ON BLOODLETTING.

SUMMARY—Bloodletting—History—Popularity and Decadence of Bloodletting—Divisions—Local Bleeding—General Bleeding—Arteriotomy—Phlebotomy—Manual Procedure of Bleeding—Experimental Researches—On the Influence of General Bloodletting—Action on the Blood—Modifications of the Globules—Modifications of the Serum—Influence on the Circulation—Modifications of the Pulse—Modifications in the Speed of the Circulation—Modifications of the Mass of Blood—Modifications of the Blood Pressure—Influence on the Respiration—Influence on the Nervous System—Influence on the Nutrition—Conclusions—Therapeutic Applications of Bloodletting—Local Bleeding by Cupping—Leeches—Artificial Leeches—Mode of Application—Physiological Effects—Therapeutical Applications.

GENTLEMEN: From a medical point of view there is no history more interesting alike to philosopher and physician than that of bloodletting. It is a history replete with useful lessons. We see there illustrated the truth that when the spirit of system and of routine takes possession of a philosophical or medical doctrine, the results are distorted and misinterpreted, and the practical outcome is barren of good fruits and baneful. If, moreover, the word of the master is worthy of respect, hot-headed enthusiasts who urge to riot and madness every good measure are always to be distrusted; finally, enlightened observation and the true scientific spirit ought continually to submit to the test of the experimental sciences the data furnished by tradition.

We are ignorant of the origin of bloodletting; we only know that it was in use at the dawn of our historical era. Eleven hundred years before Christ, Podalirius is said to have practiced it at the siege of Troy. It is probable that it was already in vogue among nations where civilization was more advanced, and that in Egypt, India, and China bleeding was a recognized therapeutic measure.

However this may be, Hippocrates, in his writings, speaks of bloodletting and its indications. Afterwards Aretæus and especially Galen insist on the importance of bleeding, and thenceforth down to the seventeenth century venesection was practiced in accordance with the principles which Hippocrates and Galen had laid down. It was as much as ever, if during this long space of time certain opponents, Van Helmont and Porcius in particular, dared lift their voices in protestation against the abuse and the uselessness of bloodletting.[1]

[1] The following passage from one of the writings of Hippocrates makes particular mention of bloodletting: "A patient had borboygmi and pain; had taken emetics without relief; was bled by turns from each arm to syncope, and got well."

From the time of Hippocrates, bloodletting has given rise to very many discussions; nevertheless, owing to the influence of Galen and Celsus, who were for ages the teachers in medicine, bleeding was adopted as a treatment applicable to a great number of complaints. Galen made the following reservation: not to bleed children under four years of age, and rarely to bleed old people.

It was in the seventeenth century that the contest between the adversaries and the par-

They were, however, little heeded, and the majority ranged themselves on the right side of Botalli, who compared diseased blood to stagnant water in a well, which becomes more and more pure the more you take out. It is precisely so, said Botalli, with the blood and with bloodletting.[2]

It was, however, in the seventeenth century that phlebotomy attained its zenith, becoming in France, as in England, the unique system of treatment of all diseases—children and old men alike were bled; the newborn babe even was not spared, and blood was taken by *quarts*. Guy Patin bled his *confrère* and friend Mentel thirty-six times in succession, and caused himself to be bled seven times for a simple cold. Pitcairn drew more than five kilogrammes from a rheumatic patient, and Gregory, for a pleurisy gave issue to more than six kilogrammes. Medicine at this epoch was reduced to these three great elements: purgings, bleedings, and clysters; and the response of the bachelor in

tisans of venesection took on the most vehemence, and a perfect furor for letting of blood seized certain physicians. Guy Paton was the most ardent of these enthusiasts. He bled his *confrere* Mental thirty-two times consecutively, and bled himself seven times for a cold. He would bleed infants at the breast, and even aged people.

Chirac went further, if possible, than Guy Paton, and to him is ascribed that celebrated utterance, "Small-pox, I will make you used to the lancet."

Pitcairn boasted of having drawn twenty English pounds of blood from a patient affected with acute articular rheumatism.

