

EXTRASYSTOLES AND ALLIED ARRHYTHMIAS

BY

DAVID SCHERF

M.D., F.A.C.P.

Associate Professor of Medicine, New York Medical College

AND

ADOLF SCHOTT

M.D. (Heidelberg), M.R.C.S.

*Medical Officer in Charge of the Cardiographic Department,
Queen Mary's Hospital for the East End, London*



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EXTRASYSTOLES AND ALLIED ARRHYTHMIAS

TO OUR WIVES

So nun die ding sichtlich werden müssen und one dise sichtbarkeit ist der Artzet nit gantz, Nun müß die natur dohin gebracht werden dass sie sich selbst beweist.

Paracelsus, *Das Buch Paramirum*, 1565

One lesson learnt long ago is that of my own ignorance. The older I grow, the more ignorant I feel, because I am continually learning how much there is yet for me to learn.

Theodore Taylor, aged 100
The Spectator, 4th August, 1950

PREFACE

WITH the possible exception of some processes in the central nervous system as shown in the electroencephalogram there is no other common disorder of a biological function in man caused by the abnormal behaviour of a small number of cells, possibly of only one cell, which lends itself so readily and so well to detailed analysis as do disturbances of cardiac rhythm due to extrasystoles and allied arrhythmias.

At first sight this topic may appear to be a very limited one, but closer study proves this view to be erroneous and reveals not only its considerable scope and complexity, but also the numerous links which relate it to other biological problems, physiological as well as clinical.

Even taken by itself the physiological and clinical implications of such disturbances of rhythm are great. Experimentally such arrhythmias can be produced by numerous and diverse means with a varying degree of ease, yet many fundamental aspects are still imperfectly understood or altogether obscure. Moreover, since Marey's and Engelmann's pioneer work the "method of extrasystoles" has been an important tool in the investigations of manifold problems of cardiac physiology.

Equally great is the clinical range of such irregularities of cardiac rhythm. There is hardly a human being who at one time or other has not had extrasystoles. Their clinical significance extends through the whole spectrum from the entirely harmless occasional "missed beat" of the healthy subject to the ominous ectopic beats heralding fatal ventricular fibrillation. And the variety and severity of symptoms mirror that of the prognostic significance: at one end of the scale the accidentally discovered asymptomatic extrasystole, at the other seemingly identical disturbances of rhythm giving rise to truly agonizing pain and distress.

Our interest in these problems was aroused nearly thirty years ago by Prof. Wenckebach to whose hospital we were attached at that time and we should like to put on record our gratitude to him as well as to Prof. Rothberger for the encouragement they gave us in our early studies. For the last three decades we have collected observations and data, and have formulated ideas about extrasystolic and allied disturbances of rhythm and their various aspects. By 1939 we thought that the progress made in this subject warranted a review in a comprehensive manner, but owing to the war we were not able to start before 1945.

We were encouraged to undertake this venture by various considerations. With the exception of von Skramlik's monograph published in 1932 and limited to certain physiological aspects no book devoted to this problem had appeared, and Léon Gallavardin's monograph, subsequently published in 1946, is confined to a description of the purely clinical aspects of auricular extrasystoles. In textbooks on cardiology, electrocardiography or physiology extrasystolic arrhythmias are of necessity not treated in a detailed, let alone exhaustive, manner. On the other hand, more recent advances in electrocardiography and physiology, particularly neurophysiology, have thrown much light on this problem and have made it possible to form more detailed views about some of its aspects than was possible some time ago.

It seems to us then that these considerations justify an attempt at a comprehensive review of such disturbances of cardiac rhythm; and in the pages that follow we endeavour to give a

description of the subject in its general biological context which we trust will also bring out its close relation to numerous allied and some seemingly unrelated phenomena. Though we are well aware of the gaps in our knowledge and of many shortcomings of our presentation we hope that this book will be of interest not only to cardiologists, but also to those who are engaged in the study of physiological and clinical problems which centre round the initiation and propagation of impulses.

