# LOCAL ANÆSTHESIA BY COLD.

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## LOCAL ANÆSTHESIA BY THE ARTIFICIAL PRODUCTION OF COLD

[Read before the Suffolk District Medical Society, April 28th, 1866, and communicated for the Boston Medical and Surgical Journal.]

By CALVIN G. PAGE, M.D.

THE recent renewed interest of the profession in the subject of local anæsthesia by the artificial production of cold, has induced me to think that a brief sketch of the various efforts in times past for producing intense artificial cold would not be uninteresting, in connection with the results of some experiments in which I have been engaged for the purpose of testing the relative merits of various instruments and materials recently devised for that purpose.

The frigorific properties of nitre were undoubtedly known at a remote period by the oriental nations. It was also used in Rome in 1550, for the cooling of various drinks. This method of reducing temperature by the rapid solution of nitre with snow was extended by Boyle, and afterwards more successfully by Fahrenheit; and at the beginning of this century, Walker, of Oxford, and Lowitz, of St. Petersburg, resumed the subject, and produced compound saline powders of intense frigorific power.

The tables of Walker are of great interest, and two or three of his results are worth quoting. For example:—

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| With sea salt, 1 part and snow, 2 parts | the thermometer fell from any temperature to –5° |
| With sea salt, 5 parts<br>Nitrate of ammonia, 5 parts<br>Snow, 12 parts | " " " " –25° |

Freezing mixtures were also made by the rapid solution of salts without the use of snow. For example:—

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| Sulphate of soda, 6 parts<br>Hydrochlorate of ammonia, 4 "<br>Nitrate of potassa, 2 "<br>Diluted nitrous acid, 4 " | reduces temperature from +50° to –10° |
| Phosphate of soda, 9 parts<br>Nitrate of ammonia, 6 "<br>Diluted nitrous acid, 4 " | reduces temperature from +50° to –21° |

Sir John Leslie showed in June, 1810, before the Royal Society, his brilliant experiments for producing artificial congelation by means of exhausting the air in a chamber containing a flat pan of sulphuric acid, over which was placed another dish containing water; in a short time the whole mass became frozen. In 1817 he substituted for the acid porphyritic trap rock in powder, and still later parched oat meal, with a box of which a foot in diameter and rather more than an inch deep, he froze one and a quarter pounds of water.

The following table of extreme low temperatures, artificial and natural, measured by the spirit thermometer, is interesting:—

−135°. The lowest artificial cold yet produced (Faraday).
−121°. Carbonic acid, liquefied by pressure, freezes.
−55°. Lowest atmospheric temperature observed by Parry.
−60°. " " " " " Ross.
−71°. " " " " " Bach.

The possible use of cold for the production of local anæsthesia was first announced by Dr. James Arnott, of England, in November, 1847. More elaborate accounts of his process appeared in the *Lancet* of July 22d and Sept. 9th, 1848. Previous attempts in this direction—for example, the experiments of Mr. Nunnely on inferior animals and man, published June 24, 1848, and experiments by Prof. Simpson, of Edinburgh, on the local application of anæsthetics—show that earnest thought was turned to this subject very soon after general anæsthesia was found possible by ether and chloroform. Dr. Arnott says, in the *Lancet* of Dec. 1st, 1849, that it is two years since he first used cold for local anæsthesia, and more than a year since he assisted in its use for a surgical operation at the General Military Hospital at Chatham.

In 1850, by direction of M. Velpeau, who had seen some recent experiments by Dr. Arnott (in 1849) in the Paris hospitals, Messrs. Berand and Fouchêt were directed to report upon the employment of frigorific mixtures to produce anæsthesia. The report is given in No. 42 of the *Union Médicale* for that year, and the opinion of M. Velpeau on its use may be found in his work on Cancer of the Breast (translation of Marsden, London, 1856). Arnott's undeveloped ideas on this subject may be found as early as his work on "Indigestion," &c., with an account of applying heat or cold in irritative or inflammatory diseases, London, 1847, 8vo., pp. 107.

