The Goulstonian Lectures

ON

DEATH BY ELECTRIC CURRENTS AND BY LIGHTNING.

DELIVERED BEFORE THE ROYAL COLLEGE OF PHYSICIANS
OF LONDON.

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LECTURE III.—DEATH BY LIGHTNING (*continued*).

The Mode of Death by Lightning.

It would seem as if sudden death by lightning might occur in at any rate three different ways—by failure of the heart, by failure of the respiration, and by failure of both together. In the vast majority of cases the senses are lost at once, and in most death takes place very rapidly if at all. The extreme suddenness with which it must have occurred, as proved by the natural position of the corpse and its placid expression, has often been noted. As is the case in non-fatal strokes, there is reason to suppose that the nervous system is profoundly affected, though no microscopic lesions may be demonstrable.

1. *Death by failure of the heart*, which may be supposed to be thrown into a state of fibrillation, is assumed to be the commonest mode of death by lightning; in man it is probably final and irremediable, although the respiration may continue for a short time. The face in these instances is pale, free from congestion.

2. *Death by failure of the respiration* from Brown-Séquard's inhibition, while the heart continues to beat until asphyxia stops it, would explain why so many of those killed by lightning present all the *post-mortem* appearances of death by asphyxia. Such deaths might be averted by artificial respiration, continued until the respiratory centre in the bulb has had time to recover from the injury inflicted on it by the stroke. In non-fatal cases it has been noted that the patients' symptoms were those of asphyxia or the breathing of irrespirable gases^{1, 2}; Nick records an instance in which gradual failure of the respiration became complete in about four hours. Apparent death may last for three-quarters of an hour, yet be followed by recovery (Sahut). Kelly has described an instance where the heart was still beating ten or fifteen minutes after the stroke, though respiration had ceased; but in this instance artificial respiration did not restore life.

3. *Death by Failure of the Heart and Respiration together*.—It is probable that this form of death occurs after lightning-stroke, just as it may after the passage of industrial electric currents; but I do not know of any evidence to prove that it does.

4. In a very few cases, mentioned already, gross lesions of the brain have been found *post mortem*, and may well have been the cause of death in these instances. The older *post-mortem* examinations very generally failed to bring to light any pathological changes in the central nervous systems of the victims of lightning-strokes. It is possible that the more delicate modern methods of investigation would not give such negative results here.

Prognosis.

Unless sudden death follows, the probability that a person struck by lightning will recover is large; Dechambre collected 365 instances in which the immediate effects of the stroke were survived, and found that only 15 of these victims died subsequently from late effects of the lightning. It seems to be very generally assumed that immediate treatment would improve the prognosis considerably, and that many of the people killed by lightning are only apparently dead, and still capable of recovery if properly treated during the next few minutes. I do not know of any statistical evidence to prove this point.

Prophylaxis.

The ancient Greeks and Romans protected themselves against lightning by the use of incantations and amulets,

and by wearing the skins of animals like the seal, hippopotamus, and hyaena (Fougères) that were supposed to be immune to lightning-stroke; they also had the good sense to take refuge in caves or cellars during thunderstorms. An Etruscan—Tages—protected his landed property by setting up an ass's head as tutelary deity, suitably enough. In the Middle Ages flight to England was advised, as that country was supposed to be free from lightning—a view sadly contradicted by Müller in 1690.

At the present day only general advice can be given, as the accumulated records have shown that no place is completely protected against lightning. It is certainly safer to be indoors than out, and a large house is much safer than a shanty. The windows and doors of the room in which one is should be shut, and one should keep away from the walls, and particularly from the fireplace, because, when a chimney-stack is struck, the contents of the chimney and the fireplace are often blown out into the room and cause bodily injuries. A great many people have been struck in sheds and barns, especially when they have been near doors or windows, or in currents of air. Turley recommended the centre of a railway carriage at a distance from the engine as the securest place of all; Scheffcik, a feather bed. To take refuge in the cellars merely to avoid a thunderstorm is not necessary as a routine, though in exceptional cases it may be advisable.