Tweedie, in a case of pericarditis, took first 421 grammes, then 720 grammes, then 960, then 1200, and finally 1440, before the patient was relieved.

Gregory caused a pleuritic patient to lose 5520 grammes in the course of several days.

There was a revival of excessive bleeding under the influence of Broussais at the beginning of this century, and Bouillaud, with his bleedings, "blow after blow" (*coup sur coup*), was the last representative of this period, which Schneider has characterized as the period of *hæmatomania*.

The ancients practiced phlebotomy with various instruments; generally a spear-pointed fleam, called *fossorium*, was thrust into the vein. This instrument is still used by veterinary surgeons when they bleed horses. One of these *fossoria* was found in the ruins of Pompeii.

They also used an instrument called *scalpellus*, with which they opened the vein. Galen employed a cutting implement which he described under the name of *phlebotomon*. Albucasis made use of all three kinds, the *scalpellus*, the *fleam*, and the *phlebotomon*.

The words *lance* and *lancet* were not introduced into surgery till about the year 1200. (*a*)

[2] Botalli was a physician of the University of Paris; afterwards (from 1571), Physician to Charles IX. His controversy with the faculty, and in particular with Donatus, has become famous. The latter reproached him with the hardihood of his bloodlettings. He was one of the greatest partisans of phlebotomy. He bled all his patients to excess, basing himself on the principle which he enunciated to his friend Etiénne Pasquier: "The more you withdraw of stagnant water from a well, the more of pure water flows in to take its place. The more the wet-nurse is sucked by the infant, the more milk she has; the like holds good with bloodletting." (*b*)

(*a*) Journal, Considerations Relative to General Bloodletting, 1867. Brichetau, Bloodletting, Its Physiological Effects and Therapeutic Indications, Bull. de Thér., lxxv. p. 261, 1868. Article Saignèe, in Dict. Encyclop. des Sciences Méd. Saucerotte, Bull. de Thér., li., p. 145.

(*b*) Etiénne Pasquier, Lettres liv. xiv., lettre 19; Botalli, "On the Cure of Disease by Bloodletting, including the Opening of Veins, Scarifications of the Skin, and the Application of Leeches." Antwerp, 1583.

the immortal comedy of the *Malade Imaginaire* is in exact conformity to the prevalent practice of the epoch, when he replies to all the questions propounded to him by these three lines :

Clysterium donare,
Postea seignare,
Ensuita purgare.

When one thinks of the prodigious number of purges ordered, the enormous quantity of lavements administered, and the sanguinary floods which phlebotomy produced in this and the succeeding epoch, one can but exclaim with Bouley, physician to the hôpital Necker, in view of such heroic medication: "A sick person has more vital resistance than one would think !"

This mania for bloodletting, after having abated for a number of years, burst forth with new ardor at the commencement of the nineteenth century, and Bosquillon with his humoral ideas, Broussais with his physiological doctrine, Bouillaud with his system of bleedings, *blow upon blow* (coup sur coup), gave a new *eclat* to the practice of phlebotomy. Then the zeal by degrees died away again, and it may be truly said that to-day the prescription of a phlebotomy is an exceptional thing in the practice of our hospitals, and it is as much as ever if I order one or two bleedings a year. Peter has indeed made some attempts the last few years to show the evil consequences of so complete an abandonment of this therapeutic measure. We will now see by the most recent data of experimentation, if the favor which bloodletting once found and its present abandonment, are susceptible of justification.

We purpose here to divide our subject into two parts, and study in particular the action of general bloodletting, and that of local bloodletting. We purpose also under each of these heads to examine successively the operative procedure, the physiological effects, and lastly the indications and contra-indications of general and local bloodletting.

