

The History of Opium*

Facts Concerning One of Our Most Valuable Drugs and its Derivatives

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If the entire materia medica at our disposal were limited to the choice and use of only one drug, I am sure that a great many, if not the majority, of us would choose opium, and I am convinced that if we were to select, say half a dozen of the most important drugs in the Pharmacopeia, we should all place opium in the first rank. If we were to inquire, however, into how much the great majority of the medical men know about the history of this wonderful product of plant life, which, when judiciously employed, has proved such a boon to suffering humanity, if we were to ask about the origin of some of our most familiar remedies—laudanum or paregoric, for instance—I fear the information gleaned would be meager. It is doubtful whether it is even generally known that opium, so widely used in China, is not indigenous to that country, but was introduced there at a comparatively late date. This were apology enough for a brief historical sketch on the subject, but a glance at the history of opium and its derivatives from the earliest time to the present may teach us more. If the aim of the history of medicine is not altogether the recitation of interesting anecdotes, but rather to trace the progressive development of our noble art and science, then is the history of no other drug more calculated and better fitted to illustrate the gradual transition from the obscurity and mysticism of the ancient *Dreck-Apotheke* or polypharmacy and kakopharmacy to the rational therapeutics of the present day.²

EARLY HISTORY.

The medicinal properties of poppy juice date from a remote period, and yet not so far back in antiquity as we might expect, for the earliest definite and authentic references to it are found only in the Greek and Latin literatures. Of course, recalling the mystic rites and highly developed culture of the ancient Egyptians one is inclined to imagine that the narcotic properties of opium were known to them; but the investigations of Unger (1857) have failed to trace any acquaintance with opium in Ancient Egypt, and Dr. Ember, of the Semitic Department of this university, tells me he knows of no reference to it in Egyptian literature. According to some Hebrew scholars, there is a reference to poppy juice in the Bible. In several passages in the Old Testament the word *rôsh* is mentioned in connection with the word *la'anah*, wormwood or absinthe (Jer. viii 14, ix 14, etc.). *Rôsh* in these passages is in the authorized version rendered hemlock. *Rôsh*, however, in Hebrew is the word for "head," and so it has been taken by later scholars to mean poppy-head, and *me-rôsh*, or the juice of *rôsh*, rendered by Jewish interpreters as "poison water," is taken to mean the juice of the poppy. This interpretation fits well enough in the context, and further support is given it by the fact that the Latin for poppy-heads is *caputa*. Prof. Haupt is convinced that *rôsh* means the poppy, and so also is Prof. Post, who is considered an authority on the flora of Palestine. In the Talmud we have one reference to opium, under the name *ophion* (Jerusalemic Talmud, Tr. Abodah Zarah, 40a), but that word was clearly borrowed from Greek.

In regard to Sanskrit, Prof. M. Bloomfield of the Sanskrit department of this university tells me that opium is not at home in India, and so in the classical Hindoo literature (Brahmanical, Buddhist, Jinist) there is found no reference to it. From the time of the Mogul Conquest on there appears a word *Khaskhash* which means poppy-seed, and *Khaskhasha-rasa*, juice of the poppy. In this it is easy to recognize our modern word *hashish*; and so it seems that at that early date the narcotics opium and cannabis indica were confused with each other.

In modern Sanskrit lexicons there are found the names *aphena* and *ahi-phena* applied to opium; *aphena* strictly means "foam," and *ahi-phena*, "serpent's foam." As these words for opium do not occur in any literary

document, Dr. Bloomfield suspects that they are the English opium "sophisticated by what is known as popular etymology."

The original home of the poppy was in Asia Minor. From there it was carried to Greece at a later period.

The name opium is derived from the Greek *ὀπός* or "juice." From this word were later formed the Hebrew *ophion* already mentioned, and more particularly the Arabic *af-yun*, which has found its way into other Asiatic languages. The Chinese name for the drug *o-fu-yung* (and its modifications *ya-pien* and *opien*) are not of native origin, but are all derived from the Arabic.

It is not at all certain whether Hippocrates was acquainted with the juice of the poppy. According to Wootton, he refers to a substance called *mecon*, to which he attributes a purgative as well as narcotic action. Some think that it was opium; others believe that he was referring to another plant. In any case, he made but very little use of the drug.