The advice given by various authors to persons caught out of doors in a thunderstorm is contradictory. It is probably unwise to take shelter in a shed unless one can get out of the way of doors, windows, and draughts while one is in it. A shed containing domestic animals is certainly more dangerous than the open. If one has to remain in the open, there are certain things that should be avoided at any cost. The first of these is the proximity of wire fences, because when such a fence is struck the electric discharge may be carried along the wires and cause death at a distance from the place actually struck. The second is proximity to such things as hedges, ponds and streams, isolated trees, crowds of people and herds of domestic animals. Crowds of people or animals seem to have a mild attraction for lightning, very possibly by virtue of the warmth and dampness they impart to the atmosphere immediately round them. Certain varieties of trees are less dangerous than others; in similar conditions the beech is much less often struck than any other tree that is common in Europe, while the oak is very many (perhaps forty or fifty) times more liable than the beech to be struck and injured. This may be because the electric conductivity of beech trees is low at all times of the year, beech wood being always rich in fat and poor in starchy matter.²⁶ Hence, if one has to take shelter under a tree, that tree should be a beech,²⁷ and one should not be near its trunk. But to take cover in a forest or wood is quite safe, as trees *en masse* are rarely struck. If one is in quite open country, there is nothing to show whether it is better to be on high ground or in a valley; it seems to be agreed that to lie or sit down is safer than to stand up, that umbrellas should not be hoisted, and that riders and drivers should dismount and not stay near their horses or conveyances. It has often been said that to have had the clothes thoroughly wetted by rain and rendered conducting gives some protection to people who are struck by diverting the path and violence of the lightning from the body to the clothes. I have found seven well-recorded instances in which the effect of the stroke was to blow all, or practically all, the wetted clothes off the body, by the generation of steam, as I believe. There can be no doubt that a part of the energy of the lightning was expended on the clothes in these cases, but three of the seven victims were killed notwithstanding. So the protection of wet clothes cannot be considered at all complete.

Vincent makes an ingenious practical suggestion—perhaps too ingenious. It has long been known, he says, that animals are more liable to be struck than men; hence one should always take a dog out walking in order that if a thunderstorm comes on, the dog, already the friend of man, may also serve as his lightning conductor.

* Compare the German proverb:

Vor den Eichen sollst Du weichen,
Vor den Fichten sollst Du flüchten,
Doch die Buchen sollst Du suchen.

In these days, when vaccine therapy is so widely employed, it is not without interest to note that in South Africa both the Zulus and the Caffres inoculate themselves against lightning by rubbing into cuts the flesh of animals (bullocks) killed by lightning (Frazer).

Treatment.

Persons struck and apparently killed by lightning should at once be given plenty of fresh air, their clothes should be loosened, and artificial respiration by Schäfer's or Sylvester's method should be applied and should be continued until either recovery occurs or cooling of the body and *rigor mortis* show conclusively that death has taken place. In the medical writings of from fifty to two hundred years ago one often sees bleeding recommended, and this might well be of service in those cases of lightning stroke in which the heart goes on beating while the respiration stops. If it were immediately—within a few minutes—available, to give strong electric shocks to the *præcordia* would be well worth trying in desperate cases. As regards other remedies—such as stimulants in all forms, hot or cold applications, the inhalation of pungent vapours—very many have been recommended, but none seem to have met with any success.

In conclusion, I may say that it is very highly improbable that any one of us will be struck by lightning. But to the attention of those who are struck and survive may be recommended the French superstition that such people have for forty days the power of curing all kinds of disease by "touching." I may quote for their encouragement the case¹⁸ of a girl of 8 who was struck at Douai, and afterwards "touched" over 600 persons in this way; and, as it is recorded that the parents did not refuse the modest offerings presented by the visitors, one may assume that the girl "touched" their pockets as well as their persons. As regards those who are fated to be killed by lightning, the only consoling thought I have been able to find for them is taken from the recently published diary of Queen Victoria. On June 1st, 1838, the Queen wrote:¹⁹

"I told Lord Melbourne I never could forgive him for having stood under a tree in that violent thunderstorm at Windsor last year; he said, 'It's a hundred to one you're not struck,' and then added, smiling, 'It's a sublime death.'"

