

ART. XIV.—*Review of Dr. Antisell's Work on Photogenic Oils, &c.*

[The following Review of Dr. Antisell's book on Photogenic Oils has been for some months in type waiting an opportunity when our other engagements would permit its publication. It will amply repay the careful perusal of all who are interested in this important practical subject.—Eds.]

REVIEW.

1. *The Manufacture of Photogenic or Hydro-Carbon Oils from Coal and other Bituminous Substances capable of supplying Burning Fluids*; by THOMAS ANTISELL, M.D., Professor of Chemistry in the Medical Department of Georgetown College, D. C., etc. etc. New York and London: D. Appleton & Co. 1859. pp. 144.—In entering an earnest protest against the work before us, we would not have our motives misunderstood. We are not of those who would condemn a book solely on the ground that it is "not so good as it should be," and will not therefore urge this objection against the effort of our Author, although it would be hard to find a case to which the charge would more forcibly apply. But we do condemn most heartily the presumption of the man who in these days attempts to write a handbook upon any scientific or technological subject with which he is not somewhat familiar. We believe, moreover, that errors, either of omission or of commission—accidental or intentional—in scientific writings, which exceed the well-understood conventional limits of *tolerance*, should not be allowed quietly to pass without correction.

Dr. ANTISELL, from his position of chemical examiner in the Patent Office at Washington, has naturally had a rare opportunity of familiarising himself with the recent improvements which have been made—or claimed—in the manufacture of coal oils. In the work in question, he has published an index of these, which cannot but be acceptable to all who are interested either in the practical or scientific consideration of the subject. Had this list been published by itself, or had it been incorporated with a portion of the materials which Dr. A. has now exhibited, in an article, or a short series of articles, in some one of our scientific or technological magazines, it would have been most gratefully received, and, we doubt not, widely copied. Diluted and scattered as this information has been, however, that it might fill a volume, its value has been lessened in no slight degree.

We have endeavored, in vain, to make out the point of view from which the Author regarded his subject. Claiming the attention of all persons engaged in the manufacture of liquid products from the distillation of mineral combustibles, his work is nevertheless not a didactic one. In it scarcely any attempt is made to instruct the manufacturer, either by a clear enunciation of general principles to be followed, or of special details to be observed in given cases;* while a most lamentable lack of familiarity with the chemistry of the subject is continually exhibited throughout the work. Indeed the book is simply a jumble of badly selected extracts, huddled together in a manner which must be anything but edifying to the student. As a compilation, it has the merit of directing attention to a number of sources from which valuable information may be derived; while it has the great fault of omitting to mention numerous other sources of knowledge of equal or of greater value.

In several instances, moreover, erroneous assertions are made, or wrongful conclusions drawn. One or two of these we propose to discuss and correct

* In this respect our author has fallen far below the level attained by previous writers upon the subject. Compare for example: УЛЕНБУНН, *Handbuch der Photogen-und Paraffin-Fabrikation*. Quedlinburg Basse, 1858.

in this article. Our attention will be especially directed to the first chapter of Dr. Antisell's book—"History of the Art"—for in it are errors which have too long been current in the annals of chemical science—errors, the repetition of which by our author is the more unpardonable, since, from his very position, he should have known them to be such. Indeed, from statements to be found in various parts of his work, it would appear that he must have known of these errors—that he must have been in possession of most of the facts which will here be brought forward.

That we may form a correct notion of the subject under discussion, let us here digress for a moment.

As a general rule, when any bituminous substance is subjected to distillation—in the ordinary acceptation of the term, *i. e.*, when it is gradually heated in any appropriate apparatus, a quantity of an oily fluid is produced, which may be collected in receivers; small quantities of gas, water, and other incidental products being at the same time obtained.

The oily liquid, which alone interests us here, known in this country as *crude coal oil*, is a mixture of various hydrocarbons, among which the wax-like substance Paraffine is an almost never-failing constituent. Crude oil, though of course varying greatly, according to the sources from which it is derived, like the various marketable "coal oils" obtained from it by purification, is specially characterized by its low specific gravity, being capable of floating upon water.

