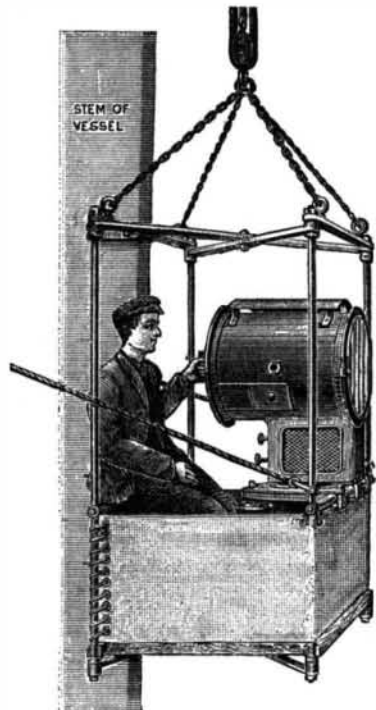


ELECTRIC LIGHTING OF THE STEAMSHIPS VICTORIA AND BRITANNIA.

THE magnificent fleet of the Peninsular and Oriental Steamship Company has, during the past few years, been gradually fitted with the electric light, one vessel following another, and each having the benefit of the experience gained in those which preceded it. From the ample opportunities thus placed at his command, Mr. Hall, the head of the engineering and marine department of the company's business, has decided that success is best obtained by the use of machinery which conforms to the ideas and habits of thought of ship's engineers, and which they can take charge of without special instruction or explanation. In order to act upon this idea, it is evident that the use of all belting, wheels, and other form of multiplying gear must be abandoned equally with the various high speed engines which run in closed casings and have more or less complicated arrangements of valves. An engine as nearly of the marine type as possible, driving direct on to the spindle of a dynamo, as if it were a screw shaft, is the ideal arrangement of Mr. Hall, and this, by the progress recently made in electrical engineering, he has been able to secure for the two splendid new



vessels, the Victoria and the Britannia. As long as the minimum speed of a large dynamo was 400 to 500 revolutions per minute, its direct driving by the ordinary type of engine was subject to too many drawbacks to render it preferable to the use of intermediate gearing; but now that machines are made capable of running at 200 revolutions, and at the same time of giving a very large output, the case is entirely changed, and there is no longer the need of resorting to driving appliances which are not viewed with favor by the sea-going engineer.

The plant erected on the Victoria and Britannia by the Anglo-American Brush Electric Light Company, Limited, of Belvedere Road, London, consists of a Tangye engine having cylinders 8 inches and 16 inches in diameter respectively, by 10 inches stroke, driving directly on to a Victoria Brush dynamo capable of feeding 450 lamps. Between the crankshaft and the armature spindle is an improved form of Oldham coupling, consisting of two plate couplings with an intermediate disk. In the face of each plate coupling there are two flattened studs which take into a slot in one face of the intermediate disk, the slots on the opposite sides of the disk being at right angles to each other. A shrouding on one coupling covers the disk and studs. Thus if the two shafts should fail to lie in the same straight line, the coupling permits them both to work freely. The dynamo, which is self-regulating, has six poles, and gives its full output at 200 revolutions per minute.

The plant is entirely in duplicate, each set being capable of maintaining all the lights. The conductors from the dynamos are led to a main switchboard, and are then distributed through the vessel on the single wire system, in which the frames and plating of the ship serve as return conductors to the engine room. The lamps and groups of lamps are turned in and out

The beam is reflected by a mirror 22 in. in diameter and 12 in. focus, and then is spread sideways by a dispersion lens which widens it into a sector subtending an angle of 22 deg. The direct rays of the arc are prevented from leaving the lantern by a carbon shield, but as the crater is turned toward the mirror there is very little loss from this cause. By the use of this apparatus the time of passing through the canal is reduced from an average of 36 hours to 15 or 18 hours. In the case of a vessel fitted with duplicate plant, the spare dynamo is employed to work the arc lamp in passing the canal. Vessels that are not fitted with electric appliances take them on deck on entering the canal and discharge them at the other end, and thus one set will serve a whole fleet of steamers.—*Engineering.*

IODIDE OF STARCH.