LITERATURE.

- ¹ Abildgaard, P. C.: *Soc. med. Havn. collectanea*, 1775, ii, 157.
- ² Arago, F.: *Meteorological Essays*. London, 1855.
- ³ Arch. de l'anthropologie crim., Lyon, 1900, xv, 116.
- ⁴ d'Arsonval, A.: *C. R. Acad. des Sciences*, Paris, 1885, c, 239.
- ⁵ Idem, *C. R. Soc. de Biol.*, Paris, 1887, 8me sér., iv, 95.
- ⁶ Idem, *C. R. Acad. des Sciences*, Paris, 1887, civ, 978.
- ⁷ Idem, *Bull. de l'Acad. de Méd.*, Paris, 1892, xxvii, 424.
- ⁸ Idem, *Arch. de physiol. norm. et path.*, Paris, 1893, 401.
- ⁹ Idem, *C. R. Acad. des Sci.*, Paris, 1894, cxviii, 1139.
- ¹⁰ Idem, *Bull. Soc. internat. des Élect.*, 1910, 355.
- ¹¹ Aspinall, F. B.: *Lancet*, 1902, i, 660.
- ¹² Auzouy: *Schmidt's Jahrbücher*, 1858, c, 78.
- ¹³ BRITISH MEDICAL JOURNAL, 1861, ii, 98.
- ¹⁴ Banham, G. A.: *Vet. Journ.*, 1881, 243, 297.
- ¹⁵ Barnes, G. R.: *Med. Times and Gaz.*, London, 1868, i, 671.
- ¹⁶ Battelli, F.: *Rev. méd. Suisse Rom.*, Geneva, 1899, xix, 605.
- ¹⁷ Idem, *Congrès Internat. d'Élec.*, Berne, 1902, 583.
- ¹⁸ Idem, *Richert's Dict. de Physiologie*, Paris, 1904, vi.
- ¹⁹ Becher: *Aerzt. Rundschau*, München, 1897, vii, 529.
- ²⁰ Benjamin, P.: *The Intellectual Rise in Electr.* London, 1895.
- ²¹ Bennett, H. C.: *Amer. X-ray Journ.*, 1897, i, 127; 1898, ii, 141.
- ²² Bidermann, J. G.: *Causas subitæ mortis fulmine tactorum*. Lipsiae, 1768.
- ²³ Biraud, F.: *Thèse de Lyon*, No. 780, 1892.
- ²⁴ Bordier et Lecomte: *C. R. Acad. des Sciences*, 1901, 1295.
- ²⁵ Boruttau: *Nagel's Handbuch der Physiologie*, 1909, i, 239.
- ²⁶ Bourrot: Reported by Grange.
- ²⁷ Brauchbar, R.: *Über Unfälle durch hochgesp. elektr. Ströme*. Leipzig, 1901.
- ²⁸ Brodie, B. C.: *London Med. Gazette*, 1828, i, 79.
- ²⁹ Brouardel: Reported by Grange.
- ³⁰ Brown, H. P.: *Med.-Legal Journ.*, New York, 1888-1889, vi, 276.
- ³¹ Brown-Séquard: *C. R. Soc. de Biol.*, Paris, 1850, i, 154.
- ³² Buchanan, W.: *Lancet*, 1892, i, 629.
- ³³ Carpi, A.: *Lo Spallanzani*, Modena, 1874, xii, 551.
- ³⁴ Cipriano, C.: *Il raccogl. med.*, Forlì, 1892, 5 s., xiv., 274.
- ³⁵ Claes, E.: *Journ. de Méd. Chir. Ph.*, Paris, 1856, xxiii, 340.
- ³⁶ Clark, R. O., and Brigham, J. K.: *Lancet*, 1872, ii, 77.
- ³⁷ Colladon, D.: *C. R. Acad. des Sci.*, Paris, 1887, civ, 1136.
- ³⁸ Corrado, G.: *Arch. d'Électr. méd.*, Bordeaux, 1899, vii, 5.
- ³⁹ Idem, *Atti della R. accad. med.-chir. di Napoli*, 1898, 242.
- ⁴⁰ Coulter, F. E.: *Med. Herald*, St. Joseph, 1899, xviii, 483.
- ⁴¹ Crile and Macleod: *Amer. J. Med. Sci.*, 1905, 417.