When, on the other hand, a bituminous substance, instead of being gently and gradually heated, is suddenly exposed to the action of an intense heat—when, as in the ordinary process of gas-making, it is thrown into vessels of iron or clay, which have *previously* been brought to a bright red heat, a different set of products is obtained. A large quantity of permanent gas is produced, while the liquids formed are no longer the light oily compounds just spoken of, but are composed of another set of hydrocarbons which taken collectively, are *heavier than water*. These constitute coal-tar. Among them paraffine is no longer found, excepting in comparatively rare instances, another solid substance, Naphthaline, being a characteristic component of the mixture. When the process to which the bituminous matter is subjected is a mixed one, *i. e.*, when a portion of the substance comes in contact with strongly heated surfaces, while other portions receive only an amount of heat sufficient to distill off oils of the kind first described, a mixed product, containing both coal-oil and coal-tar, is naturally obtained. As an instance of such mixed product may be mentioned the tar obtained in the preparation of gas from Boghead coal,* it being almost impossible, in this case, to maintain the retorts at the temperature best suited for gas-making, on account of the great amount of heat which is rendered latent by the enormous volume of gas generated by this highly bituminous substance.

It should be mentioned, that both crude coal-oil and coal-tar contain a quantity of "light stuff," composed of several exceedingly volatile and inflammable liquids. Some of these naphtha-like fluids, for example benzol—the benzine of the French—(known as *benzole* in the private vocabulary of Dr. Antisell, or that of his proof-reader)—may occur both in crude-oil and in tar; others do not. We refer to these "light-stuffs" here merely for the purpose of explaining that they have been at times spoken of as "volatile oils," from the resemblance which they bear to spirits of turpentine and other essential oils, and to eliminate them from the discussion. They are of but minor interest at the present moment, when compared with the true "coal-oil" now so largely employed in this country. We may mention, in passing, that Dr. Antisell has very inconsiderately obscured his historical sketch of the progress of the art of distilling coal-oil

* In the same class are several Scotch cannels, our own Breckenridge and allied coals, also the Albert coal of New Brunswick and the like.

by blending with it the question of coal-tar naphthas. He has, for that matter, been unfortunate throughout in the presentation of this part of his subject; all the crude liquid products of distillation, at whatever temperature the process has been conducted, being indiscriminately classed by him as *tar*. Now, it is well known to practical men, as has already been described, that the products obtained from bituminous matters by slowly distilling them, is as different from coal-tar as ether is from alcohol. The term crude-oil, by which the first-named liquid is known to manufacturers in this country, characterizes it perfectly; so does the term *huile de schiste* (written at times simply "*schiste*") of the French.*

It is surprising that Dr. Antisell should have followed the example of several German authors—without their excuse—in thus perplexing his readers.

In returning from this digression, we would expressly declare our disbelief in the adage which allows for the existence of no novelty. Still we do believe that very few of the arts have sprung into existence in a day, their perfection, and especially their development, having almost always resulted from the successive labors of numerous individuals; and we do believe that the inventor, who first practically "applies" any abstract knowledge, and thus creates a new art or branch of industry, is entitled to credit therefore—and to far more credit, and that of a different order, than the man who subsequently introduces this art into a foreign country. We would not detract from the efforts of the latter; on the contrary, would accord them high praise; but we desire, first of all, to see justice meted out to him who created the art—to those who increase human knowledge, sooner than to its mere diffusers.

