

Cross pen, Fig. 95, having an air tube extending from the extreme upper end, and terminating in a spring box containing a piston or plunger to which the needle was attached. The barrel or reservoir was of richly-chased vulcanite, and the plug and cap, as well as the point section, were of gilt metal, presenting a smart appearance, which did not detract from its effective working.

Fig. 97 is a section of the point of a pen, advertised by Messrs. Burge, Warren & Ridgley as the "British stylographic pen," working on much the same principle as that of Cross. It will be noticed that the air tube is telescopic, thus forming a ready means of adjusting the position of the needle.

In Fig. 98 the writing point of the stylograph known as the "Independent" is shown in section. The needle in this case is fixed rigidly in the end of the air tube, relying on its own flexibility for freedom in writing.

Mr. C. W. Robinson has a metal pen, made in 1868 by himself, in which the rigid needle is used as here illustrated.

The "Livermore" has already been referred to. It is shown in section in Fig. 99, and it will be seen that the box carrying the spring, and the plunger to which the needle is attached, is a fixture in the point section into which it is screwed, and is not attached to the air tube as in previous examples. It was in its day a very excellent pen, but it is now seldom seen. One of these pens, which I carried regularly for some years away back in the early eighties, only failed as the result of falling on a railway platform some twenty years ago. This pen has now been repaired and is in perfect working order.

Fig. 100 shows a section of the "Riverside" pen. One of the advantages claimed for this pen lies in the method of holding the needle. A flat strip of silver is bent into the form shown below the pen, and passing through a hole in the fold is placed the needle, free to rise and fall with the spring. This combination is pushed into the point section, where it is held steadily by the effort of the silver strip, or yoke (as it is called), to expand, and the needle may readily be adjusted by raising or lowering the yoke as required. Although this ingenious little arrangement is here associated with the "Riverside" pen, I am under the impression that it is the invention of a Mr. Brown, whose name is well known as the inventor of a fountain pen which I shall refer to in my next lecture. The "Riverside" pen is one of the specialties of the London Pen Company, founded by Mr. C. W. Robinson.

De la Rue's Stylograph.—This consists of the usual number of parts, viz., the cap, the point section, and the barrel, as shown in section in Fig. 101. The cap is similar to the caps of fountain pens, but is provided with a small pad or cushion of India-rubber, the object of which is that of a safeguard to prevent any possible leakage of ink from the point when the cap is in position. The point section is formed as shown, terminating in a tapering point, which again terminates in a very small metal tube skillfully inserted therein. The barrel is a vulcanite cylinder or tube into one end of which the point section screws, as shown at *C*, while into the other end (which is practically solid) is fitted a vulcanite tube, *D*, of small diameter, extending the entire length of the barrel. The end of this tube is open to the outer atmosphere through the chamber, *F*, and the hole, *J*; its other end, *G*, is sealed, and terminates in a short solid spindle upon which is fixed a coiled wire, extending forward in a straight line as shown at *B*. This wire is of such diameter and length as to pass freely through the point, and just protrudes beyond *B*, when the point section is screwed home. One can readily recognize here the invention of Mr. Shaw of 1898, already described. Close to the sealed end *G*, of the air tube, there is a small hole, *I*, which establishes communication between the interior of the air tube *D* and the barrel.

The pen being filled the ink runs down into the very restricted annular space between the wire, *H*, and the point, *B*, and thence on to the paper. At the same time air is being admitted through the chamber, *F*, and the air tube, *D*, to the opening, *I*, whence it bubbles up through the body of ink. In the chamber, *F*, is fixed a short tube open to the outer air at *J*. This tube forms an effective trap, as previously described, preventing the ink from leaking through the air vent, *J*, should a drop happen to find its way there, in case the pen be held in an inverted position.

Altogether this is a very beautifully made instrument and one that I use continually for writing in manifold. I therefore speak from a practical experience extending over a considerable period.

I believe this pen is now called the "Pelican" stylograph, by Messrs. De la Rue, the manufacturers of it, and as I have seen it being made I can testify to the great care exercised in its production.

Having now concluded my notes on stylographic pens, I should like to be permitted to assure the reader that I have throughout endeavored to obtain the most reliable information on the various details described, and I have received very valuable help from gentlemen interested in the industry, as well as from Mrs. Robinson, to whose husband I have referred more than once. It is more than probable, however, that errors may have found their way into my descriptions, in which case I shall be glad to be corrected, and to rectify any such errors. As I intimated before, I do not attempt to advocate any one pen, but simply desire to place on record what has been done by busy inventors and workers to produce a satisfactory writing implement.