- ⁴² Crossland, J. C.: *Columbus Med. Journ.*, 1892-1893, xi.
- ⁴³ Cunningham, R. H.: *New York Med. Journ.*, 1899, lxx, 581, 615.
- ⁴⁴ Darling, Frier, and Pedlow: *BRIT. MED. J.*, 1905, ii, 1522.
- ⁴⁵ Davies, J.: *Lancet*, 1838-39, xxxvi, 681.
- ⁴⁶ Daxenberger: *Aerzt. Rundsch.*, München, 1897, 289.
- ⁴⁷ Dechambre, A.: *Dict. encycl. d. sci. méd.*, 1880, vi, 272.
- ⁴⁸ Dillner, F.: *Ueber die Wirk. des Blitzes*, etc. Leipzig, 1865.
- ⁴⁹ Donlin, P. E.: *Medico-Legal Journ.*, New York, 1889, vii, 470.
- ⁵⁰ Dunscombe-Honeyball, O.: *BRIT. MED. J.*, 1900, i, 1153.
- ⁵¹ Durand, J. J.: *Thèse de Paris*, No. 232, 1894.
- ⁵² Dürck, H.: *Münch. med. Wchnschr.*, 1895, xlii, 716.
- ⁵³ Durrbach, F.: *Daremborg and Saglio's Dict.*, IV, i.
- ⁵⁴ Dutt, O. C.: *Indian Med. Gaz.*, Calcutta, 1867, ii, 152.
- ⁵⁵ Eggleston, W. G.: *Med. Record*, New York, 1885, xxvii, 120.
- ⁵⁶ *Elektrotechn. Ztschr.*, Berlin, 1911, xxxii, 354.
- ⁵⁷ Emde, F.: *Elektrotechn. Ztschr.*, Berlin, 1910, xxxi, 675.
- ⁵⁸ Farkas, E.: *Ungar. Arch. f. Med.*, Wiesb., 1894-95, iii, 320.
- ⁵⁹ Fischer: *Med. Ztg.*, Berlin, 1837, vi, 1.
- ⁶⁰ Fischer, J. G.: *Disp. physica de fulmine*. Jenae, 1665.
- ⁶¹ Fougères, G.: *Daremborg and Saglio's Dict.*
- ⁶² Franque, J. von: *Memorabilien*. Heilbronn, 1866, xi, 33.
- ⁶³ Frazer, J. G.: *The Golden Bough*, Pt. V, vol. ii, 161. 1912.
- ⁶⁴ Free, J. E.: *Med. and Surg. Reporter*, Phila., 1887, lviii, 102.
- ⁶⁵ Gardé, P.: *Thèse de Paris*, No. 81, 1895.
- ⁶⁶ *Gaz. des Hôp.*, Paris, 1911, lxxxiv, 1237, 2028.
- ⁶⁷ Gem, W.: *Lancet*, 1909, i, 34.
- ⁶⁸ Gibbons, P. J.: *New York Med. Journal*, 1895, lxi, 482.
- ⁶⁹ Goelet, A. H.: *Atl. Med. Weekly*, Providence, 1895, iii, 241.
- ⁷⁰ Grange, E.: *Thèse de Paris*, 1884, No. 383.
- ⁷¹ Idem, *Ann. d'Hyg. publ.*, 1885, 53, 303.
- ⁷² Haberda, A.: *Wiener klin. Wchnschr.*, 1891, iv, 588.
- ⁷³ Hankel, E.: *Volkman's Sammlung*, 1897-1900, No. 208.
- ⁷⁴ Hann, J.: *Lehrb. d. Meteorologie*, 2te Aufl., Leipzig, 1906.
- ⁷⁵ Harting: *Med. Ztg.*, Berlin, 1856, xxv, 249.
- ⁷⁶ Hedges, K.: *Modern Lightning Conductors*. London, 1905.
- ⁷⁷ Hedley, W. S.: *Lancet*, 1893, ii, 437; 1894, ii, 437, 655.
- ⁷⁸ Idem, *ibid.*, 1895, i, 281; 1895, ii, 281.
- ⁷⁹ Idem, *ibid.*, 1896, ii, 1630.
- ⁸⁰ Heffernan: Reported in *Lancet*, 1877, ii, 266.
- ⁸¹ Henry, A. J.: *Loss of Life in the United States by Lightning*. Washington, 1901.
- ⁸² Heusner: *Arch. f. klin. Chir.*, Berlin, 1884-85, xxxi, 659.
- ⁸³ Hoest, G. L.: *Bull. Assoc. des Ingén. Elect.*, 1910, x, 9.
- ⁸⁴ Hoffa u. Ludwig: *Ztschr. f. rat. Med.*, 850, 107.
- ⁸⁵ Hoffmann, C. F.: *De morte in fulmine tactis*. Halae Magd., 1766.
- ⁸⁶ Hoffmann, J. A.: *Quaest. phys.*, etc. Wittenberg, 1703.
- ⁸⁷ Hofmann, G. von: *Eulenburg's Real-Encyclop.*, 1894, iii, 522.
- ⁸⁸ *Hospitalstidende*, Copenhagen, 1862, v, 61.
- ⁸⁹ Jack: *Allgem. med. Central-Ztg.*, Berlin, 1857, xxvi, 418.