We would therefore join issue with Dr. Antisell when, in his preface, he tells us that his book is a "record of the origin and condition of an infant art," and again mentions "this new branch of industry." So, also, in the first lines of his Historical Introduction, where he speaks of "the new and extensive manufacture of oils from coal and other bituminous substances." For these statements are not only erroneous in themselves, but they—no less than the unfair allusions which appear on subsequent pages—tend to do great injustice to earlier inventors, and especially to the memory of a man whose name must ever remain inseparably connected with the history of the *art* of manufacturing the fluid now known as coal or paraffine-oil. We refer to SELIGUE. More than twenty-five years ago, this inventor's method of obtaining such oil was described in the *Journal des Connaissances Usuelles*, for Dec., 1834, p. 285. (See also *Dingler's Polytechnisches Journal*, 1835, lvi, 40.) This article was subsequently followed by numerous others, until in Selligue's patent of March 19, 1845, we find the whole subject treated of most fully and clearly. As a lucid and truthful description of his processes and of the products obtained, this specification is most praiseworthy. Few subsequent writers upon the subject have been able to add anything to the stock of knowledge which it imparts. Taken for all in all, it is doubtless the most meritorious essay which has ever been published upon the art of manufacturing coal-oil. We can but reiterate our statement, that the brief, inaccurate, and exceedingly superficial comments which have been bestowed by Dr. A. (pp. 9, 80, etc.) upon the information which Selligue has imparted in his admirable series of essays, does great injustice to the subject as well as to this author.

Leaving for a moment the minute consideration of Selligue's improvements, let us first glance at the labors of some of his predecessors.

As Dr. Antisell has truly said (p. 7), the discovery of the production of oil from coal appears to date as far back as the time of Boyle, (1728–1799), when the well known experiments of Dr. Clayton were made.†

* We may here observe, that throughout this article we shall translate the French term *huile de schiste*, by its English equivalent, *coal-oil*.

† Philosophical Transactions, Jan. 1739, No. 452, p. 59; in Martyn's Abridgment, vol. ix. p. 395.

In distilling coal from a pit near Wigan in Lancashire, this observer obtained, first phlegm (water), then oil, and finally gas.

No doubt an earlier record of similar experiments might be found in the writings of the alchemists, who, as is well known, subjected almost every substance to processes of distillation.

During the last century attention was again several times called to the fact.*

It would seem, however, that nothing very definite was published before the year 1830. UNVERDORBEN† had, indeed, in the preceding year, called attention to oils distilled from petroleum, and even appears to have obtained paraffine—to which however he gave no name.‡ The attention of the scientific world was first really attracted to this substance by the memorable memoir of Reichenbach,§ who separated it, in the first instance, from wood tar, and described its properties at length. In the following year, Reichenbach|| is at great pains to prove that the crude-oil, obtained by slowly distilling coal, contains no naphthaline,¶ that naphthaline is not a product of the slow distillation of coal, but is a result of the subsequent decomposition of such products by heat; and that the coal-tar of gas-works is not crude-oil, but an impure mixture of the products of distillation with those resulting from their decomposition.**

* In addition to the authorities cited by Dr. A. (p. 8), we would mention the following from *An Experimental History of the Materia Medica, or of the Natural and Artificial Substances made use of in Medicine*; by WILLIAM LEWIS, M.B., F.R.S., 3rd Edit. 8vo, Dublin, MDCCCLXIX, vol. ii, p. 143. Article *Petroleum*; also, (according to American Druggists' Circular, iv, 36,) in the London edition of Lewis. 4to, 1761, p. 436:

"Some mineral oils, procurable among ourselves, are used by the common people, and often with benefit. The empirical medicine, called British oil, is of the same nature with the petrolea; the genuine sort being extracted by distillation from a hard bitumen, or a kind of stone coal, found in Shropshire and other parts of England."

† *Berzelius's Jahresbericht*, x, 181, from *Kastner's Archiv*, xvi, 122; also in *Schweigger-Seidel's Journal für Chemie und Physik*, 1829, lviii, 243.

‡ For allusions to other earlier German researches bearing upon the subject, see Reichenbach's Memoirs, which will be cited directly. Compare also Gmelin's Handbook of Chemistry (Cavendish Soc. Edit.), xii, 439.

§ *Journal für Chemie und Physik*, (or *Jahrbuch der Chemie u. Physik*, Band, xxix) von Schweigger-Seidel, 1830, lix, 436.

|| *Ibid.*, (or *Neues Jahrbuch der Chemie u. Physik*, B. 1,) lxi, 175.

¶ Dr. Antisell dismisses this article (p. 11) with the statement that "in 1830-'31, Reichenbach discovered naphthalin." It may not be amiss to state that naphthaline was discovered at least ten years earlier, having been described by GARDEN in 1820 (Thomson's *Annals of Philosophy*, xv, 74), to whose labors as well as to those of CHAMBERLAIN, KIDD, and others, Reichenbach particularly refers in this very article. See also *loc. cit.* B. lxxviii, [B. viii, of the "*Neues Jahrbuch*,"] S. 233.