The first authentic reference to the milky juice of the poppy we find by Theophrastus at the beginning of the third century B. C., when he speaks of it as *μηκόνιον* (*meconion*).

Scribonius Largus,³ in his "Compositiones Medicamentorum," about the year 40 of the present era, describes the method of procuring opium from the capsules of the poppy, and about the year 77 of the same century Dioscorides makes a distinction between the juice of the capsules which he called *ὀπός* and the extract of the whole plant or *μηκόνιον*, which he regarded as less active. He describes the method of incising the capsules, and refers to adulterations of the drug with the milky juices of other plants, such as *Lactuca*, so that from his statements it is evident that the collection of opium was quite an industry in Asia Minor at that time. He also describes the preparation of a syrup of poppies or *dia-kodion*, which is the original of the syrup of poppies of the German and other Pharmacopeias to this day.

Pliny devotes some space to a description of opium and its medicinal use, and the drug is mentioned repeatedly as *lacrima papaveris* by Celsus in the first century and by numerous other Latin writers. Galen spoke enthusiastically of the virtues of opium confections, and the drug was soon so popular in Rome that it fell into the hands of shopkeepers and itinerant quacks.

The introduction of the drug to the natives of the East was through the Arabs, and in the first instance to Persia. Its introduction into India seems to have been connected with the spread of Mohammedanism and was favored by the Mohammedan prohibition of wine.

The Arabic physicians used opium very extensively, and even wrote special treatises on some of its preparations. The most celebrated of them, Abu-l-ali-ibn-Sina, more commonly known as Avicenna (980-1037), recommended it especially in diarrhea and diseases of the eye. Avicenna himself is said to have met death from an overdose of the drug. Serapio (about 1090) used it freely, and Maimonides and Averroes each wrote a treatise concerning the theriac, of which I shall have much more to say a little later.

The earliest mention of opium as a product of India is by the traveler Barbosa, in his description of the Malabar coast in 1511. A Portuguese historian, Pyres, in a letter to Manuel, King of Portugal, in 1516, speaks of the opium of Egypt and Bengal. It is from Egyptian Thebes that we have the terms "opium thebaicum" and the alkaloid thebain.

Opium is supposed to have been brought to China first by the Arabs, who are known to have traded with the southern parts of the empire as early as the ninth century. Later the Chinese began to import the drug in their junks from India. At that time it was used by them exclusively as a remedy for dysentery. It was not before the second half of the eighteenth century that the importation of opium began to increase rapidly through the hands of the Portuguese, and a little later through the famous East India Company. In 1870 the English established an opium depot in Lark's Bay, south of Macao, and the traffic rapidly increased, so that very soon the Chinese authorities began to complain, and in 1820 an edict was issued forbidding any vessel having opium on board to enter the Canton River. A system of contraband followed, then political friction between England and China, and the so-called Opium War, which culminated in the Treaty of Nan-

³ Largus, Scribonius: De Composition Medicamentorum, 1786.

king (1842) by which five ports of China were opened to foreign trade, and in 1858 opium was admitted as a legal article of commerce. By that time the vice of opium-smoking had spread like a plague over the gigantic empire, and became so deeply rooted that, in spite of innumerable edicts and decrees, all efforts to check its growth have been powerless. A poor sort of missionary work by the enlightened West among the heathen Orientals!

I shall not spend here any more time in tracing the history of opium in China, or in dwelling on the horrors of the opium habit, with its frightful constipation and even more terrible diarrhea, and the physical and mental degeneracy to which it leads. Our object is rather to follow the use of opiates therapeutically, and in Europe.

Since the time of Galen, the use of opium was continued in a disguised form in various concoctions and confections containing so many ingredients that the distinction between the important and useless could not be discovered, and the value of the drug was overlooked, except by a few brighter minds.

The famous physician of the middle ages, Philippus Aureolus Theophrastus Bombast von Hohenheim, commonly known as Paracelsus (1490-1540), owed much of his success to the bold way in which he administered opium to his patients. He is said to have carried opium in the pommel of his saddle and called it the "stone of immortality." His followers were as enthusiastic as himself over the virtue of opium. Platerus of Basle in 1600 strongly recommended it, and Sylvius de la Boe, a famous Dutch physician, declared that without opium he could not practice. The celebrated chemist and physician Van Helmont, about 1640, used it so frequently that he was called Doctor Opiatus, and Sydenham about 1680 writes that "among the remedies which it has pleased Almighty God to give to man to relieve his sufferings, none is so universal and so efficacious as opium."