I now pass on to say a few words about gold pens and their manufacture.

To adapt the quill pen to modern requirements, as a writing implement, is impossible. In use, it has charms which kept it in favor for a very long time, but the disadvantages are great. It needs continual repair and attention, and it is not given to all to make a passable quill pen. Its life is limited.

The steel pen is a great stride in advance of the quill. But a steel pen has serious drawbacks. The best steel pen will be quickly corroded by the acid found in many of our inks, or it will oxidize, and many a steel pen has to be discarded through one or other of these causes just as the writer is beginning to congratulate himself that at last he has a smooth-running pen with which he can write in comfort.

True, pens are frequently made of metals other than steel—alloys not so liable to corrosion. To meet the requirements of a good pen, such a metal must be flexible, durable, and proof against the action of corrosion and acid, and experience has proved that gold is the only metal which meets the case. It is, however, not pure gold, but is alloyed with silver, and thus reduced to 14-carat quality. This is almost universally adopted as the correct standard of fineness. There is another supreme quality required which the gold does not possess in a sufficient degree, and to obviate this defect the exceedingly hard metal iridium is called into service. The high price of iridium prohibits its use in making the complete pen of that metal; but it is recorded that about the year 1822 an English engineer, John Isaac Hawkins, discovered the advantage of attaching a fragment of iridium to the point of a gold pen, placing it in such a position on the point that it was the only part of the pen coming into contact with the paper in the process of writing. Iridium still continues to be the characteristic feature of all the best gold pens, though since Mr. Hawkins's time many improvements have been made in the methods of manufacture. Mr. Hawkins conducted a long series of experiments with a view to arrive at the best material to use. He tried rubies for the purpose, but these did not prove satisfactory. He cemented diamond dust to the points of quill pens, with even less satisfactory results.

It appears that after some thirty years of experiment, Mr. Hawkins heard of the failure of a pen-maker (Mr. Robinson) to make a pen of iridium, which he found too hard to work into shape. This fact encouraged Mr. Hawkins to give iridium a trial. The excessive hardness of the metal appealed to him, and in a simple manner he overcame the trouble. A very high speed lathe solved the problem. Using diamond dust and oil on a disk running at a very rapid rate, he found that he could cut into iridium, but even then very slowly, for a ruby could be cut in about one-third of the time. If then, iridium was say three times as hard as the ruby, he felt he had arrived at the right substance to give an absolutely durable pen point. But iridium was scarce. There was only one dealer in London at that time from whom it could be procured, and his stock was so small as to become quickly exhausted. However, there was sufficient of the precious metal to form points for a number of pens.

Thus the honor of originating the present and almost universal type of gold pen belongs to England, a trivial matter it may seem, but it has grown into an extensive industry.

It remained for our American friends to invent various labor-saving machines and devices for the production of gold pens, and although a large number are manufactured in England, it is said that New York practically supplies the bulk of the gold pens used throughout the world.

By the courtesy and kindness of Mr. Evelyn de la Rue I have recently had the opportunity of seeing gold pens manufactured in the works in Bunhill-row. I have also been given valuable information on this subject by Mr. Watts, the London representative of the well-known firm, Messrs. Mabbie, Todd & Co., of New York, and I propose using by way of illustration some woodcuts with which Mr. Watts has been good enough to supply me. Without going into minute detail I would give a sketch of the various phases assumed during the process of manufacture:

Ingot of Gold.—Beginning with the brick or ingot of pure gold, the first step, of course, is to alloy this with silver and copper to a fineness of 14 carats. The alloy is melted and remelted to insure uniformity, and is then cast into ingot form. The ingots are then rolled into ribbons of a width and thickness suitable for the particular kind, or size, of pen to be afterward made from it.

Fly Press.—These ribbons are fed by hand into a fly press, the die and matrix of which, formed to the exact outline required, relentlessly cut or stamp out the "blanks" one after another as the operator swings the handle of the press, leaving the ribbon of gold as here shown, in Fig. 102. This is the birth of the gold pen, and its appearance coincides with the orifice formed in the ribbon.