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D. S.

A. S.

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INTRODUCTION

Opto magis sentire compunctionem quam scire eius definitionem.

I had rather feel compunction than understand the definition thereof.

Thomas à Kempis, *Imitatio Christi*, ch. I, § iii

When trying to define the meaning of "extrasystole" and to determine the scope of this book, some difficulties were encountered.

Originally the word "extrasystole" was used by Engelmann in his physiological work in which, extending Marey's studies, he investigated the effect upon cardiac rhythm of artificial—extra—stimuli, thereby laying the foundation for the subsequent clarification of the nature of many varieties of irregular heart action in man. It was later contended, however, that in the description of the common clinical arrhythmias the term extrasystole should be abandoned as the disturbance is not produced by an "extra" systole in the sense of an additional contraction, but the abnormal contraction usually only replaces a normal one. It was held that the term "extrasystole" is strictly applicable only to interpolated ones, in which case there is one supernumerary systole. Others were in favour of keeping this time-honoured word, pointing out that "extra" should be understood as meaning: originating outside the normal area of impulse formation, that is, synonymous with ectopic. This definition, however, excludes sinus extrasystoles which, arising in or near the normal pacemaker, are not ectopic. "Extra" could also refer to a different mechanism of origin, namely, heterogenetic, but our limited knowledge of normal, let alone abnormal, impulse formation precludes a classification of any group of arrhythmias based on differences in the mechanism of impulse formation. Others again preferred to speak of "premature contractions". While it is true that the great majority of such contractions are premature, this too is not entirely satisfactory as a basis for definition, as extrasystoles need not be premature. In cases of sinus arrhythmia an extrasystole may occur at a time when a normal contraction may well be expected, and apart from such cases electrocardiographic records have demonstrated that extrasystoles which occur at about the time of a normal systole may result in a contraction which is due to both the normal and the abnormal stimulus. As far as extrasystoles in auricular fibrillation are concerned the term "premature beats" would be altogether unacceptable.

It is therefore clear that neither the ectopic origin alone nor the prematurity alone can be considered adequate criteria for defining extrasystoles. We believe the most important feature of extrasystoles and allied arrhythmias to be the fact that, in all such cases, a dominant rhythm is interfered with, or replaced by, contractions due to abnormal impulses. The essential characteristic of this group of disturbances of cardiac rhythm is, therefore, the abnormality of impulse formation; and this feature separates it from those in which the fundamental or primary disturbance is one of conduction of normal impulses, even if this be associated with beats originating at abnormal sites, for example complete A-V block, or some varieties of S-A block.

The group of arrhythmias which are discussed in this book could be defined as contractions of the whole heart, or parts of the heart, due to impulses which are abnormal, either regarding their site of origin—ectopic—or their time of occurrence—premature—or both, interfering with, or replacing a dominant rhythm.

In the vast majority of instances such impulses are ectopic in origin.

Simple sinus tachycardia as well as sinus arrhythmias other than sinus extrasystoles are not included as they are solely due to variations in rate of an otherwise normal cardiac mechanism. The dividing line between normal and abnormal is but vaguely defined in these conditions which do not present any special problems either physiological or clinical.

Within the above great group of arrhythmias, abnormal beats following the preceding beat at a constant interval—that is having accurate coupling—command a special place, not only because this type of irregular heart action is very common clinically, but also because we believe that in this type of arrhythmia the abnormal beats are due to a mechanism different from that underlying the other varieties of disturbances of cardiac rhythm covered by the above definition. With the exception of the exceedingly rare sinus extrasystoles, in this group too the abnormal beats with accurate coupling are ectopic in origin. It is this group of arrhythmia to which, in our opinion, the term extrasystolic should alone be applied.