- ⁹⁰ Jacobsthal, P.: *Der Blitz in der orient. u. griech. Kunst*. Berlin, 1906.
- ⁹¹ Janichius, P.: *De fulmine disp. physica*. Dantisci, 1606.
- ⁹² Jellinek, S.: *Elektropathologie*, Stuttgart, 1903 (Literature quoted); *Virchow's Archiv*, 1902, clxx, 56.
- ⁹³ Idem, *Lancet*, 1903, i, 357; *Wien. k. Wch.*, 1905, 1139, 1184.
- ⁹⁴ Idem, *Atlas der Elektropathologie*. Berlin u. Wien, 1909.
- ⁹⁵ Jenks, W. J.: *New York Med. Journ.*, 1892, lv, 542.
- ⁹⁶ Jones, H. L.: *BRITISH MEDICAL JOURNAL*, 1893, i, 1318.
- ⁹⁷ Idem, *ibid.*, 1895, i, 468.
- ⁹⁸ Johnston, J. W.: *Indian Med. Gaz.*, Calcutta, 1873, viii, 213.
- ⁹⁹ *Journal of the Royal Agric. Soc.*, London, 1900, 3 s., x, 608.
- ¹⁰⁰ Kelly, B.: *Journ. Am. Med. Assoc.*, Chicago, 1903, xli, 1273.
- ¹⁰¹ Kennelly and Alexanderson: *L'Ind. elect.*, Paris, 1911, 79.
- ¹⁰² Kisling, J. J.: *De tactis fulmine*. Kiliae Holsatorum, 1673.
- ¹⁰³ Knaggs, R. H. E.: *Lancet*, 1894, ii, 1216; *BRITISH MEDICAL JOURNAL*, 1894, ii, 1236.
- ¹⁰⁴ Kratter, J.: *Wien. klin. Wchnschr.*, 1894, vii, 379.
- ¹⁰⁵ Idem, *Der Tod durch Elektrizität*. Leipzig, 1896.
- ¹⁰⁶ Kronecker, H.: *Deutsche med. Wchnschr.*, 1884, x, 364.
- ¹⁰⁷ Lane, J. R.: *BRITISH MEDICAL JOURNAL*, 1872, ii, 114.
- ¹⁰⁸ Lauffer, C. A.: *Electrical Injuries*. New York, 1912.
- ¹⁰⁹ Lawson, R.: *Quart. J. R. Meteorol. Soc.*, 1889, 140.
- ¹¹⁰ Liman: *Deutsche med. Wchnschr.*, 1885, xi, 529.
- ¹¹¹ Lodge, O. J.: *Lightning Conductors and Lightning Guards*. London, 1892.
- ¹¹² Lucas, C.: *BRITISH MEDICAL JOURNAL*, 1905, i, 134.
- ¹¹³ McAdie, A. G., and Henry, A. J.: *Lightning and the Electricity of the Air*. Washington, 1899.
- ¹¹⁴ MacDonald, C. F.: *New York Med. Journ.*, 1892, lv, 505, 535.
- ¹¹⁵ Macintosh, D.: *Lancet*, 1864, ii, 118.
- ¹¹⁶ McWilliam, J. A.: *Journal of Physiology*, 1887, viii, 296.
- ¹¹⁷ Mache, H., und von Schweidler, E.: *Die atmosphärische Elektrizität*. Braunschweig, 1909.
- ¹¹⁸ Mally: *Rev. de chir.*, Paris, 1900, xxi, 321.
- ¹¹⁹ Mangin, M.: *Ann. des sci. psych.*, Paris, 1897, vii, 213.
- ¹²⁰ Mann, J. D.: *Med. Chronicle*, Manchester, 1885, ii, 1.
- ¹²¹ Marherr, P. A.: *Weiz's Neue Auszüge*, Leipzig, 1776, v, 22.
- ¹²² Milham, W. I.: *Meteorology*. New York, 1912.
- ¹²³ Müller, A.: *De astrologismo*. Francof. ad Viadrum, 1690.
- ¹²⁴ Münnich, J. A.: *Gründl. Bericht*, etc. Halberstadt, 1732.
- ¹²⁵ Niederheimann: *Bericht Rhein. Med. Coll.*, 1833, 125.
- ¹²⁶ O'Neill, J. A.: *Atl. Med. Weekly*, Providence, 1898, x, 184.
- ¹²⁷ Oesterlen, O.: *In Maschka's Handb. ger. Med.*, 1881, i, 795.
- ¹²⁸ Oliver, Sir T.: *Lancet*, 1911, i, 363.
- ¹²⁹ Oliver, T., and Bolam, R. A.: *BRIT. MED. J.*, 1898, i, 132.
- ¹³⁰ Ouvrard: *Nouv. Journ. de Méd. Chir. Ph.*, Paris, 1821, xii, 312.
- ¹³¹ Péliissié, J.: *Thèse de Lyon*, No. 59, 1896.
- ¹³² Penfold, O.: *Austral. Med. Journ.*, 1880, n.s., ii, 120.
- ¹³³ Phayre, T.: *Dublin Med. Press*, 1842, viii, 22.