By H. B. STOCKS.

BESIDES the ordinary method of formation (*i. e.*, by adding a solution of iodine to starch paste), iodide of starch is gradually formed when dry starch and an alcoholic solution of iodine are triturated in a mortar, provided the alcohol contains water. With absolute alcohol a brown color is produced which, on the addition of water, changes to blue. It appears, therefore, that water is necessary to the formation of iodide of starch.

Iodide of starch is not formed when iodine vapor is passed over dry starch, but by using moist starch the iodide is formed. This also seems to show that water is necessary for the formation of this body.

It is formed by the action of various reagents on a mixture of potassium iodide and starch paste. The reagents are those which liberate iodine from its compounds—chlorine, bromine, nitric acid, strong sulphuric acid, ferric chloride, ozone (Schönbein), potassium permanganate, potassium bichromate, etc., produce the blue color.

The blue color produced by chlorine and by bromine is destroyed by excess of the reagents; excess of nitric acid or of sulphuric acid also destroys the compound.

In a paper by F. Mylius (*Ber.*, xx., 688, abstracted in *Journal Soc. Chem. Industry*) it is stated that the author has found that the formation of blue iodide of starch is not due to iodine alone, but also to the simultaneous action of hydriodic acid or an iodine salt. After reviewing the experiments that have been done, and repeating those of the author, I come to the conclusion that this is not the case. The statements made by Mylius are (1) that a solution of iodine in water does not give a blue color with starch; this is manifestly incorrect, because iodide of starch is formed under these circumstances. (2) That "all the iodine solutions which color starch blue contain hydriodic acid or an iodine salt." This may be answered in the same way, iodide of starch being formed when a solution of pure iodine is mixed with starch paste, or when iodine vapor is passed over moist starch. (3) "If a compound be present which destroys hydriodic acid—*e. g.*, chlorine—no blue iodine starch is formed."

With regard to this statement, Miller says that chlorine destroys iodide of starch, owing to the formation of chloride of iodine. This I think much more correct than the above.

The real fact is that a limited amount of chlorine, added to a mixture of hydriodic acid or an iodide and starch paste, colors it blue, owing to liberation of iodine, but excess of chlorine destroys the color. It may be that chlorine takes the place of iodine in the compound with starch, as a compound with bromine is known. (4) "A silver solution decolorizes iodine starch; on the addition of iodine, the mixture becomes yellow, but hydriodic acid or one of its salts restores the blue color." Repeating this experiment, it was found that, on adding silver nitrate to a solution of iodide of starch, the blue was destroyed, with formation of iodide of silver; on adding excess of iodine to this, the blue was reformed; if, however, without adding more iodine, hydriodic acid or one of its salts certainly produced a blue color; but this is simply explained when we take into account the action of nitric acid. I have not been able to find in books to which I have access what action iodine has on a solution of silver nitrate, but I believe that a portion of nitric acid is liberated, and this acts on hydriodic acid or its salt, liberating iodine, and thus we get the blue color.

I have stated the above in a concise manner, so as to show upon what grounds Mylius bases his idea that hydriodic acid or an iodine salt is necessary to the formation of iodide of starch.

Iodide of starch is soluble in a large quantity of pure water. As ordinarily prepared, it is an opaque blue mass, and when examined under the microscope is seen to consist of blue flocculent masses of the iodide floating in a liquid portion.

This shows that the idea of Liebig and others, that

cool, the blue is not reformed. Pelletier states that the blue color is reformed on cooling, provided all the iodine has not been driven off by the boiling. If the heating is stopped at the yellowish stage, and the liquid allowed to cool, the blue is reformed to a slight extent, more so if only the greenish stage has been reached, but neither regain the original intensity of color, showing loss of iodine. During the heating the smell of iodine was noticed in the escaping vapor.