The first public use of this method of local anæsthesia in our own city, which has come to my knowledge, was on June 13th, 1852, at the Massachusetts General Hospital, by Dr. J. Mason Warren, who operated on a nævus without pain, having first frozen it with a mixture of ice and salt. It was first used here on tissue in a state of acute inflammation, by Dr. Warren, in the winter of 1852–53, for a case of fascial paronychia caused by a dissecting wound; the superficial incision was painless. Since that time almost every surgeon has practically tried its value.

In the month of March last, Dr. R. M. Hodges, of this city, called the attention of the profession to a new method of producing local anæsthesia by the rapid evaporation of ether, devised by Mr. Richardson, of London, and published in the *Medical Times and Gazette* for February, 1866. Dr. Hodges at that time showed a model of an apparatus made after Mr. Richardson's description, and with *kerosolene* produced a greater degree of cold than that given by ether, with complete local insensibility of the part to which it was applied. On the 9th of April, Prof. H. J. Bigelow showed a new agent (since named rhigolene), by which a much greater degree of cold can be produced than by ether or kerosolene.

At the meeting of this Society a month ago, I showed a model of an instrument, made after the plan of Mr. Richardson, except that the tubes were not concentric, but were placed side by side. I also showed the vaporization of ether by my modified form of Bergsen tubes, originally shown and explained Nov. 26, 1865*, and expressed the opinion that a requisite degree of cold for all practical purposes could be produced by the ordinary Bergsen tubes if made in metal, and that my modification of form for atomizing in the mouth would be found to be perfectly adapted for local anæsthesia at all points where local anæsthesia was desired. I narrated a case at that time where it had been used with ether for the extraction of three teeth. I was uncertain then exactly how great a degree of cold could be produced by my instrument. Since then I have been studying the question of temperature, and have compared and registered the results produced by such instruments as I could obtain. I am indebted to the courtesy of Dr. Langmaid for the use of the original Richardson instrument brought by him from London. My first trial of the instruments, side by side, on a common thermometer, is here given:

| | | Ether. | Rhigolene. | Time. |
|---|---|---|---|---|
| April 18, 1866, Central office of Boston Dipensary, | Page's tubes, | −4° | −16° | one minute. |
| | Richardson's, | −4° | −16° | |

It is hardly necessary to give the daily detail of experiments as tabulated, but is sufficient to record that I found that the large bulb thermometers were not so quickly affected in the low temperatures as the small ones, and after April 24th all my results were registered by a standard thermometer. After this date I used an atomizer with smaller tubes and finer cones, which gave, April 27th, by standard thermometer, with rhigolene, −16°; ether, −4°; time, 45″. And on April 28th, at the office of Dr. Bigelow, with rhigolene, both his instrument and my own gave −16° in about one minute.† Practically, then, we have at command a temperature more than sufficiently low and always available.

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* See Boston Medical and Surgical Journal, Feb. 1, 1866. Extracts from Records of Boston Society for Medical Improvement.

† I have found that lower temperatures are produced by both ether and rhigolene when they have been cooled to 32° Fahrenheit, and that the difference between ether and rhigolene is pretty constant on all thermometers, being about 12° in favor of the rhigolene.

It is well known that the temperature of the ordinary freezing mixture of ice and salt is from 0° to –2°. This temperature has been found sufficient for freezing living tissue and destroying local sensibility, but this mixtures requires time for preparation, is sometimes difficult to apply, and is not available in the mouth. Ether (easily reduced to –4°), when vaporized in the mouth, produces irritation and disagreeable disturbance of the mucous membrane. Rhigolene has no such objection; when applied in the mouth it causes no irritation, nor does it produce any of the signs of general anæsthesia, the time taken in applying it being only from five to ten seconds. I have used it successfully in nine cases at the Central Office of the Boston Dispensary on teeth. The gum outside and inside should be slightly frozen, and should the crown of the tooth be found broken, it can be applied directly upon the carious part of the tooth, which may then be extracted without any outcry from the patient. I have also used it in various minor operations at the Dispensary, for Dr. S. L. Sprague, as extracting a fish-hook from the finger, extracting a needle from the hand, opening an abscess on the shoulder, a felon, &c.; and also at my own office for the first time on Sunday, April 15th, for opening a felon, and since then twice for felon and once for abscess, with perfect success.

