

Paracelsus and His Contributions to Anesthesia

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*Marvelous virtues are inherent in the remedies*¹

AUREOLUS Theophrastus Bombast von Hohenheim was born in 1493 in Einsiedeln, Switzerland. He later called himself Paracelsus, probably deriving this name from a translation of his surname. His father, Wilhelm Bombast von Hohenheim was a German physician who practiced in Einsiedeln until 1502 at which time the family moved to Villach, a mining town in Carinthia (Austria). There Paracelsus may have received early instruction in the chemistry (or alchemy) practiced in the smelting works in that city. No record of any formal medical education of Paracelsus is available. Later, his enemies accused him of being an imposter without a medical doctor's degree. Many historians believe, however, that he completed a formal medical education.² In 1526, after many years of extensive travel throughout Europe, he appeared in Strasbourg, where he was accepted in the Luzerne, a guild of millers, grain dealers and surgeons. The city fathers listed him as a doctor of medicine, presumably on adequate evidence. In the same year, a better offer brought him to Basel with an appointment as professor in the University and as municipal physician. His unorthodox teaching, his strong attacks on classic medical beliefs, and his irritating habits made him many enemies, with the result that he was forced to leave Basel after two years. He resumed his travels, never staying anywhere for more than a year or two, and ended his restless life in Salzburg in 1541.

Paracelsus lived during the beginning of the Renaissance, at a time when many established concepts and attitudes were being challenged

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by thoughtful, bold and reckless men. It was the time of Columbus and Martin Luther, of Leonardo Da Vinci, Mathias Grünewald and Erasmus von Rotterdam, of Copernicus and Vesalius, and of Aureolus Theophrastus Bombast von Hohenheim.

Paracelsus was, during his lifetime and even into the twentieth century, a subject of controversy: he received the adulation of some, and was vilified by others. He was sufficiently angered by his many critics to write in "Seven Defensiones,"³ a "reply to certain calumniation of his enemies," which give us many intimate glimpses of his person and character. In these writings he said:⁴ "It is necessary that I answer for my journeyings and for the fact that I am resident nowhere. . . . The journeys which I have thus far made have profited me much, for the reason that no man's master is in his home and none has his teacher in the chimney-corner. Thus the arts are not all confined within one's fatherland, but they are distributed over the whole world . . . he who goes hither and thither makes the acquaintance of many people, experiences all kinds of behaviour and customs that another would eat his hat and shoes to see. . . . Does not a lover go far to see a beautiful woman? How much further for a beautiful art?"

He was deeply devoted to his beautiful art and made many new observations on disease and advocated new and potent remedies. He was often exasperated because the representatives of medicine questioned not only the value of his contributions, but also his right to challenge time-honored concepts. Paracelsus pleaded for tolerance toward the new and for willingness at least to consider the rejection of the old, and acceptance of the new. He wrote:⁵ "Of what avail is the rain that fell a thousand years ago? That which falls at present avails . . . since care walks alone and every day has xii hours, and every hour

its separate action, what harm then does the twelfth hour do to the first, or of what disadvantage to the first is the twelfth? . . . the sky has a different action every day, changes daily its constitution. The reason is, it too is growing older."

He was not only disappointed in the medical authorities and their lack of understanding but also by the ethics of the "false physicians" and their medical practice. Thus he said: ⁶ "Christ, however, had twelve disciples and one of them was a traitor, how much more credible is it among men that of twelve scarcely one is good? The reason is that while we should do all things for love, yet nothing is done for love but only for the sake of squaring and payment, from which comes selfish gain. . . . Now when a thing has selfish gain for its aim, the arts are falsified, and the work too; for art and craft must come from love, else there is no perfection. . . . I for my part am ashamed of medicine, seeing to what utter deceit it has come . . . it has become a doctoral custom—where scripture sanctions it as right, I know not—that a visit should cost a gulden although it be not earned; and that there be fixed fees for the inspection of urine and other things. . . ."

These are strong statements and sometimes in a rough language. They were recognized as such by Paracelsus who stated in the sixth Defence: ⁷

"Not enough to attack me in various articles, but I am said to be a strange fellow with an uncivil answer, I do not wash up to the satisfaction of everyone, I do not answer everyone's contention in humility. This they consider and deem a great vice in me. . . . I am by nature not subtly spun. . . . Thus it is with me too: what I think is silk, the others call ticking and coarse cloth."