THE FOUR OFFICIAL CAPITALS.

No better illustration of the widely beneficent properties of opium and at the same time of the hopeless muddle of superstition, kakopharmacy and polypharmacy pervading the older materia medica and therapeutics, can be given than by a brief description of the four remedies which are sometimes known as the four official capitals, of which Wootton,⁴ in his "Chronicles of Pharmacy," says, "There were writers who ventured to criticize some of the details of composition, or some of the uses made of these compounds, but the possibility of medicine existing without them was hardly contemplated previous to the eighteenth century." These four standbys or panaceas were the *mithridatium*, *theriaca*, *philonium*, and *diascordium*.

Mithridatium was a confection which derived its name from Mithridates VI or the Great, king of Pontus in Asia Minor, born about the year 134 B. C., who was one of the most troublesome foes the Roman Republic had to deal with. He was finally defeated by Pompey. This personage is said to have been a student of poisons, and was accredited with having invented or concocted an alexipharmac or antidote as a protection against them, which was named mithridatium after him. The legend goes to say that when conquered by the Romans, to escape capture he poisoned his wife and daughters and then took poison himself; but according to the story he had so successfully immunized his body to all sorts of poisons that his efforts at suicide proved unsuccessful and he had to call on one of his soldiers to dispatch him. Hence, the origin of the term "mithridatism" or immunization against the effects of a poison through gradual administration of small doses of it. As the king of Pontus was accredited with having possessed especial skill in the production of medicines, his conqueror, Pompey, took care to ransack his medical writings and secure whatever he could. Thus, whether from Mithridates or not, a panacea bearing his name found its way into Roman literature and became very popular. Various modifications of it were later made, the most important of which was the so-called theriaca.

Theriaca was invented by Andromachus, the physician of Emperor Nero, and was devised as an improvement on mithridatium, which until then was the great antidote of Roman pharmacy. The most important difference between the two was the addition of vipers. The word "theriaca" comes from the Greek *θηρίον*, wild beast, or serpent, and has reference to its use as an

⁴ Wootton: Chronicles of Pharmacy, 1910.

* From the *Journal of the American Medical Association*.

¹ This sketch is intended to be an introduction to a pharmacologic study of some opium alkaloids carried on by the author and endorsed by a grant from the Council on Pharmacy of the American Medical Association.

² In the preparation of this manuscript the following authorities have been frequently consulted: Geissler and Möller: *Real Encyclopädie der Gesamten Pharmacie*, Leipzig, 1886-1891. Flickiger and Hanbury: *Pharmacographia or History of Drugs*, 1874. Rice: *New Remedies*, 1876, p. 229. Jones, John: *The Mysteries of Opium Revealed*, London, 1701. Guareschi: *Einführung in das Studium der Alkaloide*, Berlin, 1896. Thompson, C. J. S.: *The Mystery and Romance of Alchemy and Pharmacy*, 1892. Jeffreys and Maxwell: *Diseases of China*, 1906.

antidote against snake bites. According to Galen, the virtues of this panacea were the following:

"It resists poison and venomous bites, cures inveterate headache, vertigo, deafness, epilepsy, apoplexy, dimness of sight, loss of voice, asthma, coughs of all kinds, spitting of blood, tightness of breath, colic, the iliac poison, jaundice, hardness of the spleen, stone, urinary complaints, fevers, dropsies, leprosy, the troubles to which women are subject, melancholy, and all pestilences."

Though all this may seem a huge joke, all these virtues were accepted down to the seventeenth century, and many learned treatises were written on the subject. For some centuries various cities, such as Constantinople, Cairo, Genoa, and Venice, gained the enviable reputation of manufacturing the most efficient theriaca. Later Venice overshadowed them all; and the Venice theriaca, or as the word became corrupted, Venice *treacle*, was for a long time famous, and is found in the London Pharmacopeia as late as 1745. Our present word "treacle" is derived from this confection; in earlier English works, however, treacle signified much more than molasses, and was used metaphorically for the divinest blessings.