General bloodletting (called also venesection, phlebotomy) is practised, as you know, at the bend of the elbow; and although in my audience there are doubtless many who have never bled a person, or seen one bled, I need not now take up your time in describing the operation, which you will find in full detail in any text-book on minor surgery.[1] This ignorance of the manual procedure is quite pardonable in anybody, considering how very seldom bleeding is practiced in even our large hospitals.[2]

[1] Bloodletting has been practised from quite a number of vessels. Galen Hippocrates and Celsus bled from the veins of the nose; Rhazes and Avicenna selected the veins of the tongue, a kind of phlebotomy still practised in veterinary surgery; in fact, blood has been taken from almost all of the superficial veins of the body. To-day bleeding is practised exclusively at the bend of the elbow. Various instruments have been devised for bloodletting; the Germans still use mechanical *phlebotomes* which consist of a metallic box, a graduated lance, and a spring.

The vein at the bend of the elbow which is generally selected for venesection is the median cephalic, and this is generally preferred because the median basilic passes over the brachial artery. This is a very important relation and explains those unfortunate cases where bloodletting has resulted in aneurismal varix.

To cause swelling of the veins, a ligature or tight bandage is made to encircle the arm above the elbow, the forearm is rubbed vigorously upward, the patient being instructed to shut the fist firmly; then, when the veins are sufficiently distended, the operation is performed.

The operator takes the forearm in his hand, places his finger on the vein a little below the place of the intended puncture, and then (using the right hand for the left arm and vice versa) pushes the lance obliquely into the vein and makes it cut its way directly outward. When enough blood has been taken, the surgeon should untie the ligature above the elbow and place his thumb over the bleeding aperture. He should then put a small piece of lint on the wound and secure it with a strip of plaster; over this he should put a square compress of linen and over the whole a figure of eight bandage.

Bloodletting is generally a very simple operation, nevertheless it sometimes presents great difficulties, resulting from the corpulence of the patient and the depth to which it is necessary to make the incision. These difficulties are enhanced if the patient proves refractory during the operation.

The accidents which may accompany venesection are numerous; the most grave of all is puncture of the brachial artery; sometimes there follows abcess in the areolar tissue, or even phlebitis; the latter resulting from the carelessness of the operator in using a foul instrument or from the fact of the operation itself, however carefully it may have been performed. (*a*)

[2] Phillipart, of Tournay, has protested against the abandonment of bloodletting. He insists that the profession, in forsaking venesection, has gone too far, and that it is needful to return to this ancient mode of treatment in acute diseases. *Apropos* of the neglect of bloodletting, he cites some curious facts—namely, that the physicians of hospitals attached to the Central Bureau in the year 1867 prescribed bleeding but twice out of 8000 consultations, while in 1852 it was prescribed 1259 times. (*b*)

[3] According to Hayem, a single emission of blood not exceeding 1.75 of the weight of the body, produces a slight degree of anæmia and a reduction in the number of globules

(*a*) Vide Chelius Surgery (South's ed.) vol. iii., p. 609.

(*b*) Phillipart, On Bloodletting in the Treatment of Acute Diseases. Bull. de l'Acad. de Med. de Belgique, 1883, t. xvii, p. 128.

What are the physiological effects of bloodletting ? Here we have to study the effects of bleeding on the circulation of the blood, and on the blood itself, and the modifications which supervene in the functions of the different organs of the economy.

The blood is profoundly altered by bloodletting, and we must examine successively the modifications of the globules, and of the serum. In treating the globules, we are to consider the changes in the red corpuscles, the leucocytes, and the hæmatoblasts.

Hayem has shown us in his admirable work on the modifications of the blood, from which I derive the principal data of this lecture, that every loss of blood, however trifling, and though not exceeding 1.75 per cent. of the weight of the body, produces a diminution in the number and quality of the globules which persists from ten to twenty days.[3] When the hemorrhage is large, or when the bleeding is often repeated (*coup sur coup*), the diminution of the globules continues and even augments during the eight days which follow the operation. But that which it is important to note, is that in proportion as

the globules are destroyed, others are produced with extreme rapidity. The number of the hæmatoblasts also augments after each bleeding, and in a marked manner; this it is which has led Hayem to say that every hemorrhage inevitably causes a *hæmatoblastic crisis*. This reproduction is even so rapid in certain animals, as the dog, that it is difficult to produce in them a persistent anæmic state by bleedings of moderate intensity, even if frequently repeated.