For the purposes of this book we therefore define **extrasystoles** as *contractions of the whole heart, or parts of the heart, due to impulses which are abnormal, either regarding their site of origin—ectopic—or their time of occurrence—premature—or both, interfering with, or replacing a dominant rhythm, whereby in the electrocardiogram the abnormal beats are accurately coupled to the preceding beat and in many though by no means all cases have constant shape.*

Instances will be discussed in this book in which ectopic beats with accurate coupling have varying shapes in the electrocardiogram, but which, because of their accurate coupling, we believe to have the same mode of origin as those with constant shape, and which, for this reason, we include in the group of extrasystoles in the strict sense of the term. The very rare observations of cases with certain types of systematic changes in the coupling of ectopic beats, in which we believe the underlying mechanism to be the same as in those of extrasystoles with accurate coupling and which we therefore include in this category, do not invalidate the above definition.

It will have become apparent that, in a book having a scope as defined, we are not describing one entity, but that disturbances of rhythm of widely varying types and mechanisms are included. Thus, there are good reasons to assume that active formation of automatic impulses is likely to be the mechanism in parasystole, whereas in the commonest form of extrasystolic arrhythmias, namely those caused by ectopic beats with accurate coupling and constant shape in the electrocardiogram, the extrasystolic stimulus should be considered to be a more passive phenomenon, dependent upon, and precipitated by, the preceding beat. This distinction will be discussed in detail.

The above definition of the scope of this book includes paroxysmal tachycardia as well as auricular flutter and fibrillation. The close relation of paroxysmal tachycardia to extrasystoles is universally recognized. Not only is paroxysmal tachycardia regarded as a series of extrasystoles occurring in succession, but also the accurate coupling of the first ectopic beat of such paroxysms is a further and important link between this paroxysmal disorder of rhythm and true extrasystoles; the occurrence between attacks of isolated extrasystoles of the same shape and coupling in the electrocardiogram is an additional observation pointing in the same direction. Flutter and fibrillation being due, in our opinion, not to a circus movement, but to frequent impulses originating in a circumscribed focus, or foci, are more closely allied to extrasystoles than commonly assumed. While their nature and mechanism will be discussed in some detail, from a clinical point of view they form distinct entities and, except for some remarks on differential diagnosis, the clinical aspects of auricular flutter and fibrillation and their ventricular counterparts will not be considered as they are fully discussed in current cardiological textbooks.

Other arrhythmias which would not usually be termed extrasystolic are included for a variety of reasons. For instance, without detailed analysis dissociation with interference

cannot be distinguished from the common varieties of extrasystoles and for this reason alone had to be discussed in detail. Moreover, it can well be argued that, in dissociation with interference, the interfering sinus beats, even though they occur according to an undisturbed sinus rhythm, are premature in the sequence of the otherwise regular dominant A-V rhythm and that this arrhythmia thus presents a disorder of rhythm which falls within the scope of this book as defined. Alternans is included for entirely different reasons, namely for historical ones and because of the effect of extrasystoles on alternation.

We propose to use the term "extrasystole" as defined above, but also to employ the terms "premature beat" and "premature contraction" where applicable. As far as beats which we do not consider to be extrasystoles are concerned the terms "ectopic", "heterotopic" and "automatic" will be used. The first two denote only impulse formation at an abnormal site, without any implication as to the presumed mode of origin. The reasons for our contention that automatic beats should be separated from extrasystoles will, we trust, become clear and acceptable in the course of this book.

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CHAPTER I

HISTORICAL REMARKS

It is safe to assume that from time immemorial the rhythmic pulsations of arteries have aroused the curiosity of man and that irregularities of the pulse have puzzled the physicians as much as they have alarmed the patients. Some 3,500 years ago, some connexion was thought to exist between the pulse and the heart: "In the heart are the vessels to the whole of the body. As to these every physician, every sextet-priest, every magician, will feel them when he lays his fingers on the head, on the back of the head, on the hands, on the stomach (? heart) region" and "he will make examination of the heart on account of its vessels for every member" is stated in the *Papyrus Ebers* (Dawson; Bryan).