I am now going to quote the ingredients of theriaca, as given by Galen, first to illustrate the curious conglomeration of an enormous number of useless drugs, and secondly to point to the presence in it of opium, to which probably a great part of its virtues was due. The ingredients of this, as well as of mithridatium, were given in Greek verse, in order that they might be better remembered.

ELECTUARIUM THERIACALE MAGNUM.

"Root of Florentine iris, licorice, 12 ounces each; of Arabian costus, Pontic rhubarb, cinquefoil, 6 ounces each; of Ligusticum meum, rhubarb, gentian, 4 ounces each; of birthwort, 2 ounces; herb of scordium, 12 ounces; of lemon grass, horehound, dittany of Crete, calamint, 6 ounces each; of pennyroyal, ground pine, germander, 4 ounces each; leaves of laurus cassia, 4 ounces; flowers of red roses, 12 ounces; of lavender, 6 ounces; of St. John's wort, 4 ounces; of lesser centaury, 2 ounces; saffron, 2 ounces; fruit of amyris opobalsamum, 4 ounces; cinnamon, 12 ounces; cassia lignea and spikenard, 6 ounces each; Celtic nard, 4 ounces; long pepper, 24 ounces; black pepper and ginger, 6 ounces; each; cardamoms, 4 ounces; rape seeds, agaric, 12 ounces each; seeds of Macedonian parsley, 6 ounces; of anise, fennel, cress, seseli, thlaspi, amomum, sandwort, 4 ounces each; of carrot, 2 ounces; *opium*, 24 ounces; opobalsamum, 12 ounces; myrrh, olibanum, turpentine, 6 ounces each; storax, gum arabic, sagapenum, 4 ounces each; asphaltum, opoponax, galbanum, 2 ounces each; juice of acacia and of hypocist, 4 ounces each; castor, 2 ounces; Lemnian bole, calcined vitriol, 4 ounces each; trochises of squill, 48 ounces; of vipers, of sweet flag, 24 ounces each.

"Triturate the balsams, resins and gums in a sufficient quantity of wine to form a thin paste, and incorporate the whole with 960 ounces of honey."

Philonium was another famous antidote, invented by Philon of Tarsus, who is supposed to have lived in the early part of the first century of the present era. It is conjectured from an obscure passage in Pliny that this antidote was prescribed against an epidemic of colic or dysentery which occurred in Rome in Philon's time. Philonium was the original of the confection of opium which remained in the English pharmacopeias until 1867. In the Pharmacopeia Londinensis of 1746, the ingredients of philonium are given as follows: white pepper, ginger, caraway seeds; strained opium, and syrup of poppies, the proportion of opium being 1 grain in 36 grains of the confection.

Diascordium, the last of the four official capitals, was a medicinal compilation by Hieronymus Frascatorius, a famous physician and poet of Vernon in the early part of the sixteenth century, and is given in his book "De Contagio et Morbis Contagiosis." It was originally devised as a preventive of the plague. In the eighteenth century it became a popular household opiate and was frequently given to children for soothing purposes. The original formula, which was adopted in the first London Pharmacopeia in its integrity, mentioned among its principal ingredients cinnamon, cassia wood, scordium, dittany, galbanum, storax, gum arabic, *opium*, sorrel, gentian, Armenian bole, Lemnian earth, pepper, ginger, and honey. Later some of the ingredients were dropped, and the Edinburgh Pharmacopeia made it more astringent by adding catechu and kino. The mangled remains of this famous panacea are represented by the British and U. S. P. Pulvis Catechu Compositus, and Pulvis Kino Compositus.

LATER USES OF OPIUM.

The compound powders of catechu and kino just mentioned are not the only relics of ancient opium compounds remaining in the British and our own pharmacopeias. The commonest pharmaceutical preparations of opium still in use are of antique extraction, and it

may be of interest to devote a few words to them at this place.

Our tincture of opium or laudanum dates from Paracelsus (1490-1541). Paracelsus probably applied the name "laudanum" to several medicines, all of which contained opium. This one historian describes a *pill mass* which he designated as laudanum of Paracelsus, and which consisted of one fourth of its weight opium, to which were added henbane juice, mummy, salts of pearls and corals, bone of the heart of a stag, bezoar stone, amber, musk, and essential oils.