With regard to the decolorization of iodide of starch by heat, Baudrimont says that it is due to the volatilization of the iodine, and states that it does not occur in sealed tubes, when concentrated iodide of starch is used, or when the liquid contains excess of iodine. He also states that dilute iodide of starch, heated in a sealed tube thirty or forty times, was decolorized each time, and regained its blue color on cooling. Kraut states that iodide of starch becomes colorless when heated in a sealed tube for some hours.

It was found that a solution of iodide of starch, when heated in a sealed tube, became colorless in an hour, and did not regain its blue color on cooling; a solution containing much more iodine than the last required three days' heating before it was decolorized, and it remained colorless on cooling. It is evident, therefore, that when iodide of starch is decolorized by heat, iodine is not necessarily volatilized, as stated by Baudrimont, and that his solutions were not heated long enough, or they would have been decolorized. Langlois states the same, that a concentrated solution of iodide of starch was not decolorized on boiling. The same remark may be applied here, namely, that the solution was not heated long enough, or it would have become colorless, as a very strong solution I tried, though requiring much boiling, eventually became colorless.

The decolorized iodide still contains iodine in some form. It seems, then, that the iodine goes into combination as some colorless body, as no free iodine is present in the boiled solution. This is evidently the case, as blues containing much iodine take a longer time to decolorize than those only containing a small quantity, or, in other words, time is required for the decomposition of the iodide of starch and formation of the new body. This is stated to be hydriodic acid by Kraut; Pelletier and Fritzsche say it contains no free hydriodic acid; Langlois says it contains iodine acid. My experiments confirm those of Kraut. The starch is apparently not altered, for on adding more iodine to the decolorized liquid the blue was again formed, and this decolorization and recoloration may be continued a number of times without any effect upon the starch. In open vessels only part of the iodine is converted into hydriodic acid, the rest being volatilized; in sealed tubes, however, all the iodine is converted into hydriodic acid.

If we now refer to the trituration of an alcoholic solution of iodine with dry starch, we shall find that the iodide was not formed. This is mentioned by Pohl, who says that the alcohol overcomes the attraction of starch for iodine, but on adding water the iodide is formed, owing to its weakening the effect of the alcohol.

If absolute alcohol be added to a solution of iodide of starch, it is thrown out of solution, but the alcohol has no action upon it. I think, therefore, that the reason why iodide of starch was not formed in the above case is because of the absence of water, which seems to be necessary to its formation (see action of other reagents below).

With regard to the action of other reagents on iodide of starch, sunlight decolorizes it, as stated by Raspail, Guibort, and by Payen. A tube of iodide I exposed to diffused sunlight required about nine months to decolorize it. I expect the action of sunlight is similar to that of heat, only much slower, but have not yet examined the product, as my first tube was destroyed; however, I have another experiment in progress with a parallel tube kept in darkness.

Iodide of starch is precipitated from its solution by dilute hydrochloric, sulphuric, and nitric acids, strong hydrochloric acid, and by solutions of salts which do not act upon it, such as sodium chloride, barium chloride, etc.

Starch solutions are not precipitated by dilute acids, as the iodide is. Strong nitric acid and strong sulphuric acid decompose the iodide.

Acetic acid does not precipitate the blue compound. The blue compound is destroyed by chlorine (Henry and Humbert), by bromine (as before stated), by sulphurous acid, by hydrosulphuric acid (Langlois), arsenious acid (Pisani), alkalies, etc. According to Pisani, the blue is destroyed by trichloride of antimony, chloride of arsenic, auric chloride, ferrous, manganous, mercurous, mercuric, and silver salts.

It is stated by Payen and Langlois that alcohol and ether abstract a part of the iodine from iodide of starch, but I did not find this to be the case, unless an excess of iodine is present, as a solution of iodide of starch treated with ether gave iodine up at first, but on repeated treatment with ether it still remained blue, but gave no iodine. A solution treated with alcohol gave up no iodine.

Starch has, therefore, more affinity for iodine than has alcohol or ether, or any other solvent for iodine I have yet tried. A solution of iodine in carbon bisulphide or benzene, when treated with starch paste, lost all its iodine, it combining with the starch; and oppositely, carbon bisulphide or benzene do not extract any iodine from iodide of starch, when it contains no excess of iodine.