In ancient China, the beginnings of the art of pulse feeling seem to be lost in the mists of antiquity, but certainly date from about 500 B.C. (Read). Some records of the observation of intermittences of the pulse appear to go back to the sixth century B.C. and are contained in the *Difficult Chapters of Medicine* by Pien Ch'io (edited by Wei Yuan 1693) (Hübotter). Intermittence of one pulse in fifty was thought to be compatible with health, but with intermittences of one in forty, thirty, twenty and ten beats, one, two, three or four organs respectively were considered diseased and death expected to occur in four, three, two and one year respectively. Intermittence of one pulse in every three or four meant death within six to seven days and with every other pulse failing to appear the patient had only three or four days to live; no mistake about the prognosis was considered possible so long as such rules were observed (Hübotter). In view of the fantastic ideas in ancient China about the importance of the pulse—it was believed that the site and nature of all diseases could be diagnosed from the pulse alone—it is not surprising that various kinds of intermittency, which were thought to denote various and definite diseases, were described in detail. In the *Pen tsao*, or *System of Medicine*, which it took Li Shi-chen about thirty years to compile in the sixteenth century A.D., the chieh pulse is defined as "intermittent, slow, with occasional missing beats", the tai pulse as "irregular, tremulous, beats occur at irregular intervals", and the tsu pulse as "running, rapid, with occasional missing beats" (Wang). When such distinctions originated does not seem to be known with any degree of certainty; a *Pulse Classic* of ten volumes existed about A.D. 280. Some of these ideas can still be traced in the eighteenth century (see below).

The first to describe what may have been extrasystoles was Herophilus (born 300 B.C.). According to Arcieri the term "dicrotic pulse" is due to him (*δίκροτος* = double beating) and he compared it to the jump of a goat, being accomplished in two actions. Hence the term *Pulsus caprizans*. Herophilus also recognized that the pulsations of the arteries are caused by the heart beat and that they are rhythmic and in relation to age and disease.

The term *δίκροτος* in relation to pulse was also used in the second century A.D. by Archigenes, and by Rufus (see Appendix A) (Liddell and Scott).

At about that time Galen (132–201) published his ideas about the grave significance of the intermittent pulse, ideas which were to influence medical thought until the beginning of the twentieth century. Galen taught that of the irregularities the intermittent pulse was the most dangerous (9, 294); it may produce sudden death (9, 544), but there were many varieties the most serious of which were persistent and continuous intermissions (19, 584); if the second beat was more powerful than the first it was less serious than if the second beat

was weaker (9, 294). The intermittent pulse was considered by him to be particularly dangerous in adolescents, less so in old people and in children. In the aged the body was soft and its humours upset by smaller causes so that the body could rid itself more easily of the evil humours. In children there was, in addition, a more effective concoction of the normal humours which was a further point in assisting the elimination of the evil humours and their restoration to normal composition (9, 283).

If normal "proportions", that is time relations between arterial systole and diastole, obtain, the pulse was termed *eurhythmus*. (As Galen designated by diastole the expansion of the artery and by systole its contraction, his terminology is essentially the reverse of the modern one. This should also be borne in mind regarding the writings of Thomas Fienus, discussed below.) If such time relations were abnormal, the pulse was called *arhythmus*. Amongst *arhythmic* pulses three varieties were distinguished by Galen according to the degree of deviation from the *eurhythmus*, namely *pararhythmus*, *heterorhythmus* and *ecrhythmus*, in ascending order of abnormality. This classification warrants to be briefly mentioned since the term "*pararrhythmia*" has more recently been revived, though with a different and more specific connotation. While the terms *heterorhythmus* and *ecrhythmus* have become obsolete, the word *heterotopic* is often used as synonymous with *ectopic*. What Galen termed *intercidens pulsus* may perhaps have been interpolated extrasystoles. (8, 515; 19, 409, also 9, 471.)

Galen also distinguished between the *pulsus caprizans* and the *pulsus dicrotus*: whereas in the former there were several pulsations in one systole, in the latter there were only two (19, 640). For extracts from the original, see Appendix B.