Another laudanum, known as anodynum specificum of Paracelsus, was obtained by digesting opium, with orange and lemon juice, frog's sperm water, cinnamon, cloves, ambergris, and saffron. So much for the more ancient laudanum. The laudanum of the early London pharmacopeias was a pill mass, made of a mixture of opium, wine, saffron, castor, diambrae, ambergris, musk, and oil of nutmeg. The principal liquid preparation of opium used in England a little later was the so-called Sydenham's laudanum. The formula was given by Sydenham in his work on dysentery in 1669-1672, and called for the following ingredients: strained opium, saffron, cinnamon, clover, and canary wine. About the same time, that is, at the end of the seventeenth century, another preparation known as Rousseau's laudanum was much in vogue on the Continent. This differed from the other laudanum in being a fermented compound, and was named after a Capuchin monk by the name of Rousseau. This holy man was sent from Rome to Paris to learn medicine preparatory to mission work in Asia, but became enamored with the subject and settled in Paris to practice the art of healing. He became a favorite with Colbert, the minister of Louis XIV; rooms and laboratory were provided for him in the Louvre, and Louis ordered the Faculty of Medicine to give him a degree.

The name "laudanum," attributed to Paracelsus, is supposed to be derived from the Latin "*laudandum*," "something to be praised." According to some philologists it is related to gum labdanum or ladanum, from which a stomachic cordial was prepared in the middle ages. Others regard it as an abbreviation of the two words *laudatum opium*. Still others endeavor to find in it a corruption of the word *anodynum* with the article prefix, that is, *lanodynum*, or the anodyne, and some latter-day punsters humorously refer to it in bad Latin *Lauda non!* "do not praise," which conveys more truth than poetry.

In the early part of the eighteenth century another celebrated opiate was the so-called "black drop." Its inventor was one Edward Runstall of Auckland, and it was also known as Lancaster or Quaker's black drop. A formula for its preparation was as follows: Opium, $\frac{1}{2}$ pound; verjuice, 4 pints; nutmegs, $1\frac{1}{2}$ ounces; saffron, $\frac{1}{2}$ ounce. Boil, add two spoonfuls of yeast, and set in a warm place for six to eight weeks; then decant, filter, and put in bottles. This preparation was three times as strong as laudanum, and is the forebear of the English Acetum Opii.

Our other familiar friend and popular household anodyne, paregoric, originated with the elixir asthmaticum of Le Mort, professor of chemistry at the University of Leyden from 1702 to 1718. A modification of Le Mort's formula given in the London Pharmacopeia of 1721 was as follows: honey and licorice root, of each, 4 ounces; flowers of benjamin and opium, of each, 1 drachm; camphor, 2 scruples; oil of aniseed, $\frac{1}{2}$ drachm; salt of tartar, 1 ounce; spirit of wine, 2 pounds. In the London Pharmacopeia of 1746, the name of it was changed to Elixir Paregoricum. In that of 1888 the official name became Tinctura Oil Camphorata. This preparation was also known as Tinctura Camphorae Co., and in the German Pharmacopeia as Tincture Opii Benzoica. The word "Paregoric" comes from the Greek *παρηγορεύς*, which means "soothing" or "consoling."

Our official opium pills, or Pilulae Opii, are not a modern product, but are descended from the old English Pilulae Saponis Company, or Pilulae Saponaceae, which in their turn are an adaptation of the long famous nostrum known as Matthew's Pills or Starkey's Pills. Starkey was a physician who invented them, and Matthew was a vender who sold them. The pills consisted of opium, soap of tartar, and a number of other trivial ingredients.

No account of the history of our opiates can be said to be complete without a reference to Dover's powder, and its originator, the adventurer and knight errant of English medicine, Thomas Dover. I shall not dwell long on the life of this interesting individual, especially as an account of him by Osler⁵ has already been published. Born at Barton on the Heath in Warwickshire in 1660, he studied medicine, and in his youth lived at the house of the famous Thomas Sydenham. Many have probably read of how he later joined a privateering party, and led a life of adventure, roam-

ing around the world; how the ship in which he was sailing rescued Alexander Selkirk, the man who lived alone on an island for over four years and who became the prototype of the famous Robinson Crusoe. When he returned to London and settled down to practice, Dover wrote his "Ancient Physician's Legacy to His Country." In this work, in the chapter on gout, he gives the recipe for his "diaphoretic powder" in the following words:

"Take opium, 1 ounce; saltpeter and tartar vitriolated, each 4 ounces; liquorice, 1 ounce; ipecacuanha, 1 ounce. Put the saltpeter and tartar into a red hot mortar, stirring till they have done flaming. Then powder very fine. After that, slice in your opium; grind to a powder and mix. Dose, from 40 to 60 or 70 grains in a glass of white wine posset, going to bed, covering up warm, and drinking a quart or three pints of the posset while sweating. In two or three hours at furthest the patient will be free from pain."