"But pay heed further how I justify myself in this accusation that I give a rough answer. The other physicians know little of the arts; they resort to friendly, pleasing, charming words; they advise people with breeding and fine words; they set forth all things at length, delightfully, with distinct differentiations, and say: Come again soon, my dear sir; my dear wife, go and accompany the gentleman, etc. I say thus: What wilt thou? I have no time now; it is not so urgent . . . it is not neces-

sary to use such flattery and to deal tenderly with every boor who is not fit to be carried in a dung-barrow."

Both Paracelsus and Valerius Cordus (1515–1544) have been credited with the discovery of ether. Neither man ever claimed fame or priority in this matter and the occasionally lively controversy on this point has occurred only among historians.

There is today little question that Valerius Cordus knew of ether. He gave detailed instructions on the distillation of equal amounts of a very strong wine and the sour oil of vitriol or, in other words, alcohol and sulphuric acid. Robinson ⁸ followed these instructions carefully and obtained a mixture of diethyl ether and diethyl sulphate which resembled the "sweet oil of vitriol" described by Valerius Cordus. On the basis of this finding, we may accept Valerius Cordus as having been successful in obtaining ether, if not in a pure form.

The account by Paracelsus which is believed to deal with ether was probably written around 1525,⁹ at a time when Valerius Cordus was still a boy. It is therefore conceivable, but not likely, that Paracelsus stimulated Valerius Cordus to study sweet oil of vitriol. It is, on the other hand, quite impossible for Paracelsus to have been stimulated by Valerius Cordus (as has been suggested).

There is, unfortunately, no detailed description of the distillation of ether in the writings of Paracelsus, but there are two passages which require attention.

Here it may be necessary to digress. The method of the distillation of alcohol and vitriol affects the composition of the distillate. This was well recognized by pharmacists who followed such prescriptions well into the last century. Thus, a reasonably pure ether can be obtained by starting out with pure alcohol and pure sulphuric acid. Neither was available in 1526. Paracelsus and Valerius Cordus had to start with a strong wine. By distillation of this wine, an ardent spirit (brandy, rum, gin, whiskey, etc.) is obtained. This ardent spirit in turn can be rectified, that is, the ardent spirit can be deprived of its volatile oils and water by repeated distillations. In the process of rectification, so-called fusel oils are eliminated, which have an unpleasant odor and, when ignited, burn with a bluish flame.

The rectified spirit can be mixed with sulphuric acid and distilled. What remains is ethereal oil; the distillate containing among other things, ether. Depending on the ingredients, the duration of distillation, and the temperature many different end products can be obtained. An example is Hoffmann's anodyne, a mixture, described long after Paracelsus' days, of rectified spirit, ethereal oil and ether.

This explanation is offered because Paracelsus, in a book entitled "The Diseases Which Deprive Man of His Reason,"¹⁰ discusses these things as if his readers were polished alchemists. He wrote:

"One instruction I shall have to give you first of all: when ignorant and uncomprehending people intrude into an art, they spoil the whole thing and make a manure heap out of a well, as has been done with vitriol. At first people seized upon the spirit of vitriol and valued it as highly as possible. When that had been done, they cured falling-sickness in old and young, in men and women, in all kinds of people; but now the ignorant chemists have appeared and want to improve it. They dared to force vitriol and its virtues into another direction; they let the arcanum * boil over so that it evanesced; they searched for the oil in colcothar † when oil has nothing to do with it. For everything that is to remove epilepsy should have a sharp, fine, penetrating spirit, and then it has the power to penetrate the body and to cleanse everything. . . . In my opinion the oil which is sought by the chemists does not contain a penetrating spirit, but is earthly and goes no further than where it falls. Therefore wherever such foolishness has spread, stupidity has suppressed the right procedure and put the wrong one in its place. But no good has come from this, because it has not benefited the invalids. . . ."

"Now let me tell you how the *spiritus vitrioli* was found for the first time. It happened in the following way: after having separated the humid spirit from the colcothar, men distilled, graded, and circulated it as highly as

one can through this process. The water thus obtained can be used for various diseases, both externally and internally, and therefore also in falling-sickness. Patients felt signs of recovery. Therefore, men took still greater pains with the extraction, taking out the very best *spiritus vitrioli* and distilling it from colcothar in the hottest fire. The dry and humid spirits were both in it. They were extracted gradually. Then both spirits, the humid and the dry—which had been in one phial—were graded to a level. Then they gave this medicine to patients and found its effects even better than the first extract; they had such good results that all humoralists were put to shame. A correction was made by several masters by the addition of brandy in order to empower it still more, but the result was not found to be better."