Pen Blanks.—The "blank," as it is called, is shown in Fig. 103 at *C*. It is, of course, a flat piece of gold, and does not from its general form look like a promising writing implement, but it is ready to have its iridium point applied, and to this end the blank is first hollowed out on one side of the point as shown at *D*, to receive two carefully-selected particles of the hard and costly iridium, which the workman, by the aid of a strong magnifying glass, applies to the tip of the point. With a blowpipe flame the gold is fused

around the iridium, and holds the grains firmly in place. This leaves the blank in the condition indicated at *E*, and is ready for the next process, which consists in passing it between rollers under a great pressure, which has the effect of elongating it considerably, as shown at *F*. The point is not touched, and the amount of rolling is regulated by the degree of elasticity required in the finished pen. Tempering is attained by the action of a steam hammer, which also solidifies the gold and improves its elasticity.

Gold Nibs.—The blank is now cut a second time by means of a punch and die, when it assumes more of the appearance of a finished pen, except that it is still flat, as at *G*. (Fig. 104.) It also has embossed or stamped upon it the maker's name or some distinguishing device, and the point—which is still clumsy and thicker than the other part, as it has not been rolled—is carefully ground away with emery wheel and oil until the iridium particles are exposed. The blank is now ready for raising or shaping into the curvilinear form shown at *H*, so familiar in pens, and this is done by a blow from a die of the correct shape, which presses the pen into form between its surface and that of a counter-die. Slitting is next accomplished by means of a thin disk of soft copper revolving at a very high speed, its periphery dipping into a reservoir of very fine emery and water, and the action of this disk as a cutting tool is so positive that not even iridium can withstand it. The pen now, as seen at *I*, is not just the instrument one would select to write with. To reduce it to proper form, it is placed in a kind of holder, which firmly grips it right up to the root of the slit, and the sawn edges of the slit are carefully ground, polished on a thin iron disk revolving in oil and emery, and it requires all the skill of an experienced workman to make these edges exactly true and alike. This being done, as at *J*, *K*, the points are just as carefully ground, and the nibs are set in their familiar position. The setting must be properly done, as if one nib of the pen should be thicker or thinner than the other, or if one should not be an exact counterpart of the other, the pen will be useless. The last process is to roughen slightly the underside of the pen point, and thus enable it to hold the ink. This is done by the action of the sand blast. The result of this is indicated at *L*, and his "nib-ship" is complete.

It may be of passing interest to state that, at the works of Messrs. De la Rue the workmen employed in making the gold pens are required to wash their hands and faces before leaving the premises, with the result that something like £150 to £200 worth of gold is recovered per annum, and it is stated that in the works of the Waterman Pen Company, in the United States, a similar rule is enforced, producing about \$90 worth of gold each month. The clothing worn by the operators is the property of their employers, who burn the garments to ashes for the sake of the gold-dust they carry.

The gold nib has become the universal writing point of the fountain pen. The gold, as I have already stated, is used because of its non-liability to oxidize; and iridium is adopted because of its extreme hardness, which renders it peculiarly suitable to resist wear due to friction, as it glides over the surface of the paper. Gold pens may be had in every degree of flexibility, either with fine or broad point, and cut to any angle, so as to suit the requirements of the most fastidious, and the most exacting scribe.

(To be continued.)

THE SELECTION OF PORTLAND CEMENT FOR CONCRETE BLOCKS.*

By RICHARD K. MEADE.

In every new industry there are some successes and many failures. The concrete block industry has been more fortunate than most new industries, in that a heavy demand for building materials of all kinds has made the number of failures less than the number of successes. Whether this condition will last will depend entirely upon the class of work done by the present generation of concrete block manufacturers. If their work is good, if their product proves sightly and buildings made of it turn out to be enduring and sanitary, the failures of the future will be few, and will depend wholly upon a disregard of the law of supply and demand, or an ignorance of the business. If the work of the present generation is poor, if buildings built of its product are unsightly, damp and given to decay and ruin, the failures of the future will be many and will, of course, be directly attributable to the poor work of the present day manufacturers.

A general impression seems to prevail that sand is of many grades and must be carefully selected to give a block of good color and the requisite strength. Likewise, that each make of concrete block machine possesses features peculiar to itself which will add to the economy with which the factory can be run or the quality of its output. Portland cement, however, is thought to be Portland cement, and, like Caesar's wife, to be beyond reproach. One brand is often considered as good as the other, and the whole matter of selection often turns on a difference in price of a few cents a barrel. A sales agent for a large cement plant recently said to me, "My friend, there is no such a thing as bad Portland cement," which was another way of saying that "there is a sucker born every minute," and, if a cement is not good enough for the careful purchaser who tests his purchase, it can readily be worked off on the careless man who does not.