This will suffice for the commoner opium preparations.

THE ALKALOIDS.

Let us now turn from this region of pharmaceutical romance, superstition and mysticism, to some of the achievements that characterize the pharmacy of the nineteenth century, and which mark the beginning of rational therapeutics.

As is well known, throughout the middle ages it was the great ideal of all chemists, or rather alchemists and pharmacists, to search after essences, or quintessences of things, after the philosopher's stone, the elixir of life, etc., and it is natural to find that of all popular drugs opium should be the one especially tortured to give up its essence. Therefore the various laudanums and extracts of opium, and preparations known as magisteria opii, were products of activity exerted in that direction.

Toward the end of the eighteenth century it was a universal belief that plants could elaborate products of only an acid or neutral nature, and that alkalies were substances of a very different character, related more to the metals and exhibiting metallic properties. It was not until the beginning of the nineteenth century, with the discovery of the alkaloids, that this conception was shattered, and it is significant that the first alkaloid to be discovered was the chief active principle of opium—morphin. The honor of this epoch-making discovery belongs to a German, Friedrich Wilhelm Adam Sertürner. Sertürner was born July 19th, 1783, in Paderborn. He became an apothecary and chemist at Einbeck in Hanover, Germany, where he did his most important work, and moved later to Hameln, where he died, February 20th, 1841.

Sertürner began his investigations of opium in 1803, and published the first report of his studies in 1805, when he announced his discovery in opium of an acid, *Opium-Säure*, which he later named "meconic acid," and which he explained was combined with an alkaline base which he called morphium. In a second communication, in 1816, he gave a detailed account of his work, and described the chemical as well as the pharmacologic properties of morphin, which he tested out on himself, and came near losing his life.

"I flatter myself," he wrote, "that chemists and physicians will find that my observations have explained to a considerable extent the constitution of opium, and that I have enriched chemistry with a new acid (meconic) and with a new alkaline base (morphium), a remarkable substance which shows much analogy with ammonia." Sertürner's discovery excited so much interest, and its importance was regarded as so great, that in 1831 the Institute of France awarded to him a prize of 2,000 francs "for having opened the way to important medical discoveries."

Next in importance to morphin in point of quantity, the opium alkaloid narcotin was discovered really before morphin, in 1803, by the French pharmacist Derosne, who obtained crystals of what proved to be narcotin while diluting a sirupy aqueous extract of opium. These crystals became known as *sel d'opium* of Derosne. The basic or alkaloidal character of the body, however, was not established until 1817 by Robiquet, another pioneer in alkaloidal chemistry. The same Robiquet was the discoverer of the next very important opium alkaloid named codein, in 1832. The discoverer of the next opium alkaloid was another illustrious chemist, Joseph Pelletier, whose name is familiar to us from the active principle of male fern, pelletierin. Pelletier was born in Paris in 1788, and died there in 1842. A son of an apothecary, he was from his earliest days engaged in chemical and pharmaceutical studies, and later became a director of the school of pharmacy in Paris. He was the first to isolate a large number of alkaloids. In 1832 he discovered the opium alkaloids narcein and oxymorphin, and in 1835, with Thibouméry, another alkaloid, thebain.

⁵ Dover, Thomas, M.B.: The ancient Physician's Legacy to His Country, London, 1762.

⁶ Osler, W.: Bull. Johns Hopkins Hosp., 1896, vii, 1.