That Galen's views held sway for many centuries is common knowledge; the extent to which his teaching about the pulse dominated medical thought until the seventeenth century and influenced it even later, and the difficulties with which his assertions were subsequently replaced by the result of observations is truly astounding.

A medieval reference to bigeminal pulse may have been contained in the consil. 266 of Bartollomeo Montagnana (senior), Professor of Medicine in Padua 1422-1441 (Fig. 1). His patient was a youth named "Federicus, of the famous city of Vicenza and the celebrated family of Verlactius". After tabulating the symptoms Montagnana goes on to explain them according to current theory, that is giving the "formal" (we say "scientific") explanation. The aerial spirits conveyed in the arteries are contaminated by evil vapours. The more the vapours accumulate, the more necessary it is that they be cleared, and the heart therefore works faster and faster in order to get rid of them. Then he continues: "But this is the 'formal' cause of the bigeminal pulse. Therefore the bigeminal pulse appears in this youth with a tremulous movement of the heart; as I have said." (See Appendix C.) In considering this to be a reference to bigeminal pulse we are in agreement with Herrick, who quoted Testa in this connexion, but Willius and Dry interpret this passage as possibly referring to the arrhythmia of auricular fibrillation.

In the sixteenth century Galen's teaching seems to have been generally accepted and repeated without any questioning. An interesting discussion, held, between 1551 and 1554, entirely in accordance with Galenical views on what we would now regard as a case of extrasystolic arrhythmia following dysentery, has recently been published by Friedenwald. One of the earliest monographs on the pulse, Petropaulus Galea's *Tractatus de Pulsibus*, 1597, reiterated Galen's views.

A few examples taken from authors from the sixteenth to the eighteenth centuries may be quoted in some detail in order to show the hold of the Galenical teaching at that period and the way in which its value came to be doubted. The part played by humoral pathology will be noted.

Petrus Salius Diversus, in his *De febre pestilenti Tractatus*, etc. (1586) wrote that two signs indicated impending cardiac syncope and sudden death: first, a sensation of sudden

constriction of the heart associated with collapse, pallor and perspiration, and: "the second is that in these [patients] an intermittent pulse sometimes occurs; if the intermission extends beyond one pulse great danger threatens and it signifies that such syncope is

De egritudinibus

CAP. I.
De casu disponsio et accidentibus pccōz.

Edericus de famosa vrbe Uincetia et de celeberrima pgenie Uerlacio verriens. egrotat vna disponsio multis tñ accidentib⁹ associata q̄ indubitanter minatur sibi terminationē verendas satis nisi caute et sollicitè multū regendo se defendat ab ea.

Est enim hec dispo cōplexio frida et būda malis totius corporis pncipalibus tñ et fortior et fissa magis regitur in corde et cerebro ipsi q̄ in alijs membris. Declarat̄ hāc disponsio signa q̄ plurima. Prīmū q̄ tactu pcpit̄ qualitas corporis friditate representat̄ magis q̄ caliditate et humiditate q̄ siccitate: sed tact⁹ ē verior regula in indicio de q̄libet rāgibilib⁹. vt tercio cōplexionum capitulo tercio.

Secūdu signū est. quia pulsus parvus et rarus est. sed hec oia frigiditatis excessum signant.

Tertiū q̄ pccō pccōt̄ oīa pulsus ē et mollis vel lenis.

Quartū q̄ epistē mutatū q̄ ē vrina aliqui paleas vel subcitrina aliqui glauca tenuis vel aquosa apper. sed oīs bi colores augmentū frigiditatis ostendunt.

Quintū q̄ color et permixtus ē ad subalbedinē in toto corpore maxime vō in facie et in oculis.

Sextū q̄ anbelit̄ eīno ad paruitatē tarditatē et raritatē inclinat magis q̄ ad differētiā oppositionis ostendat nisi supueniat ei fero paroxysmalis motus periodice fleumatice nō pure. sed pueniēs a multitudine stigmaris cuius pauca quantitate colore sicut sensibilis aduenire in eo pccōt̄ variant̄ signa pccōt̄. sicut ē rōnale satis.