* Paper read before the Cement Users' Association.

The concrete block manufacturer needs the best of cement, and the future of his business will depend upon his getting this. If he allows his warehouse to become the dumping ground for cement rejected for such heavy rough undertakings as piers, abutments, foundations, etc., how can he expect the finer and more exacting class of work which he does to last?

It is the purpose of this paper to point out the properties most requisite in Portland cement to be used for the manufacture of concrete blocks. Three all-important qualities of the latter will be dependent upon the cement of which they are made—two of them will be entirely dependent upon it and the third to some extent. These properties are:

- (1) Endurance.
- (2) Strength.
- (3) Color.

The endurance of the block is, of course, an important property, as it makes little difference what strength the building may have when made if in short time it is to disintegrate. The strength of the block, however, should be such that it will withstand all stresses, strains and loads which may be applied to it, either in the laying of it in the wall or after it is in position and the building completed. The color of the block affects its marketability for superstructure work.

To take up the way of attaining these qualities in detail, we will first turn our attention to endurance.

To manufacture concrete blocks which will last, and which will retain their strength in spite of the disintegrating action of time, water and the gases of the atmosphere, a "volume constant" or "sound" Portland cement must be used. What causes certain cements to swell and expand after mixing with water and allowing them to harden is not certainly known. Those conditions surrounding the manufacture of cement which give it this tendency are well understood, however, and are usually improper proportioning of the raw material (allowing the lime to be in excess over the silica and alumina) and insufficient grinding and burning of the mixture. This has led most cement investigators to attribute disintegration to an excess of "free lime." This free lime is locked up in a case of hard cement clinker, and is almost as effectually protected from water when the cement is made into concrete as if it were sealed up in a bottle. In time, however, the hard protecting case of clinker is itself acted upon by the moisture of the atmosphere, etc., and becomes hydrated. The water then has a chance to get at the free or loosely combined lime, and this, in hydrating or combining with the water, expands with great force and disintegrates the now fully hardened concrete, just as water freezing in an inclosed vessel will burst the container, no matter what its strength may be. This is the most common explanation of the "blowing" or expanding of unsound cement, but be the reason what it may, it is a fact that such Portland cement sometimes expands to such an extent after hardening that the expansion may even be measured and blocks of concrete made from such cement will sooner or later fall to pieces and disintegrate.

Certain brands are much more liable to this tendency than others. Some mills are provided with insufficient grinding machinery for the raw materials, and can, therefore, seldom make a cement which is sound when fresh. These depend on seasoning to make their product sound, and hence, when pushed for orders, are very apt to ship fresh, and consequently, for them, unsound cement. Lack of knowledge, or of skill in manufacture, or of system in supervising the process, often is the cause of unsound cement. It is probably easier to make a sound cement from cement rock alone than from any other material, and next to this comes the cement-rock-limestone mixture, the difficulty with this growing, as the percentage of limestone in the mixture increases. It usually costs less to make an unsound cement than a sound one, because less care is needed in proportioning the raw materials, less grinding is necessary to prepare them for the kilns and less coal may be employed in burning them. Consequently, the block manufacturer should exercise care in purchasing cement to make sure he does not secure cheaply or carelessly made and, consequently, often unsound cement. If he does secure such a cement, the result will be this: his blocks when freshly made and after "curing" will be sound and hard, and will present no sign of the dissolution, which may ultimately take place with them. They will go out and be laid in the wall of a house. In time, possibly in a year, maybe more, the face of the blocks will begin to crumble and strip off the blocks, cracks will appear in them, and, if the cement were very much unsound, the blocks will eventually crumble away.

Unsound cement is by no means a rare occurrence, either, and there are manufacturers who believe "no cement is bad" and ship fresh, whether it passes standard "soundness" test or not. The cement inspector of a large corporation recently told me that 90 per cent of the cement offered his concern by a certain manufacturer was rejected because of its failure to pass the soundness tests. Are you certain that you did not get any of this cement? I know that cement tests are expensive, yet I know of no better safeguard against unsound cement than the laboratory test. The next best thing is confidence in the knowledge, skill, care and good faith of the manufacturer himself. The concrete blocks made of unsound cement differ in no way perceptible to the senses from those made of sound. It may not disintegrate for years; it may, indeed, for that matter, never disintegrate, but the chances are that the blocks made of unsound cement will sooner or later crack and crumble, and the concrete block industry in the sections in which this does

occur will very likely receive a serious setback thereby.