Pelletier was also the discoverer of strychnin, and together with Caventou, of brucin, quinin, and chinchonin, together with Magendie of the at present interesting emetin, together with Corriol of aricin, together with Thiboumery of pseudomorphin, together with Couerbe of picrotoxin, and together with Pelleton of berberin. Since his time opium has become a nidus for a large number of alkaloids, and promises to yield a few more. Up to the present, according to Winterstein and Trier,* opium has yielded besides protein bodies, sugar, gum, resin, salts, and organic acids, twenty-two different alkaloids of which the following is a list: morphin by Sertürner in 1804; narcotin by Robriquet in 1817; codein by Robriquet and narcein by Pelletier in 1832; thebain and pseudomorphin by Pelletier and Thiboumery in 1835; papaverin by Merck in 1848; cryptopin in 1857; gnoscopin in 1878 and xanthalin in 1893 by T. and H. Smith; codamin, laudanin, meconidin, and lanthopin by Hesse in 1870; laudamosin and hydrocotarnin in 1871, and protopin in 1872, also by the same investigator; oxynarcotin, by Beckett and Wright in 1875; tritopin by Kander in 1890; laudanidin by Hesse in 1894; and last, pseudopapaverin and papaveramin by the same man in 1903.

Besides the primary opium alkaloids, a large number of derivatives of them have been made, which we need not enumerate here. Let me but mention apomorphin, apocodein, heroin, dionin, and peronin.

All these chemical individuals have been analyzed, their empiric formulas established, and an attempt, at least in case of some of them, has been more or less successfully made to determine their structure. Along with this chemical work, which forms one of the most brilliant chapters of modern chemistry, a great deal, though by no means complete or sufficient, physiologic and pharmacologic work has been done with them.

Only within the last few years, the work of Straub, Faust, Bürgi, Sahli, and others has marked a still further step in our knowledge of their therapeutic properties. These authors have shown that not only have the various opium alkaloids individually definite pharmacologic actions, but that also still other effects can be produced by combining them with each other.

Thus, if we trace the history of opium from its earliest beginnings to the brilliant researches of recent years, if we but compare the analytic and synthetic, chemical, physiologic, and pharmacologic studies of the same old drug with the fantastic and puerile effusions on the subject of our medical predecessors, we cannot help being impressed with the long strides forward which medicine has made; yet, on the other hand, our very recent studies on opium and its alkaloids serve but to emphasize the more our meager knowledge of the subject and the still greater task before us.

Coal Substitutes*

Use of Chalk Fuel and Peat Proposed in England;

If coal remain at a prohibitive price it cannot be expected that, after their present contracts have run out, the suppliers of gas and electricity will continue to let us have these essentials at the old price. Already, in certain industries, it is being found cheaper to use some other source of power than coal, and this is a tendency that will increase as long as the price of coal is rising and that of gas and electricity remains stationary. It is a tendency, however, deserving of every encouragement, for the consumption of coal in small quantities is often a wasteful proceeding, and we ought as a nation to do everything we can to economize fuel, so as to have no shortage when the time of great industrial expansion arrives after the war.

It was stated some months ago—before the war—that “the internal combustion engine is the power agent of the future, and it will be a problem of no mean dimensions to provide the very large supplies of fuel which we must have if we are to hold our own in the world’s markets.” The reference was largely to liquid fuels, but we have to consider also the internal combustion engine which derives its energy not only from petroleum, its allied products, or even from alcohol, but from producer-gas. In this latter case anthracite has been a necessity heretofore.

Some recent experiments would seem to suggest that there may be available in this country suitable substitutes not only for anthracite in gas-producers, but also for coal generally, even for domestic purposes.

One of these substitutes consists of a mixture of chalk, rough small refuse coal, and solidified tar, in the proportions, respectively, of about 60, 30, and 10 per cent, the mixture being compressed into ovoids or pieces about the size of a large plum. This chalk-fuel, as it may be termed, burns freely, when once combustion is started, in an open grate or under a boiler, and is quite smokeless.

* The London Daily Telegraph.

* Winterstein and Trier: Die Alkaloide, Berlin, 1910.

The idea of using crude chalk in the grate alongside with coal is not a new one, and it is often claimed that economy of coal results in this way, which is quite possible seeing that chemical action proceeds when chalk is heated, this chalk giving up some of its oxygen to form carbon-monoxide, and lime being left behind as ash. But the addition of the above-mentioned carbonaceous substances to the chalk naturally increases both its heating value and freedom of combustion, and the resulting chalk-fuel is expected to be a useful fuel in the future, especially as destructor refuse can be worked in as one of the materials composing the compressed ovoid. This is a valuable feature, as many towns spend as much as 10s. per ton to get rid of their refuse.