** It must here be explained that Reichenbach has suffered great injustice at the hands of those who, in translating portions of his papers, have rendered his term "*Steinkohlentheer*" literally—coal-tar. Now the term coal-tar, in countries abounding in gas-works like England or the United States, means the tar of gas-works, and it means nothing else. Gas-works, it must be remembered, were, until quite recently, by no means so common in Germany, and were doubtless rare enough in 1830, consequently, it is not at all strange that the English idea of "coal-tar" should not have become current in that country. Reichenbach, for that matter, distinctly and repeatedly asserts, that his "*Steinkohlentheer*" is a very different substance from the tar of gas-works. In a word, it was *crude-oil*. If, perchance, there may be any person who would accuse us of mistranslating certain words used by Reichenbach, we would at once refer such an one to the original memoirs of this author. Submitting it to the judgment of any competent chemist, whether we have misinterpreted his lan-

These experiments were made upon a manufacturing scale, Reichenbach being, at this time, "chief of an extensive system of mines, iron furnaces, machine shops, chemical works, etc., most of them established by himself on the estate of Count Salm [Blankso, Moravia]. These works lie along a line some fifteen miles [5 *Stunden*] in length." (Schweigger Seidel).

In another article published later, in 1831,* he describes his method of obtaining paraffine from the distillation of flesh and of coal (portions of 75 lbs. weight having been operated upon). With regard to coal, he particularly urges the necessity of slow distillation, in order to prevent the decomposition of the first products and the consequent formation of naphthaline, as explained in his previous article, to which he refers. The paraffine was separated from the less volatile portions of the rectified oil by cooling—the description of which oil R. reserves for a separate article.† He also obtained paraffine from petroleum. Two more papers upon the subject were published by Reichenbach in this year,‡ only the first of which is of particular importance in this connection. It relates to *Eupion* (εὐ very, πῖον fat). A term by which Reichenbach designates, in some instances, a portion, in others the whole of the somewhat difficultly volatile, fat-like oils, prepared by purifying the first product obtained by slowly distilling substances of animal or vegetable origin. This eupion was, in fact, a mixture of several hydrocarbons—the same which, in similar mixtures, are now collectively known in commerce as coal-oil; called paraffine oil by some, and designated in the retail trade by innumerable other names of only local significance.

Eupion was obtained by Reichenbach from the products of the slow distillation of animal and vegetable substances, as well as from coal, and was minutely described by him. We make but a single extract from this article, which occupies some thirty-two pages: "When any one shall succeed in separating eupion, at a sufficiently cheap rate, from the tars [crude-oils], it will very probably enter into the circle of substances useful in household economy. For, since it burns from a wick, brightly and clearly, and is free from smoke, it is in no wise inferior to the finest oil as an illuminating material. It does not grease nor crust the wick, nor stiffen when cold. If we consider, in addition to this, that for all purposes where cold can exert no influence, the paraffine need not be separated, but can be left dissolved in the eupion, and used in conjunction with it for lighting; we shall perceive that this is of some importance, since the two substances are thus mutually improved for technical purposes."

In 1832, Reichenbach§ again published a note upon eupion; and, in 1834, another long article,|| in which he once more dwells upon its useful properties.

Reichenbach's contributions on the subject of the dry distillation of organic substances, are comprised in some twenty or more long articles, not counting

guage, [compare, for example, *loc. cit.*, B. lxviii., [B. viii, of the *Neues-Jahrbuch.*] S. 226].

It may be worth while also to call the attention of the reader to the fact that all of the substances discovered by Reichenbach in "tar" (as the text-books tell us) were in reality obtained from crude-oil. Knowing this, every one familiar with recent chemical literature, will perceive at once why so few of R.'s scientific results have been corroborated. For, until quite recently, the attention of chemists interested in such researches, has been almost completely occupied with the subject of coal-tar. Compare also Reichenbach's complaint against Dumas and Laurent, in Schweigger-Seidel's *Journal für Ch. u. Phys.*, 1838, lxviii., 223.