As for the leucocytes, Weber and Bauer maintain that they augment with losses of blood; Hayem affirms, on the other hand, that it is not so, and that their number remains the same after as before the emission of blood.

The modifications effected in the blood-plasma are less known than those of the globules. Thus, while Prévost, Dumas, and Jürgensen allege that there is augmentation of albumen, Becquerel and Rodier maintain that there is diminution. There is the same dispute with regard to the fibrin; White, Andral, Gavarret, Schutzenberger, Nasse, Sigmund, Mayer, Jürgensen, assert that fibrin is increased; Magendie, Coze, Hirtz, Brücke, affirm a decrease; Hayem is of the opinion of the first-mentioned experimenters, and according to his numerous researches there is a positive increase of fibrin after each blood letting.

As for the plasma, note that Arsonval has always found peptones in the serum after copious bleedings; this is a fact of great importance, and shows the modifications affected in nutrition by phlebotomy, the peptones being the result of a veritable *autodigestion* provoked by each bleeding.[4]

which persists from ten to twenty hours. When the hemorrhage is large a much more marked diminution in the red globules follows, and continues for several days.

In the dog it is difficult to cause any great degree of anæmia by bloodletting, and you cannot reduce the number of globules below 200,000 without producing death.

In the dog, moreover, reproduction of the red globules is effected with great rapidity.

Bloodletting, according to Hayem, is always attended with augmentation in the number of hæmatoblasts, what he calls a "hæmatoblastic crisis" resulting.

[4] Bleeding modifies the blood-plasma. We have few precise data respecting the modifications effected in the proportion of albumen.

According to figures given by Prévost and Dumas, there is augmentation in the quantity of water and albumen.

Jürgensen also found increase of albumen while Becquerel and Rodier report diminution.

As for fibrine, there are two contradictory opinions, Andal, Gavarret and Schutzenberger, have maintained that bleeding augments the proportion of fibrine and that the blood becomes more coagulable. Brichetau affirms that it is after the second bleeding that this augmentation in the proportion of fibrine is produced.

Other authorities, as Nasse and Jürgensen, have also noted increase of fibrine, and with their observations agree those of Hayem. Brucke and Magendie, Coze, Hirtz, singularly enough, have arrived at precisely opposite conclusions.

Darsonval has found constantly in the dog after bleeding, notable proportions of peptones in the blood. These peptones come from the auto-digestion which ensues after each bleeding. (*a*)

(*a*) Prévost et Dumas, *Examen du sang et de son action dans les différents phénomènes de la vie* (*Ann. de chimie et de phys.*, t. XXIII, p. 51, 1825).—Jürgensen, *Blutentziehungen* (*Hand. der. Allgem. therapie*, Bd I, p. 163, 1880).—Andral, Gavarret, Delafond, *Recherches sur la composition du sang de quelques animaux domestiques dans l'état de santé et de maladie* (*Ann. de chim. et de phys.*, t. V. p. 304, 1842.

This same modification in the nutrition is still further indicated by the diminution in the quantity of gases dissolved in the blood.[1] Lothar Meyer Mathieu, Urbain, Vinay, and Noil, have in fact observed a decrease in the quantity of carbonic acid, and especially in that of oxygen.

Bleeding has also an influence on the circulation. It at once modifies the pulse, and here, too, Hayem has shown us these modifications in the frequency, force, and form of the pulse. We must here distinguish the effect of one bleeding from that of several, and this distinction should always be made when the physiological effects of blood emissions are to be studied. When there has been but one bleeding, the pulse, half an hour afterward, becomes slowed; when on the contrary there have been repeated bleedings, the pulse augments in frequency in a sensible manner; in augmenting in frequency it diminishes in force, and its form takes on that which is observed in cases of anæmia or aortic insufficiency. The ancients attached great importance to this action of bloodletting on the pulse; they maintained that bleeding *raised the pulse*. One can readily understand, to-day, that this increased amplitude of the pulse results not from the greater energy of the circulation, but from the diminution of the vascular tension in consequence of the loss of blood.[2]

[1] Lothar Meyer, Vinay, Mathieu, and Urbain have remarked a diminution in the proportion of CO_2, and especially of O in the blood, after bloodletting.