- 184 Pla, E. F.: *Consideraciones medico-legales acerca de la muerte por la electricidad industrial*. Habana, 1891.
- 185 Pockels, F.: *Meteorolog. Ztschr.*, Wien, 1901, xviii, 40.
- 186 Prevost, J. L.: *Rev. méd. Suisse Rom.*, 1898, xv, 545.
- 187 Prevost, J. L., et Battelli, F.: *Rev. méd. de la Suisse Romande*, Geneva, 1899, xix, 545.
- 188 Idem, C. R. Acad. des Sci., Paris, 1899, cxxix, 651, 1267.
- 189 Idem, *Journ. Phys. et Path. gén.*, Paris, 1899, i, 1085, 1114.
- 190 Priestley, J.: *The History of Electricity*. London, 1767.
- 191 Rasbach, J. C.: *De eo quod medicum decet circa fulmine tactos*. Erfordiae, 1737.
- 192 Richardson, B. W.: *Med. Times and Gazette*, London, 1869, i, 511, 595; ii, 183, 373.
- 193 Robinovitch, L. G.: *Sommeil électrique*. Nantes, 1906.
- 194 Röser, C. J.: *Disp. phys.-med. de fulm.* Regiomonti, 1704.
- 195 Roy: *Rec. de mém. de méd. chir. pharm.*, 1864, xii, 231.
- 196 Sahut: *Soc. des Sci. Méd. de Gannat*, Moulins, 1874, 40.
- 197 Scheféik, J.: *Wiener med. Presse*, 1877, xviii, 814, 847.
- 198 Schmidt, K. E. F.: *Meteor. Ztschr.*, Wien, 1905, xxii, 362.
- 199 Schmitz, W.: *Deutsche Med.-Ztg.*, Berlin, 1887, viii, 821.
- 200 Schneider, S. A. J.: *Deutsche Ztschr. f. d. Staatsarznk.*, Erlangen, 1870, n. F., xxviii, i, 161.
- 201 Schottin, D.: *Med. Convbl.*, Hildburghausen, 1831, i, 1.
- 202 Schumacher, E. D.: *Unfälle d. elek. Starkströme*. 1908.
- 203 Sheild, M., and Delépine, S.: *BRIT. MED. J.*, 1885, i, 531.
- 204 Shettle, R. C.: *Lancet*, 1895, ii, 694, 809.
- 205 Sonrier: *Gaz. des Hôp.*, Paris, 1872, 833.
- 206 Stanton and Krida: *Med. Record*, 1910, 896.
- 207 Stock, J. C.: *De fulmine*, etc. Jenae, 1734.
- 208 Sutherland, W. G.: *Lancet*, 1893, ii, 1033.
- 209 Swinton, A. A. C.: *Lancet*, 1893, ii, 957.
- 210 Sycyanko: *Berl. klin. Wchnschr.*, 1868, v, 227.
- 211 Tatum, E.: *New York Med. Journ.*, 1890, li, 207.
- 212 *The Girlhood of Queen Victoria*. London, 1912, i, 337.
- 213 Thomson: *Trans. Amer. Electrotherap. Assoc.*, 1894, iv, 261.
- 214 Thys: *Ann. de la Soc. de Méd. Prat.*, Malines, 1851, ix, 389.
- 215 Trotter, A. P.: *J. Inst. Electr. Eng.*, 1902, xxxi, 762.
- 216 Trowbridge, J.: *Mém. Amer. Acad. of Arts and Sci.*, 1908, xiii, 185.
- 217 Turley, E. A.: *Med.-Chir. Review*, London, 1844, xl, 177.
- 218 Verhoogen, R.: *Journ. de méd. de chir. et de pharm.*, 1894, 729.
- 219 Vincent, F.: *Gaz. des Hôp.*, Paris, 1885, lviii, 724, 755, etc.
- 220 Idem, *Gaz. des Hôp.*, Paris, 1892, lxx, 928, 958, etc.
- 221 Vollmar, J. G.: *De fulmine tactis*. Argentorati, 1765.
- 222 Weber, L.: *Schr. d. Naturwiss. Schleswig-Holst.*, 1878, 99.
- 223 Weiss, G.: *Bull. Soc. Inter. des Electr.*, Paris, 1911, i, 417.
- 224 Wheeler, W. M.: *Med. Brief*, St. Louis, 1896, xxiv, 1177.
- 225 Wilks, G.: *Lancet*, 1879, ii, 655.
- 226 Witz, A.: *Ann. de psych. et d'hypn.*, Paris, 1893, n.s., iii, 193.
- 227 Zacon: *Bull. Soc. Internat. des Electr.*, 1911, i, 437.
- 228 Zwaluwenberg: *Journ. Amer. Med. Assoc.*, 1903, 967.