The result of all my experiments and trials seems to prove that rhigolene is a perfectly successful local anæsthetic, and in the mouth is superior to anything yet used; That ether will do the work on the external surface of the body without difficulty, as it can be brought below the temperature of the ordinary freezing mixture, but requires more time; That the Richardson instrument has no powers not equalled or surpassed by my modification of the Bergsen tubes. It is probable that the ordinary Bergsen tubes, made of smaller tubing and with finer points, will be finally used for local anæsthesia, with such modifications of form as will render them applicable to the mouth and the vagina. The excess of fluid in the tube is best prevented by placing a bit of sponge or wicking in the open end of the fluid-bearing arm of the tube.

Instruments with stop-cocks or cylinders requiring lubrication are not available with rhigolene, which takes up all oily matter in solution and causes leakage—for example, Luer's atomizer. Glass tubes will not answer, glass being a non-conductor.

Dr. Bigelow, in his article on Rhigolene, gives a temperature of –19° as easily produced, but does not give the time necessary to produce it. I doubt if such a low temperature can be produced on a standard thermometer in sixty seconds, the time allowed in most of my experiments, by any instrument yet devised, though it can be if sufficient time is taken. The only objections to rhigolene are that it must be kept very cool and cannot be conveniently carried about in warm weather or in the evening, as it boils at 70°, and is inflammable.

NOTE I.—In addition to the authorities named in the body of the article, gentlemen interested are referred to the following works for more detailed information. These references are to the early efforts to produce artificial cold, and to show its early history as an anæsthetic. It must not be understood that they are intended to be a complete bibliography of the subject. Philosophical Transactions, vol. 65, p. 124; vol. 77, p. 282; vol. 78, pp. 125, 277, 395; vol. 85, p. 270. Enc. Britan., art. Heat. Biog. Sir John Leslie, &c. Tomlinson's Useful Arts, vol. 2, p. 13. Four Pamphlets by Dr. James Arnott, London, 1849, 1851, 1852, 1855. Bulletin de l'Académie de Médecine, vol. 15, p. 85, séance du 16 Octobre, 1849. Union Médicale, Nov. 23, 1850. Gazette des Hôpitaux, Nov. 16, 1854. Holmes's System of Surgery, London, 1860, vol. 1, p. 568; vol. 3, p. 92. Erichsen's System of Surgery, London, 1861, p. 13. Chemistries, article Heat, e. g., Turner's, p. 39 et seq. Simpson's Obstetric Works, second series, Philadelphia, 1856, p. 667 et seq. Boston Society for Medical Improvement, Extracts from Records, vol. 1, p. 344. Boston Medical and Surgical Journal, April 12 and April 19, 1866. And the following, quoted in Braithwaite:—Monthly Journal of Medical Science, July, 1854, p. 33. Lancet, April 15 and May 6, 1854, pp. 415 and 489. Medical Times and Gazette, July 1, p. 11; Sept. 2, p. 248; Sept. 30, p. 342; Oct. 7, p. 379, all of 1854. The date of its introduction into Germany I have not been able to obtain; it was probably 1848–9.

NOTE II.—To allay any theoretical apprehension of dangerous reaction, I append the following quotation from Arnott, p. 21, on Neuralgic, Rheumatic and other Painful Affections, &c., London, Churchill, 1851. "Any objection to congelation, on the score of reaction being likely to be caused by it, or other injurious effects, can only originate either from not distinguishing between the lowest temperatures hitherto employed in medicine, and one forty degrees lower still, or from not perceiving the difference that subsists between a regulated and limited congelation and one that is uncontrolled or unlimited. Although it has now been employed thousands of times, both as an anæsthetic and a remedy, I have never observed any such result." My own experience, though limited, accords with this view.

C. G. P.

J. Wormald Esq
with Mr. Louis Comfort