Hayem, after an exhaustive study to determine the respiratory capacity of the blood, with relation to hæmoglobin, concludes that this respiratory capacity remains appreciably proportional to the contained hæmoglobin. (*a*)

[2] Hayem has remarked, after one bleeding, increase of pulsations during the operation, but this increase ceases half an hour afterward. When the hemorrhage is mortal, the pulsations increase at first, then diminish, and become irregular at the moment of death.

In the case of repeated venesections, the augmentation of pulsations becoms more and more marked with each bleeding, as is seen by the following table:

Before first bleeding	122	pulsations per minute.
During " "	164	" "
One-half hour after first bleeding	149	" "
Immediately " " "	180	" "
Before second bleeding, 24 hours later	148	" "
During " " " "	204	" "
Immediately after second bleeding, 24 hours later	189	" "
One-half hour " " " " "	209	" "
Before third bleeding, three hours later	188	" "
During " " " " "	240	" "
Immediately after third bleeding, three hours later	220	" "
One-half hour " " " " " "	220	" "

As for the force, Vinay from his experiments concludes that the force diminishes with acceleration of the pulse, and this is the rule in bleedings of moderate intensity. In fine, as to the form, after abundant hemorrhages the character of the pulse is like that observed in aortic constriction and insufficiency. (*b*)

(*a*) L. Meyer, Die gase des blutes (Zeitscher. f. rat. Med., Bd., 8, s. 256, 1857). Mathieu and Urbain, Des Gas du sang, experiences physiologiques, etc. (Arch. de Phys., 1872). Vinay, Thése agrég., 1880. Hayem, Leçons sur les modifications du sang, 1882, p. 227.

(*b*) Hayem, Modifications du Sang., p. 177. Vinay, Des Emissions Sanguinés dans les Maladies Aignës, Thèse de Concours, 1880, p. 25.

These modifications of the pulse are subordinate to the disturbance occasioned in the blood-pressure. For it is now admitted by all experimenters—Volkmann, Navrotky, Gatzirck, Vorm-Muller, Vinay, Hayem—that hemorrhages diminish the blood-pressure;[1] but in order that this diminution may be effected and maintained, considerable losses of blood are required, for, as Vinay and Arloing have shown, these circulatory depressions disappear with great rapidity. This diminution in pressure is accompanied with a swifter blood-current, but on condition always that the hemorrhage has not been too considerable.

These circulatory modifications give rise to troubles more or less profound in the functionating of the different organs. The respiratory movements, at first slowed, become more frequent, and more tumultuous in proportion as the hemorrhage becomes more considerable. Nevertheless, when the blood loss is moderate in amount, the dyspnœa is diminished; and this it is that explains the relief experienced by most patients affected by pulmonary diseases after bleeding. These respiratory troubles are connected with the perturbations caused in the functions of the nervous system by bloodletting.[2]

This *rôle* of the nervous system renders more complex than one would suppose the question of the physiological effects of blood-letting. Since we have learned the existence of the vaso-motors we are obliged to assign to the nervous influence, modified by the hemorrhage, a part quite as important as we ascribe to the direct effect of the loss of blood on the mechanical and physical conditions of the circulation.

[1] According to Volkmann's table, the normal vascular pressure being 155, a bleeding of 2 per cent. of the weight of the body reduces the blood-pressure to 56, and one of 3 per cent. to 30. Vinay and Arloing have established the following laws:

1. That venesection produces immediately a considerable lowering of blood-pressure in the arteries.
2. That equilibrium is reëstablished with great rapidity.
3. That copious bleedings effect great oscillations of pressure.

According to Hayem, the lowering of pressure is not progressive. Scarcely appreciable in the first fifth of a mortal hemorrhage, it is between the first and second fifth that the diminution takes place the most rapidly. It is inappreciable in the last stages of the hemorrhage.