* *Loc. cit.*, lxi, [or B. 1, of the *Neues-Jahrbuch*], S. 273.

† *Vid. infra.*

‡ *Loc. cit.*, lxii, [or B. ii, of the *Neues-Jahrbuch*], S. 129, 273.

§ *Loc. cit.*, B. lxvi, [B. vi, of the *Neues-Jahrbuch*], S. 318.

|| Erdmann's *Journal für praktische Chemie*, i, 377.

several smaller "notes." A tolerably complete list of which may be found in Erdmann's *Journal für praktische Chemie*, i, 1. It is very much to be regretted that these memoirs have never been collected and published as a separate volume. Even now, any chemist who could find time to collect these scattered articles and translate them into English or French, would unquestionably promote the cause of science by so doing.

Looking at the question for a moment, solely in its scientific bearings, we cannot refrain from an expression of astonishment, that the details of Reichenbach's researches are so little known to the generality of chemists;* while, on the other hand, we are forced to confess, that it is indeed rare that scientific researches, conducted by a chemist in his laboratory, have so fully described a future art—have so accurately pointed out the methods to be followed and precautions to be observed by the practical manufacturer. We must not omit to mention that, in 1831, Christison† of Edinburgh made known his discovery of paraffine in petroleum from Rangoon. Not knowing of Reichenbach's previous publication, Christison named it *Petroline*, but subsequently admitted its identity with paraffine. In 1833, Bley‡ distilled oils from lignite.

A little later, in 1834, Gregory§ published an able article upon paraffine and eupion, and their occurrence in petroleum. Of this memoir we cite but two lines, (*vid. Trans.*, p. 129, or *Rep.*, p. 113). "It follows," says Gregory, "that there are some kinds of naphtha [petroleum] which contain paraffine and eupion, and are consequently the results of destructive distillation."

In the following year, v. Kobell|| also noticed paraffine in petroleum.

For the labors of Hess in Russia, and of several other chemists in Germany, as well as for the interesting discussions which followed between these

* This lack of information appears to depend upon the circumstance, that the writers of most recent chemical text-books seem to have derived their knowledge of the subject in question, from Gay Lussac's brief abstract of Reichenbach's earlier memoirs, which was published in 1832, in Poggendorff's *Annalen*, xxiv, 173; also in the *Annales de Chimie et de Physique*, [2], 1, 69; and quite extensively copied by the journals of the day.

In this connection we would respectfully urge upon all those who have fallen into the common habit of regarding as somewhat apochryphal the numerous substances of greater or less scientific interest, which Reichenbach separated from the products of dry distillation, that before seeking to discredit—or allowing themselves to disbelieve—them, they should conduct experiments similar to his, *on a scale of equal magnitude*. Let us here also bear in mind the luminous conclusion of the late Dr. Hore of Edinburgh, who, as the story goes, (*Vid. London Chemical News*, i, 56), one day informed his class that Reichenbach had discovered in tar, "creosote, picamar, paraffine, cedriret, capnomor, and a host of other substances of no interest or importance whatever." Of these "unimportant" substances, two at least, eupion and paraffine, are to-day as well known, in the world, as bees-wax or spermaceti, although comparatively little—we had almost said nothing—has been added to the scientific knowledge of them, since the publication of Reichenbach's memoirs. If, perchance, any other of these well-nigh forgotten bodies should be found to possess any technical importance, we would quickly enough find some one claiming credit for its "discovery," and oppressing chemical nomenclature, by adding yet another name to the existing "host." Even now we await, with no little interest, the elucidation of the question—whether the new violet dye, prepared by oxidizing anilin, which is exciting so much interest, under the names anilein, Perkin's purple, *mauve*, etc., is not identical with, or a component of, the *pittical* of Reichenbach.

† *Transactions of Royal Society of Edinburgh*, xiii, 118; also in *Repertory of Patent Inventions*, 1835, [N. S.] vol. iii, p. 390.

