "house painting," and covers the paintof painting is known as "coach painting," in which the color is the thing sought for, the protection of the surface. and also of the coloring material of the paint being secured principally by the varnish. These two kinds of painting are characteristic and distinctive, and both require different qualities in the material to be used. In our last article only house painting was considered, although much that was said in regard to durability in that article, will apply equally well to varnish This is especially true of mechanical injury, the action of deleterious gases, the destruction during cleaning, and the action of water, which, as will be remembered, were cited among others as causes being carried on by his executors. The contract requires | for the deterioration of paint. Indeed, we really do not know of any additional cause, beyond the seven mentioned The work is divided into nine sections, each under | in the last article, which interferes with the life and duracharge of a separate staff. A railroad and a telephone | bility of varnish, except, perhaps, its cracking, and upon this point we are hardly yet prepared to express any positive opinions. In what follows we will endeavor to recognize the two kinds of painting.

In order that paint, to be used for house painting and analogous purposes, should work well, two or three points seem to be essential. First, it must not run off the work; second, the brush marks made during application must disappear later; and third, the work must not appear spotted or streaked. In general these qualities are obtained by what is commonly known as proper mixing, although the grinding, the purity of the oil, and the kind of dryer used

all have influences.

The running of paint may be due to two or three causes. The paint may be applied too thickly for the kind of paint used; for example, to put on as thick a coat of very thin paint as paint containing a larger percentage of pigment, would inevitably result in the paint running. Of course linseed oil alone can be applied to a surface with a brush without running, provided too much is not put on, and the greater the percentage of liquid in a paint, the thinner the coat must necessarily be. This application of thin coats is a very common fault, especially in contract painting. Where the pigment is strong in coloring and covering power, the temptation is to put on very thin coats, which temptation is increased by the fact that thin coats dry quicker than thick ones. Of course with proper care in using a very thin paint, there need be no difficulty from running. Another cause which may lead to running is want of proper grinding. The finer and better mixed the pigment and liquid are, the less the tendency to run. A paint mixed up by simply stirring the dry pigment into the liquid, is more apt to run than one which has been ground. second, that it shall work properly during its application; | The oil leaves the coarser portions of the pigment, and carries off the finer portions with it, resulting in streaks down the work. With proper proportions between the liquid and pigment, this difficulty can be obviated, but some pigments, as is well known, cannot be ground, and are therefore always used by simply mixing with the liquid, but a paint otherwise good and properly proportioned may give difficulty from running, if it was not finely enough ground. Still another cause of running is too long a time after the paint is put on before it sets. We have mixed up two paints, one of which would take a set, although not dry, in from six to eight hours, and another which would not take a set in twice that time, the amount of pigment and liquid and the grinding being exactly the same, and the second would run, while the first would not. It is very easy to see why this should be so. A thin layer composed of liquid and pigment, maintaining its limpidity, and being in a vertical position for a long time, will run off from the surface more readily than one which does not maintain its limpidity, although other things are the same. The paint which takes a set, thereby loosing its limpidity, resists the strain which produces the flowing or running in the other paint. Adulterated oil, especially linseed oil, containing petroleum product, is liable to this same difficulty, and for the same reason,