IN his introductory remarks on the health of Colombo, Ceylon, for 1911, Dr. Philip, M.O.H., states that the mean temperature of the year was much the same as the average, but there was, for the ninth year in succession, a great shortage of rain recorded (24.06 in.). The birth-rate during 1911 was higher than the average, but, owing to the large number of children of Colombo parents who are born and registered in districts outside the town, the birth-rate as recorded—24.7 per 1,000 living—does not afford a true measure of the fertility of the population, which is undoubtedly great in the case of the Burghers and Cingalese. The general death-rate—33.8 per 1,000 living—was rather above the average, though there was a reduction in the mortality amongst Europeans. Amongst the principal causes of deaths, only pneumonia and enteric fever showed an increase; but, in the case of enteric, the apparent increase was more than counterbalanced by the decrease in the number of deaths ascribed to simple continued and remittent fever, both of which terms were being, to a large extent, abandoned by the medical profession. The mortality from phthisis had shown a noteworthy improvement during the last two years. The infant mortality, which had been improving steadily for a series of years, was higher than the record low rate of 1910, but was still 22 per 1,000 below the average, the death-rate per 1,000 recorded births being 316. There was a considerable increase in the number of infectious diseases notified and dealt with during 1911 compared with the previous year, which was in a large measure due to the notification of phthisis having been made compulsory, and to an improvement in the diagnosis and notification of enteric fever. Dr. Philip remarks, with regard to the food supply of Colombo, that proper food laws are much required, but that they could not be properly administered unless the council appointed a sufficient staff for the purpose. The housing problem has become very acute, both as regards the insufficiency of accommodation and the existence of unhealthy areas and unhealthy dwellings. A municipal bacteriological laboratory was instituted during the year, and Dr. Hirst assumed duty in July.