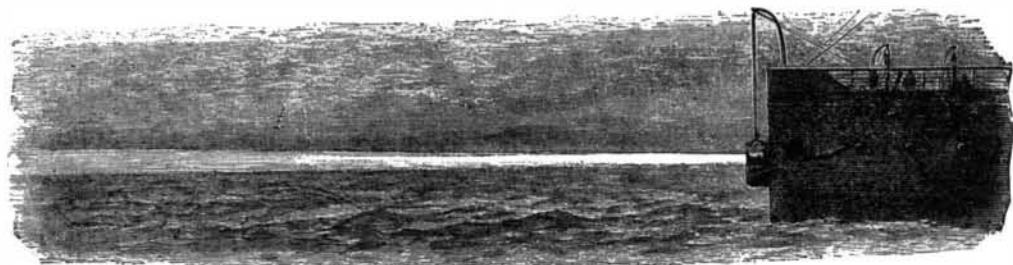
Therefore I think we are justified in regarding iodide of starch as a compound, or probably more than one compound, of starch with iodine, water also being taken into account, and refer its decolorization by heat to the fact that the iodine contained in it is converted into hydriodic acid.

Many analyses have been made of iodide of starch and formulæ proposed, but as the figures are so widely different, it will be necessary to estimate the amount of iodine in iodide of starch prepared in different ways. I have not yet made any analyses of iodide of starch, but intend to do so if circumstances permit.

As the blue color produced by the action of iodine on starch is of an interesting nature, I may mention as a sequel the few other cases in which a blue color is produced by addition of iodine to organic substances.

1. A blue color is produced when iodine is added to a solution of Iceland moss or Carrageen moss. This is due to the substance called lichenin, which is similar to starch in its composition and properties.

2. By the action of sulphuric acid on cellulose a body is produced which is blued by iodine.



THE ELECTRIC LIGHTING OF THE STEAMSHIP VICTORIA.

by the porcelain switches made by Messrs. Dorman & Smith, of Manchester.

The Peninsular and Oriental Company's vessels pass through the Suez Canal, and according to the present regulations they are allowed to steam on at night, instead of being obliged to moor at dusk, if they are provided with search lights. For this purpose the Brush Company provides the apparatus illustrated above. This consists of a cage which is suspended over the bows of the vessel and is lowered within 8 ft. of the water. In this cage there is mounted an arc lamp taking a current of 70 amperes and 65 volts. The lamp is regulated by hand by an attendant who sits behind it and feeds the carbons together as they are consumed.

the color of iodide of starch was due to the starch granules being mechanically colored by iodine being deposited on their surface, was not correct, as in the above case the granules were entirely broken up.

On examining starch granules colored by iodine, it appeared as if the whole of the interior of each granule were colored. The iodine evidently had penetrated through the coating of starch cellulose into the inner portion, which consists of real starch.

The chief peculiarity of iodide of starch is the readiness with which the color is destroyed by heat. The change is gradual, the liquid becoming first greenish, then yellowish, and finally colorless. If, after boiling the iodide of starch until colorless, it be allowed to

3. In a paper by Frank E. Lott (*Journ. Soc. Chem. Ind.* 495, 1887), in a description of Fritz's butyl bacillus, he says: The contents of the cells are partly colored by iodine of a violet approaching black, either the whole contents or single isolated patches of it (two or three) or sometimes only one spot. I might add that the reaction with iodine does not take place at all stages of the growth of this organism. It depends, also, to a great extent, on the nourishing medium."

It is most probable that in the last two cases it was really starch that gave the blue color.—*Chemical News*.

[Continued from SUPPLEMENT, No. 627, p. 10019.]

CHEMICAL AND ALLIED INDUSTRIES.*

By WATSON SMITH, Lecturer in Chemical Technology in the Victoria University, etc.

GROUP III.—DESTRUCTIVE DISTILLATION.