The materials required are so cheap that it would seem to be possible to produce this fuel at about half the normal price of coal, at any rate on the South Coast, where chalk is plentiful and coal expensive.

From an engineering point of view, the experiments in power production that have been made on a gas-producer plant are instructive. This particular plant ran two gas engines of 90 brake horse-power each, and supplied gas (equivalent to 10 horse-power) to lacquering ovens. Using bituminous coal, the fuel consumption was 23 hundredweight per twelve hour day, as compared with 17 hundredweight of chalk-fuel for the same period. As might be imagined, the gas from the latter was much cleaner than that produced from anthracite or coke. The lower fuel consumption meant that stoking was not so frequent, and consequently a saving of labor could be effected; further, there was no clinking.

An interesting point in the running of the engines was that much more air could be admitted to the mixing chamber than was the case with ordinary gas; in fact, the air-valve could be worked fully open. This rather bears out the assumption that an unusual amount of carbon monoxide gas was formed (from the disintegrating chalk, which afterward falls to the bottom of the producer as lime), and this would, of course, need an extra amount of air for efficient combustion, and would explain why less fuel was required to give the same amount of power. The flames arising from the gas when burnt in the lacquering ovens were also very hot, as they would be from a gas rich in carbon monoxide. The latter gas, it was shown by analysis, was present to the extent of 18 per cent, other constituents being carbon dioxide, 10 per cent; hydrogen, 7 per cent; marsh gas, 4 per cent; and nitrogen, 61 per cent.

The fuel itself, when analyzed, was found to consist of fixed carbon, 28.45 per cent; volatile matter (including water), 26.95 per cent; and ash, 44.6 per cent. It should be possible to use it in locomotives, and, as there is also the prospect of the use of gas-producers on ship-board for driving internal combustion engines, we may yet see the chalk cliffs of old England becoming a diminishing quantity in order that England’s ships may put out to sea.

A second substitute for coal in this country is peat, of which there are vast quantities in Ireland, Wales, Scotland, and also in many parts of England.

A great amount of work has been done in the direction of employing peat as a fuel, especially in Canada and the United States, where peat fuel is in regular use in place of coal, and it has been shown that, besides being useful for domestic purposes, peat can be used under boilers or in gas-producers. Peat dust formed into briquettes with 5 per cent of coal dust has been successfully used in locomotives drawing trains weighing from 218 to 260 tons, the consumption of peat fuel being just twice as great as was the case when coal alone was used.

That the use of peat for driving gas engines is not now a mere experiment is clear from the success of the recently established Weismoor electric generating station in East Friesland, where the total supply per annum of energy for lighting and power is now almost 10,000,000 kilowatt-hours, all derived from peat-consuming gas-producers.

A smaller but similar British plant has been found to give very much more satisfactory results with peat than with coal after the separation of tar from the gas had been effected by means of an ample water spray for cooling and washing the gases, the tar being thrown out by a centrifugal tar extractor. The plant can be run for three weeks without cleaning, and the saving in cost between running the factory on coal and on peat amounts, when peat is employed, to over £15 per week.

The Canadian Department of Mines has had a series of peat-fuel tests made on a Körting gas engine at the Ottawa Fuel Testing Station, which show that the fuel consumption per brake horse-power hour—including stand-by losses—is for full load, 1.7 pound of peat, or 2.3 pounds of peat containing 25 per cent moisture; for three quarter load the corresponding figures are 2.1 pounds and 2.8 pounds. Assuming that peat can be delivered to the plant at 8s. 6d. per ton, and that the

plant be run with a power factor of 75 per cent for 3,000 hours, the fuel costs would be 36s. per brake horse-power year, including stand-by losses.

Peat fuel is expected to have a big future, not only in this country, but in Canada, Russia, and other countries possessing large peat deposits. Russia alone has more peat than all the other countries of the world, and it has been calculated that its average selling price in Russia should be about 9s. 6d. per ton. There would thus appear to be a useful opening for British engineers to develop a new branch of industry—the supply of the necessary gas engines and gas-producers for use with peat fuel.

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