It is now generally recognized that seasoned cement is much better than fresh. My own experiments indicate that cement seasoned in bulk for about six months is at best. Cement which has been kept in bags this length of time, unless stored in a very dry place, may lump, however, and consequently the block manufacturer may have some trouble making a good sand mixture. There is much to be said in favor of the block manufacturer buying his cement in large quantities and storing the same for some months. By doing this he will be much less likely to use unsound cement, since unsound cement is often cured or made sound by seasoning. The cement will also gain some in strength. Two objections to storage are, the liability of the cement to lump or cake, and possibly in some cases of its becoming quick setting. The latter tendency is usually met with in low limed and poorly manufactured cements, though under certain conditions all cements seem liable to become quicker setting with seasoning.

It is a well known fact to those versed in the technology of Portland cement that the addition of plaster of Paris to unsound cement often makes it pass the standard steam test; and that some manufacturers make a practice of so "doctoring" unsound cement. The addition, however, is harmful to cement, as an excess of plaster not only causes the concrete to weaken in time, but also causes unsightly white streaks and efflorescence on concrete blocks. The unsoundness caused by plaster can only be detected by long time tests, so that the usual plan of guarding against it is by limiting the amount of sulphur trioxide found in the cement to 1.75 per cent. Since this is the active constituent in plaster of Paris, by determining the amount present (as can readily be done by a chemical analysis), we can calculate if a harmful percentage of plaster has been added to the cement.

While not strictly falling under the title of this paper, it may be well here to mention some causes of unsoundness in concrete blocks, which are not due to the quality of the Portland cement itself, but to qualities which are developed in it by the use of certain chemicals, etc., added to facilitate manufacture or give color. The demand for a quick setting cement has brought into use the carbonates and hydroxides of potash and soda. These chemicals are the base of nearly all the quick hardeners sold to the concrete block manufacturer. They cause unsoundness to a marked degree, and should not be used except upon the advice of an expert cement chemist. They also cause efflorescence on the block.

Some care should also be used to guard against coloring matters for the blocks which contain chemicals, such as the sulphides or sulphates, chromates, acetates, etc., likely to react with the cement to the damage of the block. Most sulphides are readily oxidized to sulphates, which change is accompanied by expansion and consequently disintegration of the block. Pure oxide colors are best, and can be used with safety. Sands with a large percentage of soda and potash minerals (such as mica) or containing pyrites (iron sulphide) are also objectionable for the reasons given above.

The strength which Portland cement may develop is due to various conditions of its manufacture, such as chemical composition, thoroughness of burning, and fineness to which it is ground. As cement is always used with sand, no attention need be paid to its neat strength unless blocks are to be faced with very rich mixtures. Neat strength is very deceptive and is seldom a reliable indication of sand strength.

One of the most important qualities of Portland cement in determining the strength of the concrete made from it is the fineness to which it is ground. Other things being equal, the finer the cement, the greater will be the strength of the concrete. Thus, a cement as ground by the manufacturer so that 95 per cent of it would pass a 100 mesh sieve, gave a sand tensile strength of 267 pounds in seven days, while the same cement ground to all pass a 200 mesh sieve gave 375 pounds for the same period, or an increase of 40 per cent in sand strength due to finer grinding.

Probably all concrete block manufacturers are striving for a waterproof block—one in which all the voids are filled. This latter may be achieved by the use of a richer mixture, by waterproofing compounds, or preferably by the employment of a sand containing the proper proportion of fine particles. These fine particles help to fill the interstices between the coarse ones and to so keep out the water. One of the oldest principles of good concrete is "to coat the particles of sand with the cement paste," and that the strength of the concrete is proportionate to the thoroughness with which this has been done. Now, the finer a body is pulverized, the more surface it will present. Thus, if we divide a cube an inch square into halves, we will increase the surface area from 6 to 8 square inches, and if we quarter it we will increase to 10 square inches, etc. Consequently, the finer the sand we use, the more surface there will be to coat and for exactly the same reason the finer must be the cement to coat this sand.

By using a sand containing fine particles and a finely ground cement in place of a richer mixture, fine cement is made directly more economical than the coarsely ground one.

By "fine cement" however, is not meant a cement ground by rolls, etc., to show a good sieve test, but a cement which contains a large percentage of flour. Since in such a dense concrete there are no voids, or practically none, there is no room left for the expansion of the cement during hardening, as is the case with ordinary porous concrete where the cement can usually expand a little into the spaces between the

sand grains, and it is doubly important to use a sound, or, in other words, a non-expanding Portland cement.