The Broxburn Oil Company, Limited, Royal Exchange Square, Glasgow (No. 750).—This firm exhibits specimens of the products obtained by the destructive distillation of Scottish boghead shale, together with samples of the raw material itself. It is an industry originally founded by the late Dr. James Young, F.R.S., about 30 years ago. Dr. Young commenced, however, not with boghead shale, but with the boghead canal itself, a mineral the identity of which with canal coal was disputed in a celebrated lawsuit started to upset Young's claims. This suit failed in its object, and so vigorously was the manufacture of paraffin oils, naphthas, and wax pushed, that the mineral became speedily exhausted. A fine specimen of this now extinct Scotch mineral, presented to the writer by the late Dr. James Young, is to be seen at stand 781. In the great lawsuit already referred to, the presence of a single characteristic coal fossil in the mineral would have quickly decided the case and have saved much expenditure of money, but no fossils were to be found in this boghead canal. It is interesting, however, to mention that Professor W. Boyd Dawkins, when recently in Australia, identified a canal which is practically identical with the old Scottish boghead, and fine specimens were brought over by him, and are now to be seen in the geological museum of the Owens College. The interesting point is that the Australian boghead *does* contain fossil remains. The first record we have of the manufacture of paraffin wax is that by a Manchester man (nevertheless a Scotchman), Mr. John Thom, of Birkacre (and of the firm of M'Naughton & Thom), who made it before the year 1835, by Reichenbach's process, from the products of the distillation of wood, as he informed the writer. He has still a specimen of the paraffin wax then actually put in the market. Mr. Thom was then the chemist in a works at Camlachie, near Glasgow. The present approximate annual production and value in the United Kingdom of the staple articles manufactured by the paraffin oil trade represented over £2,250,000. In the year 1886, to produce this value in the staple articles, there were consumed 1,816,600 tons of shale, and in the manufacturing processes there would be over 500,000 tons of coal consumed. The capital invested in the paraffin oil trade amounts to about £2,000,000. The articles exhibited by the Broxburn Company are: 1, crude oil; 2, sulphate of ammonia; 3, the refined products of the crude oil, which are burning oil in several qualities, naphtha of shale spirit, lubricating oil in various qualities, ordinary and debloomed; solid paraffin scale, the same in a refined state as wax of various qualities and candles prepared from it. The specimens of candles vary from the cheapest to the finest hand-painted kinds for drawing room use.

The Linlithgow Oil Company, Limited, Edinburgh, and 4 St. Ann's Square, Manchester (No. 748).—This is also one of the Scottish shale-distilling firms, and exhibits fine specimens of its raw and manufactured products, similar to those of the Broxburn Company.

The Dee Oil Company, 5 Cross Street, Manchester, and Saltney, Chester.—We now pass on to a handsome exhibit, illustrating the extraction of paraffin wax and paraffin products, not by destructive distillation from shale or canal, but by direct distillation from crude American petroleum residues first deprived of their light naphtha in the States before export to this country. This is a special line of paraffin industry of itself, and the annual production and value in this country of the staple articles thus produced amount to about £150,000. For this an annual consumption of raw materials takes place represented by about £50,000.

The works of this firm are established just on the borders of Cheshire and Flintshire, at Saltney, near Chester, and the history of the oil trade in the locality of North Wales is one of peculiar interest. The trade may be said to have had its origin in the discovery of "curley canal" coal in Flintshire, on the borders of Cheshire, about 26 years ago. This discovery led to the establishment of many companies and works in Flintshire for the production of paraffin oil, and the new industry was commenced with great vigor. However, American petroleum also came to the front, and the competition became too severe for the Flintshire paraffin industry. Burning oil reaches this country from the United States far cheaper than it could be made here from English products. At the present moment there is not a single firm in North Wales producing oils from the curley canal of the district, which moreover is nearly exhausted. During the decadence in this locality of the canal paraffin industry, one of the last of the surviving companies—viz., the Coppa Oil Company, who amalgamated with the Dee Mineral Oil Company, which then assumed the title of the Dee Oil Company, under which title it trades at the present time. There is a lesson for chemical manufacturers in this little history, one which as to facts has been repeated and will be repeated scores of times. It is this: In times of change, depression, and revolution of circumstances, only those can survive and continue to flourish who possess elasticity and energetic mental and physical vigor, backed up by and supported with scientific knowledge and intelligent observation. It is clear that the Dee Oil Company possessed these qualities, and the subsequent history of the firm shows that they were thoroughly needed. Thus, somewhat later, it was found that the paraffin scale and crude wax market became glutted, and no competition could be longer undertaken in that direction. The Dee Com-