"This is my procedure: the vitriol is imbued with *spiritus vini*, then distilled as I have described above, for the dry and humid *spiritus*. I find that when this has been done, if *spiritus tartari correcti* is added in the proportion of one third to the vitriol, and also a fifth of *spiritum aquae theriacalis camphorate* to the vitriolic spirits, the result is excellent. This should be given to the patient before the attack, or several times a day. You should know that there is great power in such medicine against this disease, so great indeed that if I had one free wish, I could wish for nothing better in nature. . . . Such vitriolic extractions of the arcanum are not only good in falling-sickness, but also in its varieties, such as in syncope, ecstasy, etc., . . ."

"Physicians could find still other virtues in vitriol, apart from those I indicate, if they were really zealous. You should also know that the prescriptions, in which I have primarily described how to prepare the humid *spiritus vitrioli*, cannot be written more clearly; . . ."

I believe that in these passages the evidence for preparation of ether is good. His prescription of imbuing vitriol with *spiritus vini*, that is adding alcohol to sulphuric acid and then distilling it, is very similar to the method of Valerius Cordus and should yield ether.¹²

Furthermore, Paracelsus speaks of a dry and a humid *spiritus*. This once again may refer to the qualities of ether which to the touch

* The effective principle in a remedy.

† Here believed to refer to a brownish residue obtained when a strong wine and vitriol are distilled.¹¹ Colcothar was used by Paracelsus externally for wounds and various skin diseases.

appear dry, and to the qualities of water, diethyl sulphate or ethereal oils which in comparison feel wet or oily. Another description of this dry spiritus of vitriol as pointing toward ether is his statement that this arcanum (which can effervesce) should have a sharp, fine and penetrating spirit. This again suggests to me diethyl ether, above all other drugs. Paracelsus states in these passages that the residue, that is the oil which is sought by some chemists, does not contain the penetrating spirit and that the spirit is in the distillate rather than in the residue. I also believe it significant that Paracelsus says "a correction was made by several masters by the addition of brandy in order to empower it still more, but the result was not found to be better." It may be that long before Hoffmann, someone attempted to make Hoffmann's anodyne.

This spirit of vitriol was given, for instance, in falling-sickness. If we are correct in assuming that it contained ether, we may reflect here that several hundred years later ether was again introduced in the treatment of status epilepticus.

While Paracelsus was at times carried away by his enthusiasm, we may assume that he was dealing with a potent remedy when he says that: "there is great power in such medicine against this disease (epilepsy), so great indeed that if I had one free wish, I could wish for nothing better in nature." Ether is such a potent medicine. Paracelsus' enthusiasts are at liberty to read a prophesy on anesthesia into his statement on zealous physicians—who could find still other virtues in vitriol.

While these passages suggest that Paracelsus was dealing with ether, they also suggest that he was not the only one nor the first to distil mixtures of wine and vitriol: ^{13, 14} apparently he was not the only one to treat patients with the "spirit of vitriol." One passage particularly indicates that he may not have been the first to obtain the *spiritus vitrioli* because he said that *men* distilled, graded and circulated and took still greater pains with the extraction and that *they* gave this medicine to patients. I assume that he would have used the first person singular if these experiments and procedures had originated with him.

Another passage which has been widely

quoted as the first report on animal experimentation with ether and which appears in many textbooks on pharmacology, reads as follows: ¹⁵ "I shall, however, give you a short general rule that all sulphurs from vitriols and salts are *stupefacientia, narcotica, anodina, somnifera*, but of such quality that the somniferous effect is brought about in a mild and easy way and removed again without any bad effects. There is no opiate effect as in *hyosciamo, papavere, mandragora*, but it works mildly and well, without any infection. I have personally prepared and corrected such *somniferum* and *stupefactivum* with such excellent results. And as we, the physicians, know that the *somnifera* do many excellent things, and that the *opiata* contain such poison that they cannot be applied without quintessence, we should all the more rely on and trust in these *somnifera*, because we know of many diseases which cannot be cured without anodynes. God has given us a cure for them through the nature of anodyne."