Remarks

ON

THE FOOD REQUIREMENTS OF CHILDREN.

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As a member of a subcommittee of the Edinburgh School Board, co-opted to advise as to the best means of supplying nutritious meals at small cost to the necessitous and other children fed by the Board, I was led to make the following investigations.

1. To ascertain by chemical analysis the amount of food consumed daily by apparently healthy children, about 5 years old, in good social circumstances.

2. To devise nutritious one-course meals at small cost, suitable for a large number of children (2,000 or more) fed by the school authorities.

The results of these investigations will be shortly stated:

Brief reference may first be made to the part played by proteins in the dietary. In early life proteins have special importance from the physiological point of view because they are the chief tissue builders; the proportion of protein in the dietary of children should therefore be relatively high. It is important to note, however, that the nature and source of the protein require quite as much consideration as the amount consumed. In later life proteins have special significance from the pathological point of view, because, being incompletely oxidized in the body, products of their incomplete combustion are liable to accumulate in the blood and tissues, and there give rise to various manifestations of so-called "auto-intoxication." The commonly accepted standard of daily food requirements in adults is that associated with the names of Atwater and Voit, namely:

Protein.	Fat.	Carbohydrates.	Caloric Value.
120 grams (4.2 oz.)	65 grams (2.2 oz.)	500 grams (17.6 oz.)	3,147

In recent years considerable doubt has been thrown on the accuracy of this teaching by the important researches of Chittenden, whose results led him to conclude that the standard hitherto accepted as correct is unduly high. In regard to protein in particular, Chittenden has laid down a standard of 80 grams or less of protein as the physiological intake for an adult under ordinary conditions. We are not here, however, concerned with the food requirements in adults, and the above figures are merely cited because of their bearing on what is to follow.

I. THE FOOD REQUIREMENTS OF CHILDREN.

So far as I have been able to learn from the study of textbooks on dietaries of children, authorities give little or no precise information on this subject. Details are given as to the kind of diet suitable for children of different ages, but nothing is said as to the total amount of protein, fat, and carbohydrates that should comprise the diet of a child, say, of 5 or 10 years. When we turn to textbooks of physiology and of dietetics, a definite statement is laid down as follows:

A child from 3 to 5 requires 0.4 the food a man at moderate work.

A child from 6 to 9 requires 0.5 the food a man at moderate work.

A child from 10 to 13 requires 0.6 the food a man at moderate work.

On looking into the subject, it would seem that this estimate has been arrived at empirically, the figures, once laid down, having been reproduced by all subsequent writers on the subject. If for the moment we accept the Atwater standard as a reliable guide for the food requirements of an adult, we find that the daily food requirements of a child of 5 years are as follows:

Protein.	Fat.	Carbohydrates.	Caloric Value.
48 grams	30 grams	200 grams	1,270

No attention is paid to the salts in the dietary, as these