pany therefore utilized the apparently hard circumstances by at once erecting its only candle works, where it could manufacture its own raw material into candles and so remove it beyond the region of impracticability and danger. To cut down other expenses the company further erected its own sulphuric acid works, and will shortly put up its own stearin plant. Competition was thus fought with its own weapons. The samples of manufacture exhibited comprise specimens of crude petroleum as taken from the American wells, refined petroleum, burning oils and residuum, which, as has been stated, is the material used by this firm. From it are manufactured lubricating oils of different brands, cylinder oils, and a special class of oils termed "valvolines" sterling. They are oils for internal lubrication, and are said to be superior to even the best makes of cylinder oils. They are especially recommended for use with sight feed lubricators and in all high pressure steam cylinders. They are remarkable for a high flash point (510° to 550° F.), a low setting point (under 32° F.), and a great viscosity, even when exposed to high temperatures. An entirely new method is used for their preparation, avoiding, it is said, distillation and treatment with acids and alkalis. Three grades are exhibited—"torpedo oil," for use on torpedo boats, launches, etc.; "dynamo oil," adapted for electric machines; "gas engine" and "ring spindle" oils. We observe also a preparation for therapeutic use, *oleum Deeline*, a medicinal oil for skin diseases. Besides these we see many other varieties of oils, and also fine specimens of paraffin wax, and candles, both plain white and colored.

Messrs. Ragosine & Co., 7 Idol Lane, Great Tower Street, London, E. C. (No. 733).—This exhibit is one illustrative of the advanced present position of the Russian petroleum industry. Two of the most wonderful things in connection with this industry are its apparently inexhaustible stores of natural raw material in the neighborhood of Baku, South Russia, and the enormous rapidity with which that industry has developed. To give an idea of this advance and development, it may be interesting to sketch the history of the firm whose beautiful exhibit is under consideration—that of Ragosine & Co.

In 1876, when the monopoly in petroleum at Baku was abolished by the Russian government, the production began at once to increase enormously, but so far the only valuable products obtained from the crude oil were spirit and burning oil. Since the Russian crude oil only yields 27 to 30 per cent. of these, there remained an enormous production of residuum, which was for a long time used as fuel or entirely wasted. It was Victor Ivanovitch Ragosine who first suggested the utilization of the heavier portions of the crude oil for the manufacture of machinery oils and greases. The firm of V. I. Ragosine & Co. was founded by him in 1876, at Nijni Novgorod, with a capital of 200,000 rubles. A refinery was built at Balachna, on the Volga, in 1876, and a second at Constantinow, in 1880. The capital of the company was raised by successive fresh issues to 3½ million rubles, and in 1880 this company obtained an imperial charter. The works at Balachna and Constantinow are supplied with raw material from Baku, by a system of tank barges, which are towed up the river during the month of May. The two refineries together have storage in iron tanks (each of about 2,500 tons capacity) of upward of 30,000 tons of crude oil and residuum. The plant at the two works includes 54 stills, and is capable of treating 35,000 to 40,000 tons of crude oil per annum, and of producing from 30,000 to 35,000 tons of lubricating oil, etc. The oils made from the Russian petroleum were first introduced into England in 1878. No mineral oils of the same "body" it is said, have been seen before, and this "body," or better "viscosity," of the Russian mineral lubricating oils indicates their special advantage. The viscosity of Russian oil of specific gravity 0.915 is about six times that of American oil of the same specific gravity at 60° F. The viscosity diminishes rapidly as the temperature rises, but even at 120° F. the Russian oil is claimed to possess three times that of the American of the same specific gravity. As compared with colza and olive oils, the Russian of 0.905 specific gravity has roughly about two or three times the viscosity at 60°; at 120° F. they are about equal. These statements are confirmed by the tables of William McIvor and Boverton Redwood. Hence (1) high viscosity—i.e., lubricating power; (2) freedom from acid; (3) absolute immunity from "gumming," since oxidation and drying cannot take place; (4) very low freezing point. The Russian crude oil contains practically no paraffin. A valuable product, viz., paraffin wax, is lost by this peculiarity, but the cost of freezing out the scale from the lubricating oil is saved. The burning oils, "petroleum" of specific gravity 0.826, No. 3, now largely used in this country and said to have a higher flash point than the corresponding American product, and equal illumination, "pyronaphtha" and "australine," special oils of very high flash point, viz., 200° and 130°, and used in specially constructed lamps, are pressing the American oils very hard. When the inert residuum of the American petroleum is destructively treated in red hot tubes, a large amount of charring takes place, and very little—scarcely any—increases of value in the distillate occurs, but if Russian petroleum residues are similarly treated, as was first discovered by Letny, and Liebermann and Burg, of Berlin, these residues are converted, it is true with much charring, into the true coal tar products, benzene, toluene, naphthalene, anthracene, etc.