‡ Schweigger-Seidel's *Journal für Chemie u. Physik*, B. lxix, [B. ix, of the *Neues-Jahrbuch*], S. 129.

§ *Transactions of Royal Society of Edinburgh*, xiii, 124; also in *Repertory of Patent Inventions* 1835, [N. S.] vol. iv, p. 109.

J. pr. Chem. v. 213.

observers and Reichenbach, the reader may consult the general index [Namen-u. Sach-Register zu den Bänden i. bis lx, Leipzig, 1845] to Poggen-dorff's *Annalen der Physik u. Chemie*.

At the same time that these scientific researches were in progress in Germany and Scotland, or even earlier, numerous practical efforts to manufacture oils from bituminous substances were made in France.

Although the precise date at which these experiments were commenced is somewhat obscure, it will not be difficult to trace the history of the successful development of the industry to which they gave rise.

As stated by Dr. Antisell, the MM. Chervan* had a patent, dated in 1824, for distilling bituminous substances. Blum and Moneuse,† in 1832, claim only the application of coal-oil to purposes of lighting—not its manufacture, which they allude to as being well known.

Subsequently (7th October, 1833) Boscary‡ obtained a patent for extracting pyrogenous oil from different substances, asphaltums, etc., and especially from the shales which occur in the environs of Autun (*Saone et Loire*), and finally from all the bituminous matters in France. The oil, which is obtained by distilling the shale in metallic cylinders, may be used, according to Boscary, instead of fish-oil or resin, for gas-making—a much better gas than that prepared from coal being thus obtained.

In 1833, Laurent§ occupied himself with the investigation of various bituminous shales, both French and English, at the instance of the MM. Blum, whom he mentions as being occupied with the distillation of oil from the shales of the environs of Autun.¶ Laurent gives the details of the process employed by himself, telling us that the retort in which his shales were distilled attained a sombre red heat at the close of the operation; also of the percentage amounts of oil (20 p. c.), gas, coke and water obtained from the Autun shale; how the oil cannot be burned in ordinary lamps, on account of smoking, but affords a very luminous flame when consumed in lamps furnished with suitable chimneys. He shows moreover that the oil contains paraffine, and does not contain naphthaline.

Laurent subsequently published another paper¶ upon this oil, in which article he records his efforts to ascertain what definite chemical compounds are contained in the oil. One of the products obtained by fractional distillation, viz., an oil boiling at 167° to 170° (C.) = 333° to 338° F., he considers as identical with eupion.

In 1834, we find, for the first time, an article** describing the process of Selligie, although it would appear from the statements of this chemist and of others, that his attention had been directed to the subject of distilling bituminous shales several years earlier. The cited article relates how the shale is *slowly* distilled in iron cylinders, until no more oil comes over; how the oil obtained is characterized by containing neither oxygen nor naphthaline, but a solid substance differing from the latter, and resembling that called parannaphthaline†† by Laurent.

* Brevets d'Invention xviii, 232.

† *Ibid.* lxxv. 250.

‡ *Ibid.* lxxviii, 359.

§ *Annales de Chimie et de Physique*, liv, 392.

¶ According to Laurent, he had himself proposed to a company, in 1829, to work these shales, in order to extract the oil contained in them, and to employ it for lighting.

¶¶ *Comptes Rendus*, 1837, iv, 909; more fully in *Annales de Chimie et de Physique*, lxiv, 321.

** *Journal des Connaissances Usuelles*, Dec. 1834, p. 285; also in *Dingler's Polytechnisches Journal*, 1835, lvi, 40, from which our extract is taken.

†† The inadvertency of confounding this body with paraffine was subsequently corrected by Selligie.

In 1834, '35 and '36, Selligie* was principally occupied with his well-known process for making water-gas. In calling the attention of the French Academy† to this, he remarks that, in conjunction with David Blum, he holds a patent granted in 1832 for the application of oils obtained from shale to purposes of direct illumination, and that the working of the shale employed is in the hands of a company capable of developing the business to any extent which commerce or the arts may require.

In the same year Payen,‡ in reporting upon Selligie's water-gas, remarks upon the great importance of the new industry of distilling oil from shales which S. has introduced.