"As for sulphur, † you should know that of all kinds that of vitriol is most widely known; it is firm. Besides, it is so sweet that chickens eat it and then fall asleep, but wake up again after some time without any bad effect. You should know that this sulphur can cure any illness which is to be cured by anodynes, without any bad after effects. It extinguishes pain and soothes the heat and painful diseases. It is a medicine preferable in every respect; the cure afterwards is *confortativum quinte essentia*. What can you physicians do? These two medicines are better than all those of Apollo, Machaon, and Hippocrates. Remember, you physicians, that this sulphur is *sulphur philosophorum*, because all philosophers have tried to have a long life and good health and to resist illness. This they found in this sulphur; therefore, according to their request, it was called *sulphur philosophorum* and you should know how to grade, separate, and refine it."

Paracelsus refers to it as the *sulphur philosophorum* and not as the *spirit of vitriol* (see above) or *sweet oil of vitriol*. While he may

† Sulphur is used in many different ways by Paracelsus; sometimes referring merely to a combustible substance or principle and at other times to ill-defined chemicals not necessarily related to the element sulphur.

have been inconsistent, I believe that this point does require attention and suggests that he was referring not to an ether or a mixture containing ether. While he emphasized that this *sulphur philosophorum* is different from opiates or belladonna drugs, two other points make it unlikely that he could have been writing of ether:

(1) He stated that this sulphur of vitriol is firm. The German version given by Sudhoff¹⁶ casts some doubt on the translation. It might indeed have been firm (as opposed to liquid), in which case it certainly would not have been ether. It might have been fixed to (or mixed with) something, or it might have been stable: in these two instances it could have been ether.

(2) Another problem arises, however, in that it is stated that a chicken will eat it. The German text is quite explicit and rules out some translations which have appeared, such as chicken will "take" it. It is also impossible to translate it as "chicken will drink it," thus there is much doubt that this passage can refer to ether.

Many writers have tended to ignore these points and have assumed that since Paracelsus called it sweet and since it is a sulphur and that of vitriol, that it dealt with sweet oil of vitriol which Valerius Cordus later described so adequately. I am not sure that we may ignore all the inconsistencies here. But let us assume that Paracelsus had ether or a mixture of ether and other substances and that he decided to test such a substance on chickens.

For such an experiment he had to decide upon the mode of administration. Today, we would give it by inhalation. In Paracelsus' time, the concept that a medicament could be inhaled for its effect was also accepted. Paracelsus was well aware of this from his studies on the lung sickness in miners, where he pointed out that air was drawn into the lung,¹⁷ "And in the same manner as the stomach digests its food, one part being taken for the use of the body, while it excretes the other, thus it must also be understood of the air, of which the one part is also consumed, and the other part is excreted as an excrement. The air must be discussed, and it is entirely to be understood like a food, and as it is possible

that food produces diseases, thus it is also possible for the air to give birth to these things." Thus, the concept that pulmonary disease might be treated by the inhalation of drugs, a concept which eventually smoothed the way for the arrival of inhalation anesthesia, could have been formulated by Paracelsus in his time. This is apt to be true since physicians of his and earlier times had recommended the inhalation of vapors and perfumes for various reasons. However, to test such a drug in chickens by inhalation would have required means of controlling the atmosphere about these animals and would imply that concepts of the composition of gases had been grasped by Paracelsus: for this there is no evidence. It would have required enclosed quarters for the chickens to which the gases were admitted and to my knowledge nothing of this type had ever been attempted.

On the other hand, if he had a liquid which he wished to test, he might have prepared it as a food for his experimental animals. Valerius Cordus, for instance, recommended that his sweet oil of vitriol be taken in wine or on lumps of sugar (anticipating that which Friederich Hoffmann (1660-1742) many years later recommended for his anodyne). Paracelsus, therefore, might have had a similar idea and offered *sulphur philosophorum* to his chickens mixed with some type of food. I tested this possibility by preparing chicken feed with ether, mixtures of diethyl sulphate and ether, with pure diethyl sulphate, and with Hoffmann's anodyne (a mixture of ether, alcohol, and ethereal oils). To eliminate laboratory artifact as much as possible, and to simulate Paracelsus' experimental conditions, I kept 13 white Leghorn hens on a farm, caused them to fast for 24 hours and then offered them the usual chicken feed moistened with these artificial vitriolic mixtures. The chickens were in a run exposed to the air, the temperature 69° F., the sky overcast, the relative humidity 60 per cent, the barometric pressure 30.12 inches, the wind from the east southeast at 7 knots.