Hanc vero malā cōplexionē fri. et bu. mālēs in corde auctā signa iam pmissa declarat̄. Et iterū hoc confirmat p pñus accidens q̄ cōcomitat̄ hāc disponsio ē et motus tremulus cordis qui nō est ictigianus motus. sed fortius illo est. nec pulsus vel saltus cordis q̄ pñm cōsequatur necessitatem valde auctā in corde aut vebementē conatū virtutis ad nocuētū expellēdū in eo expit̄. Est ḡ motus tremulus medio modo he bñs iter pulsariū et ictigianū victus.

Pulchre considerādū ē q̄ in tali tremulo motu cordis nō raro imo frequēter apparet mot⁹ bis pulsatus cū enim in corde augeat friditas que debilitat inatū calozē ei⁹ ne cesset multitudine vaporū in corde gñari et augmētari q̄ incitant virtutē ad sepe fistolādū grā mūdificationis pccōt̄. sed vñs p̄p debilitat eius nō pōt cōueniētē appplicare ptes artarie de circūferētia ad cētrū. Ita vt tātū expellat̄ de vapore quātū in eo gregatur. ergo citius in surgit fistolādū necessitas q̄ insurgeret si virtus maiorē faceret fistolādū. Cū ḡ vñs mouet artaria a termino a quo ad terminū ad que grā finis pccōt̄. prīmū augmētatur necessitas mūdificādi maior a multitudine vaporū. ḡ pñ tpe mouebit artaria scdm aliquas ptes q̄ cōpleat̄ ei⁹ mot⁹ a termino a quo ad terminū ad que sed ista ē rō formalis pulsus bis pulsantis. igit apper in B iunēculo cū tremulo motu cordis pulsus bis pulsatus: q̄ erat dclorādū.

Et si considerat diligētē inspiciat videbit motū quasi cōsimilē i fistole anbelit̄. pñs enī tpe q̄ cōpleat̄ fistoles anbelitus a termino a quo ad terminū ad que augmētatur cōtinua necitate mūdificationis necesse ē incitari virtutē ad frequēter cōstringēdū anbelitū vt ipsa sufficiētē alleuet se cū mūdificatione fumoꝝ i pectore cōtemtorū. sed hec ē rō formalis pccōt̄ anbelit̄ duplicati vel bis pulsantis. igitur et cetera.

Et ex B fidamētō subtili pccōt̄ apparet q̄ si disponsio nō curabit ab B iunēculo i boeni tpe multiplicato vapore et necitate supaddita p̄p extramētōem vaporū q̄

Con. CCLXVI.

nō debite regat̄ a virtute par⁹ ē de tremulo motu cordis pmutari ad magnū pulsū cordis pccōt̄ q̄ minat̄ sibi mortē subitā. Ille enī q̄ h̄s motū tremulū cordis sibi cōtinuū caueat ne subita intercipiat mortē. vt 3^a pñl. cap. 8 bis q̄ pñsticat egritudines. et 12^a terry. caplo de tremore cordis vñalr colligit. Vñ ex hoc fidamētō apper q̄ scdm accidēs hāc disponsio cōmitat̄ nocuētū in anbelitu dñmā nolandū et p̄prie cū p̄stictioe anbelitus.

At vero iterū declarari oīs hanc frigiditatem et humiditatem i capite et cerebro b⁹ iunēculi inalefcere q̄ facile ex multis declarari pōt.

Primo q̄ pccō pccōt̄ oīs friditatis et būditatis augmentū magis ostendit q̄ alia qualitatū excessum.