In the following year we again find Selligie before the Academy§ requesting that body to appoint a committee to examine the merits of his new system of gas-lighting; his process of distilling bituminous shales on the great scale by means of apparatus, each one of which furnishes from 1,000 to 1,400 pounds of crude oil per day—this being about 10 per cent of the weight of the shale employed, and being almost all which exists in the raw material; also of his process of separating various products from the crude oil, some of which are applicable to the production of gas, others to ordinary purposes of illumination, and others to different uses in the arts. This petition was referred to a committee of three—Thenard, D'Arcet and Dumas—who reported in 1840.¶ They mention the localities of Selligie's three establishments for obtaining oil from shales; the amounts of oil obtained from the different kinds of shale, &c.

In 1838 Selligie also obtained a new patent¶¶ “for the employment of mineral oils for lighting.” In his specification he informs us that the principles upon which his processes for rendering the oil obtained from shales proper for the purposes of direct** illumination depend, are:

I. Removal of almost all odor. II. Removal of all tar. III. Removal of the most volatile portions of the oil, which are also the most inflammable and the most odorous, the presence of which would cause the oil to have too great fluidity for the capillarity of ordinary wicks. * * *

The operations, continues Selligie, consist in slowly distilling the bituminous shale, and collecting the liquid products in large receivers. These products are redistilled, and divided into fractions by refrigerating. They are treated with concentrated sulphuric acid for a longer or shorter time according to the nature of the shale employed. Twenty-four hours are ordinarily sufficient, the oil being agitated from time to time. The quantity of acid used varies from $\frac{1}{10}$ to $\frac{1}{20}$. After this the oil is to be carefully drawn off from the tar, and washed with water. Slaked lime is then added and a current of steam passed through the oil in order to carry off by distillation all the more volatile and odorous liquids. This last, says Selligie, is the most important part of my process, for if this very inflammable portion were allowed to remain in the oil, one could not use the latter in ordinary lamps *à courant d'air*. * * * This patent it should be observed claims only to be an improvement upon that of Blum and Moneuse (*vid. Supra*). Selligie asserts, however, that coal-oil had never before been prepared in such a manner that

* See seven patents in *Brevets d'Invention*, lxx, 269. Of these patents two are dated 1834; two, 1835; and three, 1836. For a description of his process of gas-making see also *Bulletin de la Société d'Encouragement*, Oct. 1838, p. 396; or Dingler's *Polytechnisches Journal*, lxxi, 29.

† *Comptes Rendus*, 1837, iv, 969.

‡ Dingler's *Polytechnisches Journal*, lxxviii, 201; from *Bulletin de la Société d'Encouragement*, Dec. 1837, p. 493.

§ *Comptes Rendus*, 1838, vii, 897.

¶ *Comptes Rendus*, x, 861; also in Dingler's *Polytechnisches Journal*, lxxvii, 137.

¶¶ *Brevets d'Invention*, lxxviii, 395.

** The term “direct illumination” is constantly used by Selligie in contradistinction to the indirect use of the oil in his process of gas-making.

it was fit for use in common lamps. This has, indeed, he says, been the subject of many researches, but no one has hitherto succeeded in avoiding the empyreumatic odor, and the very inflammable products which caused the oil to rise too quickly to the summit of the wick. He goes on to define the difference between his purified oil and the crude oil obtained directly from shale. On the 27th of March, 1839, Selliguet specifies certain additions and improvements to the preceding patent. I should add, he says, that I now divide the products of distillation into four distinct parts, which afford me every facility for employing these products in the arts and for domestic economy. In these divisions there are indeed some anomalies which arise from differences in the shales, &c. which I treat; but the following products are always obtained:

I. A light, volatile oil more or less odorous according to the source from which it is derived. * * * This can be used in painting, for dissolving resins, &c., for lighting by vaporising it (it being very volatile) or for the production of gas according to my system.

II. A fat oil only slightly volatile, and having but little odor; this can be used for domestic purposes in ordinary lamps with or without admixture of animal or vegetable oils.