The setting time of Portland cement also has an important influence on the strength. Slow setting cements, that is, cements which get their final set in from 4 to 9 hours, are much stronger than those which set more quickly. Quick setting cements are nearly always overlaid, and contain less of the active silicate and aluminate of lime, to which cement owes its strength, than the slower setting ones. This may seem paradoxical, but is nevertheless true. The compounds in cement which set quickly are not those which give it great strength, consequently cements giving an initial set of less than 30 minutes are hardly ever as strong as those which require from 2 to 3 hours. For example, a cement which sets in 30 minutes rarely ever, unless very finely ground, gives a 7-day sand test of over 250 pounds, while one with a set of 2 or 3 hours may easily give 300 to 350 pounds, or even more. Cements with a "flash" set, that is, which set up under the trowel, should not be used in making blocks, as these latter are apt to be weak. With such cements the set is broken by working, the processes of solution and crystallization are interfered with, and consequently have only half a chance to do their work. The set of the cement should always be sufficient to give ample time to mix the mortar and fill the machine, or molds.

One of the greatest requisites of Portland cement to be used for concrete blocks is that it shall be a quick hardener. It must get its strength promptly. By prompt hardening is not meant quick setting cement. The term "set" is merely used to define the change undergone by the mortar in passing from the plastic to the solid state. The hardening only begins after the setting process is completed, and quick setting cements are not necessarily prompt hardeners, and are, indeed, usually the reverse.

The best test for prompt hardening is the 7-day sand strength. Cements which get a tensile strength of 300-350 pounds per square inch in 7 days are now on the market, and these are best suited to concrete block manufacture. If the blocks do not lose strength, the sooner they get their full strength the better, because the sooner they can be used, as less time is needed to cure them. A cement which has a sand strength of 350 pounds after 7 days, and which has only increased 50 pounds in a year, is, to my mind, much better for the purpose than one which has a strength of 200 pounds at 7 days and increased 150 pounds in the same length of time; because it will stand the same stress seven days after making that the other one will after it is a year old. A building may have to bear its full load three months after the blocks are made, and hence the prompt hardening cements are needed for block making.

Concrete blocks are now sometimes waterproofed by coating their exposed surface with a thin layer of paraffine. This thin layer effectually protects the interior of the block from the moisture of the air, and as cement cannot gain in strength after it is so coated, consequently, where waterproof blocks are made, prompt hardening cements should be used, and the block should be allowed to gain good strength before applying the coating. For a similar reason these blocks should not be made too dry.

The concrete block manufacturer will probably be more interested in the color of his blocks than in any other one of their properties, since upon this will depend the immediate marketing of his product. Uniformity of color is, therefore, very important to him, since the color of a building, in order to be pleasing, should present a uniform appearance to the eye. Uniformity can only be secured by making the block of uniform cement and sand mixed in definite proportions and manufactured into blocks under as nearly the same conditions as it is possible to obtain. For coloring blocks, dark colored cements may be used but their color should be uniform. For lighter blocks, light colored cements must be used. As the color of cement gets lighter as it is ground finer, only finely ground cements should be employed for this work. The percentage of iron and manganese in the cement also influences the color. Cements free from iron and manganese would be white, and the color darkens as the percentage of iron or manganese increases. Most cements are practically free from manganese, and hence the color is usually due to iron.

Sulphate of lime, which is always added to cement to regulate the set, is one of the causes of the white efflorescence seen on concrete blocks. This salt is soluble and is carried to the surface of the block by the water which "sweats" out during curing. The less sulphate of lime present in cement intended for concrete block manufacture, the better. As Portland cement can be obtained which contains less than 1.5 per cent sulphuric trioxide (the chief constituent of the sulphates and the way they are usually reported in a chemical analysis), it is hard to see why cement containing more than this amount should be used.

The alkalis are also soluble salts, and are to some extent responsible for the saline efflorescence on concrete. Cements low in these should, therefore, be used. Most American Portland cements, however, contain less than 1 per cent alkalis.

Sulphide of iron is sometimes met with in cements burned in upright kilns. This causes dirty brown blotches to appear in the work from the oxidation of the iron to brown oxide of iron or "rust." Overlaid cements also show the same dirty brown color throughout the mass, as in such cements the iron seems to be present as the red brown "sesquioxide" instead of the black "magnetic" oxide of well made cements.