Secūdo q̄ bitudo faciei semicaceticā est vt sensus vñs ostendit. ē enī facies eius cū iflatioe representata: q̄ gdm nō pūit ex nocuētō epatis. discurredo enī p signa ostēdētia lapsū epatis nō apper ipm ē lēsum in opationib⁹ cōibus: sufficiētē enī cūbiū trāsmutat i būditatē mām fecitrat ipm a supfluis et delegat ei⁹ ptes ad loca q̄b⁹ nā luer deputate sūt. Necq̄ ē apper epas ex lapsum i opationibus p̄p̄s. sufficiētē enī ip̄s nutrimentū attrahit et retinet digerit et expellit supflua ei⁹. alr enī cōtinuē macerando deficeret. Cū itaq̄ caceticē ip̄s in facie b⁹ iunēculi apparet et p̄steno nō pueniat a nocuētō epatis vt arguitur ē segit q̄ op̄s illius iuenire cām vel cās pducit. Est igit̄ modus imaginādi B talis nutrimentū enī q̄ fess ad cerebrū et totū caput grā ipsius nō sufficiētē digerit et depurari pōt a supfluis p̄p friditatis et būditatis augmentū i eo. et q̄ l̄s nutrimentū appōat cerebro et pñl. cap. 1. ip̄s nō sufficiētē vñf neq̄ assimilāt mēbris illis. Cū itaq̄ delectat̄ a pueniēti ope nāe a calozē aliquā extraneo puerit̄ i humilitates et vapores q̄ i poris subcutaneis et venis capillarib⁹ imerit̄ tumozē i tota facie efficiat vt i telligēt apper. vñ et si nutrimentū sit cā b⁹ caceticē remōis vapor vō ex illa gñatus sit cā i mediata: tñ fortior vñ esse opinio tua ad pccōt̄ vaporē ab iferioribus pñbus ad caput eleuari posse cā mālē cām b⁹ caceticē disponsio. Cū mīoz enī pueniētia mouet vñs ad agēdū in vapore vñ in obiectū nō sibi p̄portionatū q̄ ad agēdū in nutrimentū sibi pueniēti: sed nō pōt rectificare nutrimentū. igit neq̄ poterit regere et rectificare vaporē q̄ erat declarandus.

Uñ ex fidamētō B apper q̄ b⁹ caceticē duplex assignatur cā. Prīma ē mala corpore frigidi et bu. cerebrū pccōt̄ cōmū vaporū gñatus. Secūda ē mālīs cā cōordinatū et ē multitudine vaporū a toto corpore ad caput eleuatorū. p̄p q̄ nō raro p̄tingit errare medicos in iudicio cāz. caceticē similis. Frequēter enī diiudicat illius caceticē cāz cē nocuētū epatis et nō est vñz semp vt ex pccōt̄ apper.

Tertiū motū ad p̄bādū iterū cerebrū eius cē infrigidatū et burnectatū sumit a supfluitatū inuentione. multiplicat enī cerebrū eius supfluitates mīcosas et aquosas que qñq̄ per palatū: non raro vero p̄ nasum: et aliq̄ per oculos sensibiliter effundunt. qñq̄ ē infensibiliter et occulte per venas et nervos a cerebro ad pccōt̄ multiplicatur et stomachū: et sunt causē quarū accidentis statim dclorandū: sed bñ materiatū multiplicatio oīo arguit excessum humiditatis et frigiditatis. quare et. Tñ curari hic adducere signa sumpta ab opationibus aīalibus: vt a lō gitudine et p̄fuditate somni. neq̄ sumpta ab opationib⁹ sensuum exteriorū et interiorum effugiens magis pccōt̄ p̄tatem q̄ ignozantiam.

Quartum accidens et verendum satis q̄ pccōt̄ disponsio cōcomitat̄ et tensio in regione media stomachi b⁹ iunēculi cū dolore ibides salte tactu illius loci multiplicata et intensā: q̄ qd̄ dolor et is poterit ēē tempore pccōt̄ disponsioem pccōt̄

FIG. 1.—Page of Bartolomeo Montagnana, *Consilia medica*. Cons. 266. Venice, 1497.

imminent; which intermission, as well as the feeling of suffocation, originates nowhere else but from that amount of thickened blood which obstructs and impairs those vessels and internal parts." (See Appendix D.)