The feed was moistened with the agents under study, just barely so. The chicken did not find palatable ether, diethyl sulphate, or the mixtures of diethyl ether and diethyl sulphate. They pecked at it several times, but

shook their heads and soon desisted. Those hens offered chicken feed saturated with Hoffmann's anodyne ate it indeed, even though one doubts that they really found it sweet or very sweet. Nevertheless, they ate enough of the preparation to become unsteady, then settle down for brief respites lasting less than a minute only to rise again for another try at the chicken feed with Hoffmann's anodyne. They could be roused easily from their tranquil moments. On this basis then, it is possible but still far from certain that the hens of the early sixteenth century were offered and ate a mixture which contained ether, perhaps alcohol in addition.

Paracelsus has also been cited as the discoverer of laudanum, now synonymous with tinctures or extracts containing opium.¹⁸ A most scholarly and extensive analysis of the term and of the sense of the word laudanum was published in 1889 by Husemann.¹⁹ The latter reached the conclusion that the term had been used, interchangeably even before Paracelsus, with ladanum which refers to a resin, presumably of a pharmacologically rather inert but aromatic wood. Paracelsus provided no clue that he was dealing with an opiate when he wrote: "I have an arcanum, which I call laudanum; it is powerful over all which will lead to death." In Paracelsus' writings, there are many references to the laudanum, but he did not use it consistently and nowhere can the clear deduction be made that he used it primarily to denote a compound containing opiates, rather than other substances. It was only in later years that tinctures or extracts of opium were called Paracelsus' laudanum which was adopted then in the pharmacopoeias of the times.

Lastly, and least well known, is a reference that Price²⁰ supplies to a paper written by Chaussier²¹ crediting Paracelsus with having introduced mechanical devices for artificial pulmonary ventilation. Paracelsus is said to have inserted the nozzle of a fire-side bellows into the nostrils of an apneic patient and rhythmically inflated the lungs. The bellows used however were fouled by cinders thus vitiating success. It is not certain whether this is legend or fact. I could not find the article of Chaussier quoted by Price nor a passage crediting Paracelsus with such an accomplish-

ment; nor was I able to find, with the help of the Registerband²² [which I searched in the entries relating to breathing, suffocation, blowing, and fire-side bellows], anything in the writing of Paracelsus which would confirm what Chaussier is said to have written about Paracelsus. Over the years, many discoveries have been credited to Paracelsus by his adherents, but in most instances it has not been easy to substitute their claims.

Paracelsus deserves to be remembered by all physicians as a devoted and idealistic healer, a magnificent observer, a bold and imaginative innovator in therapeutics, a colorful personality and a religious mystic. For an additional reason he deserves to be remembered by us in that he recorded the fact, made and smelled and used a dry, sharp, fine and penetrating spirit of vitriol—in which physicians could find still other virtues.

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INTESTINAL MOTILITY To ascertain the relative contribution of premedication, anesthesia, operative trauma, and postmedication on the postoperative behavior of the intestinal tract, effects on the gut were separately studied in dogs in which small bowel loops had been constructed. Small bowel motility was found to be suppressed by operative trauma, atropine, promethazine, ether, and halothane. It was not depressed by other factors commonly utilized in abdominal surgery such as morphine, thiopental, nitrous oxide, tubocurarine, prostigmin, and meperidine. Inhibition of motor activity occurring in response to any individual mechanical stimulus was seen to be transient, lasting a few minutes only. No factor that is part of modern abdominal surgical technique was found to abolish small bowel motility for a protracted period. If the postoperative status of the gut was predicted on the basis of these experimental observations, then the existence of small bowel motility immediately or soon after operation would be anticipated. (*Tinckler, L. F.: Surgery and Intestinal Motility, Brit. J. Surg.* 52: 140 (Feb.) 1965.)

NEUROLEPT ANALGESIA Dehydrobenzperidol and phentanyl appear to be a safe combination for the repair of defects by open heart surgery. Dehydrobenzperidol provides a unique kind of alpha adrenergic block which does not significantly block the alpha effects of norepinephrine on blood pressure. It does not significantly interfere with cardiovascular function except possibly in patients in shock who have an increase in circulating epinephrine. Dehydrobenzperidol has a shorter duration of action and is more potent than chlorpromazine. Clinically, the combination of the two drugs with nitrous oxide-oxygen mixtures for sleep and amnesia appears to provide smooth induction of anesthesia, effective pain control during the anesthesia course, and prompt and uneventful recovery with minimum discomfort. (*Corssen, G., and others: Neurolept Analgesia and Anesthesia for Open-Heart Surgery, J. Thor. Cardio. Surg.* 49: 901 (June) 1965.)