According to Vinay, small or medium-sized hemorrhages are accompanied with a more marked irrigation of the tissues, but when the loss becomes more considerable the course of the blood changes, and is slowed. (*a*)

[2] Lichtenstein has remarked a diminution in the number and profundity of the respirations following medium hemorrhages. Bauer has arrived at the same results, but when the hemorrhage is more considerable, this diminution gives place to augmentation. In the experiments of Hayem, the respiratory movements augment and become more and more irregular in proportion as the hemorrhage continues.

These modifications result from the anæmia of the spinal cord produced by the loss of blood. (*b*)

(*a*) Volkmann, Hemodynamik, 1850. Vinay, op. cit., p. 21. Hayem, op. cit., p. 162. Gatzirck, Centralbl. f. d. Med. Wissensch, No. 53, p. 883, 1871.

(*b*) Lichtenstein, Zeitschrift f. Biologie, Bd. vii, 2 Hft. Bauer, Geschicht des Aderlasses, München, 1870. Hayem, op. cit.

We ought also to attribute to this double influence the action of bleeding on the temperature.[1]

Bleeding lowers the animal heat, and this in the normal as well as in the pathological state. It even seems to me that we have not of late years insisted enough on the therapeutic value of this powerful anti-thermic means. I know of none more active or more efficacious, and in contemplating what sometimes takes place in certain pyrexias, as typhoid fever, one is tempted to ask if it would not be well to return to the practice of bloodletting, after the manner of our fathers. This is what happens with our typhoid patients: when in the course of this disease a moderate hemorrhage appears, you see immediately the thermometric curve fall, and this lowering of temperature long persists. I know that this benefit is obtained at the expense of a convalescence often long and painful, but the fact none the less remains that, placing ourselves exclusively on the stand-point of hyperpyrexia, bleeding is a powerful depressant of this high temperature, and I am astonished to see an attentive observer like Lorain consider this fever-fall as transient and illusory.

Bleeding acts not only on the circulation, on the respiration, on the nervous system, on the temperature; it modifies the organism in its entirety, and the conditions of nutrition even.

Every abstraction of blood, as Lepine, Bauer, Claude Bernard, and especially Hayem, have shown, energizes the nutritive movement; but this activity produces, if the bleedings are prolonged, a fatty transformation of the different organs, and particularly the heart, and this is a point which must not be lost sight of.[2]

If, then, I were to sum up the physiological effects of bloodletting, and with special reference to its pathological applications, I would say: sanguineous losses of medium intensity diminish the number of globules and raise the pulse, while they enfeeble the blood-tension; they also lower the temperature; their

[1] In animals a lowering of temperature is observed after hemorrhage. The experiments of Marshall Hall, of Bœrensprung, of Gatzirck, and of Hayem, were absolutely demonstrative of this; in man the pathological temperature falls also. At the same time Thomas and Lorain have considered this fall as transient and illusory. (*a*)

[2] Experimentally, under the influence of bloodlettings, instead of obtaining a slowing of the nutritive exchanges, there is an acceleration; the experimental researches of Lepine prove this. According to Claude Bernard, bleeding has a constant effect to accelerate and provoke the organic exchanges. Bauer has studied experimentally on animals the action of bloodletting on nutrition, and he proves by the examination of the urine, as well as by that of the gases of respiration, that there is an exaggeration of the phenomena of denutrition and accumulation of fatty matters. He insists especially on the augmentation of urea, which is produced immediately after the bleeding, and which persists for several days. According to him, bleeding causes not simply a loss of fluid pabulum, but a real alteration of the organs and tissues. There is also a perturbation of nutrition under the influence of repeated bleedings, characterized especially by fatty transformation of the organs, and in particular of the heart, as Perl has shown. (*b*)

(*a*) Gatzirck, Centralb., 1871, p. 53. Bœrensprung, Müller's Archiv, 1851, p. 126. Hayem, op. cit.

(*b*) Lepine, Soc. de Biologie, 1880. Perl, Virchow's Archiv, 1873, pp. 39–51. Bauer, Zeitschrift f. Biologie, viii. Bd., 4 Heft., Munich, 1872.