Besides a fine collection of crude petroleum, with naphthas, lubricating and burning oils of all kinds, as well as oils for other special uses, a set of interesting specimens of aromatic hydrocarbons, such as are obtained from gas tar by the tar distiller, and used in the making of aniline and other coal tar dyes, is exhibited. Those specially interested, on proceeding to Stand No. 781, may see there a specimen of crude anthracene obtained from the Russian petroleum in the way specified, and another of 20 per cent. alizarin prepared from the anthracene, and finally a piece of printed and dyed cotton, in the coloring of which some of this alizarin was used. It has been, however, sufficiently proved by numerous practical experiments that the method of preparing coal tar hydrocarbons by carbonizing the petroleum or residuum will not pay, and we believe the process is now entirely or almost entirely abandoned.

J. C. & J. Field, Upper Lambeth Marsh, London (No. 752).—This firm, though also manufacturing and

exhibiting a special kind of soap, is best known for its "ozokerite" candles, ozokerite being a peculiar mineral wax occurring largely in Galicia, and containing a very considerable proportion of paraffin. It is thus a kindred substance with crude petroleum. Ozokerite was probably formed by the denuding action of water on peaty and similar vegetable remains, the vegetable part being gradually removed and the insoluble resins washed away or deposited. Till about 1770 wax and tallow were the sole ingredients of candles. The wax candles were "rolled," the tallow "dipped" or "moulded." The wicks in all cases were of twisted cotton, except in the cheaper tallow candles, in which rushes, partly stripped, were used. In 1850, James Young having isolated paraffin, J. K. Field took out a patent for manufacturing candles therefrom, which at once became very popular. Subsequently various members of the Field firm patented different forms of the candle—spiral, cable, etc.—to which the plastic and transparent paraffin readily lent itself. In 1872 the attention of F. Field, F.R.S., was drawn to the mineral wax ozokerite, long known in Galicia. In 1874 a patent was taken out for the distillation of the crude earth wax, and the white, very hard paraffin now known as ozokerite was produced (melting point 142° F.).

The recent introduction of semi-refined paraffin scale into the candle trade has almost annihilated the composite and tallow candle branch of the industry. The amount of candles and night lights produced in Great Britain annually cannot be much under 30,000 tons, probably it exceeds this estimate. Price's Company turn out over 60,000,000 night lights annually. The amount of palm oil imported into England exceeds 40,000 tons, tallow (exclusive of home consumption) 20,000 tons. (See Field's Cantor Lectures, *Journ. Soc. Arts*, 1884, and Rep. on Oils and Fats, C.I.E., 1886.) The principal part of Messrs. Field's exhibit, the "sapphire soap," is an article made by Dr. Alder Wright's ammonia process, and in this process all free alkali is removed. Moreover, a small quantity of free iodine is introduced, and glycerin of specific gravity 1.26 is substituted for the 20 per cent. of water usually present in toilet soaps. Eucalyptol, the essence of the *Eucalyptus globulus*, in an iodized and semi-saponified form, is finally added.