III. A fatty substance almost odorless, possessing all the properties of the fats, and well adapted for use in the arts. It can also be used for lighting, either by mixing it with light oils or by decomposing it for the production of gas. It can moreover be used for soap* since it saponifies very well, and being without odor affords a very good soap; with ammonia the fat forms a sort of pomade.

IV. An odorless pitch of great purity and tenacity, suitable for preparing a black solid varnish for preserving wood, iron-work, &c. * * *

In 1839, Selliguet in alluding to the use of his oils in the treatment of cutaneous diseases speaks of the three large establishments for the distillation of bituminous shale which he has erected in the Department Saone et Loire, and mentions the fact that the oil (crude?) is furnished at the rate of about two cents [ten centimes] per pound.

The question of price is again discussed a few years later, when Selliguet says: it has been stated that crude shale oil costs only \$1 50 per 100 pounds, and that it contains 60 per cent of a very light volatile ethereal oil well suited to afford light, as well as 40 per cent of a fat substance. Now since 1837, I have extracted more than 4,000,000 pounds of oil from bituminous shale, but the oil (crude?) costs 20 cents a gallon (22 frs. the hectolitre) or even 27 cents when delivered in Paris. From every hundred measures of the crude oil are obtained (by distillation) 20 measures of volatile oil boiling at 100° C.=212° F.; 30 measures of less volatile oil boiling at 150° to 260° C.=302° to 500° F.; 14 measures of an oil containing paraffine, and 28 measures of fat—five measures being lost. In purifying these products a further portion is lost.

The clearest of all Selliguet's specifications, however, is that of the patent granted to him March 19, 1845§ for the distillation of bituminous shales and sandstones.

After describing the various forms of apparatus used in distilling, into one of which superheated steam was introduced, he enumerates the products of distillation as follows: I. A white, almost odorless, very limpid mineral oil—somewhat soluble in alcohol—which may be used as a solvent, or for purposes of illumination in suitable lamps, &c.

* This "soap," (emulsion) is described more fully in the sequel.

† *Comptes Rendus*, ix, 140; also *Annalen der Pharmacie*, von Wöhler u. Liebig, xxxii, 123.

‡ Dingler's *Polytechnisches Journal*, xci, 193; from the *Moniteur Industriel*, 1843, No. 770.

§ *Brevets d'Invention*, [new series, (loi, du 5 Juillet, 1844.)] iv, 30.

II. A sparingly volatile mineral oil of sp. gr. 0.84 to 0.87, of a light lemon color, perfectly limpid, almost odorless, never becoming rancid, and susceptible of being burned in ordinary oil lamps, of constant level à *reservoir supérieur*, with double current of air—a slight modification of the form of the chimney and burner being alone necessary. This oil can also be mixed with the animal or vegetable oils. Oils thus prepared do not readily become rancid, nor do they congeal easily when subjected to cold.

III. A fat mineral oil, liquid at the same temperature as olive oil. This oil contains a little paraffine; it is peculiarly well adapted for lubricating machinery, and has an advantage over olive and other vegetable oils, or neats-foot oil in that it preserves its unctuousness when in contact with metals and does not dry up. It saponifies easily, and forms several compounds with ammonia.

IV. From the oils Nos, I, II, and III, I extract a red coloring matter which can be used in various arts.

V. White crystalline paraffine which needs but little treatment in order to be fit for making candles; this substance does not occur in very large proportion in the crude oil, and the proportion varies according to the different mineral substances upon which I operate. There is but little of it in petroleum, and in the oil obtained from bituminous limestone. I often leave a great part of the paraffine in the fat oil and in the grease in order that these may be of superior quality.

VI. Grease. This grease is superior to that of animals for lubricating machinery, and for many other purposes, since it does not become rancid, and remains unctuous when in contact with metals.

VII. Perfectly black pitch—very “drying”—suitable for preserving wood, metals, &c.

VIII. An alkaline soap obtained by treating the oils with alkalies.

IX. Sulphate of ammonia. X. Manure prepared by mixing the ammoniacal liquor, or the blood of animals, with the crushed fixed residue (coke) of the shale. XI. Sulphate of alumina from the residue of the shale. F. H. S.

[To be concluded.]