Price's Patent Candle Company, Limited, Belmont Works, Battersea, London, S. W.—This exhibit is one made by a firm which has a remarkable history. It is owing to a discovery made by a member of this firm that cheap and pure glycerin may now be had in abundance. To describe the development of the firm in detail would be out of the question, for, to begin with, more than eighty patents have been held by Price's Company. The great French chemist Chevreul, now over a hundred years of age, but still active as a chemist, in 1811 began his researches on the constitution of fats and oils, and in 1823 he completely published his discoveries in this direction. In conjunction with Gay Lussac, he attempted the industrial application of the scientific principles he had made known, but did not attain the success he doubtless anticipated. It was reserved to M. De Milly to lay the foundation of the stearic candle manufacture in 1832. In 1833 the "Bougies de l'Etoile," as the candles of MM. De Milly and Motard were called, were sold in Paris at about 1s. 8½d. per pound (retail), and at this price were placed on the market to the extent of about 25 tons per annum. In 1839 Mr. James Soames, of London, separated cocoanut oil into its solid and liquid components by pressure. He took out a patent for it. The patent was purchased by Mr. William Wilson and his partner, who worked under the title of "E. Price & Co." They perfected it, and produced by its aid cocoanut candles and lamp oil. In 1847 the concern passed into the hands of "Price's Patent Candle Company," Mr. William Wilson becoming the first chairman, and his two sons—J. P. Wilson and G. F. Wilson—the managing directors. The plated wick, patented in France in 1835 by Cambreres, was introduced in England by Henri Meyer, subsequently manufactured near Derby by Mr. Thomas Topham, and he in 1836 was supplying the wick to E. Price & Co. In the year 1840 Mr. J. P. Wilson, while endeavoring to produce a cheap self-snuffing candle for the coming illumination in honor of the marriage of Her Majesty Queen Victoria, then approaching, succeeded in making such candles of a mixture of equal parts of stearic acid and cocoanut stearin. They gave a brilliant light, required no snuffing, and could be sold retail at 1s. per lb. The new candles came rapidly into notice, and the sales advanced in a manner entirely without precedent. They were termed "composite," because of the mixture of materials in them. Such was a new and successful departure in illumination for our homes and on festive occasions at the date of the marriage of Queen Victoria.

In 1840 George Gwynne took out a patent for the distillation of the fatty acids *in vacuo*. It is these fat acids which, chemically united with glycerin, form true fats, much as sulphuric acid united with soda forms a salt, sulphate of soda. The knowledge which had already been acquired that these fat acids could be distilled without destruction or decomposition was thus for the first time commercially applied. But in 1842-43 Messrs. Price & Co., in the names of W. C. Jones and G. F. Wilson, patented a still more important discovery, superseding the first. They discovered that all the good effects of the vacuum process could be gained by substituting the use of free steam. Thus the costly vacuum still was avoided. With respect to the hardening of fats, Fremy, another great French chemist, had shown in 1836 that treatment with 50 per cent. of their weight of sulphuric acid in the cold was needful. In commerce this was impracticable. Clarke and Gwynne patented a process based on the foregoing in 1840, but Jones and Wilson subsequently proved that if the mixture were warmed, not cooled, then 33 per cent. of sulphuric acid would suffice, and still all the good results be obtained that were realized in the other process. Another commercial success was the result.

In 1848 the night light patent of G. M. Clarke, and in 1849 the night light business of S. Childs were acquired, a new factory was erected, and in 1852 the sale of night lights already amounted to over twelve millions per annum. Some years before the English mill owners could be induced to use oleic acid instead of olive and other oils for the oiling of wool, that acid, as produced in large quantity in the manufacture of stearic or hard candles, had been thus successfully used on the Continent. The

* Report on Section III. of the Manchester Royal Jubilee Exhibition.