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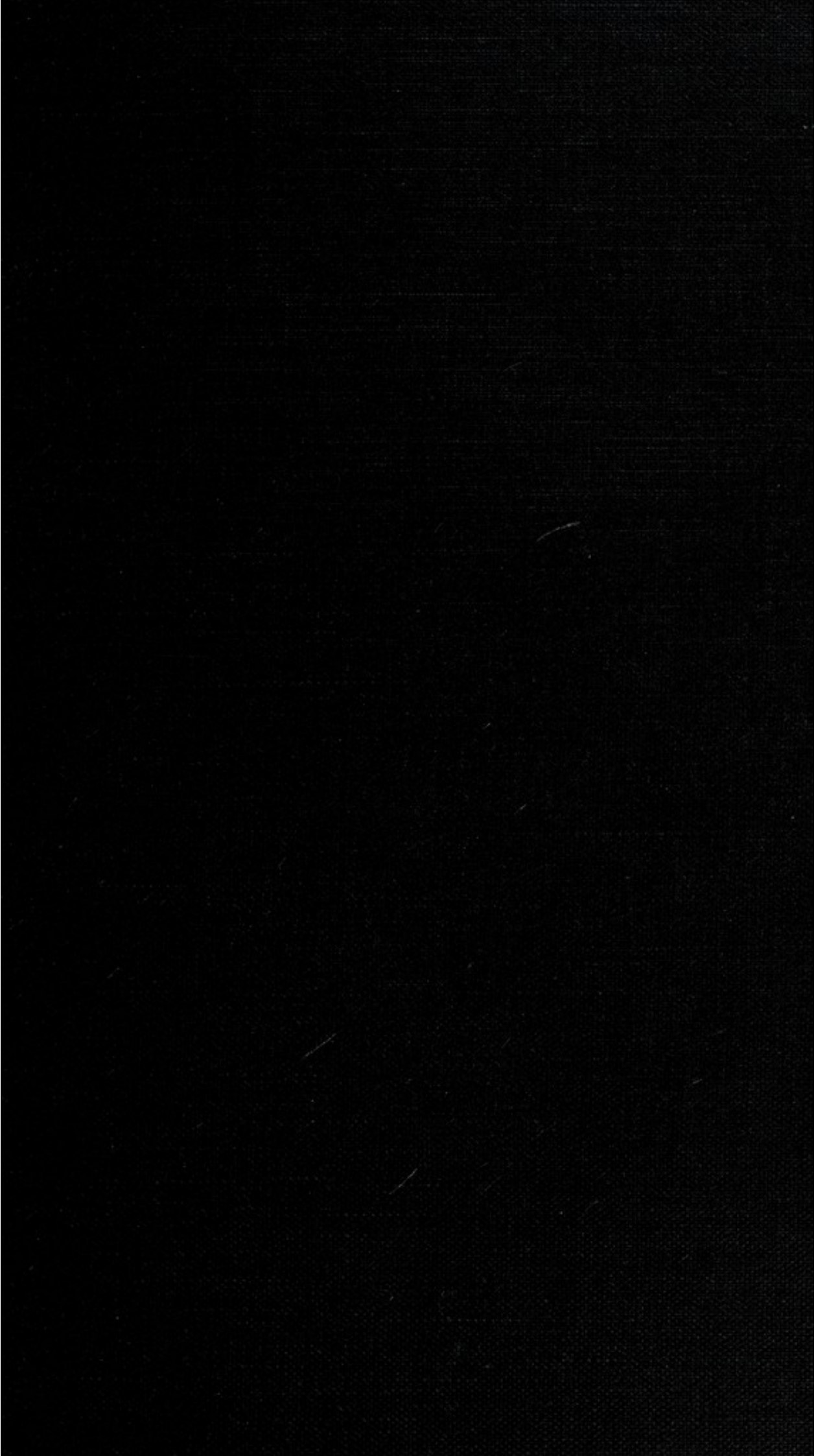**Persistent URL**

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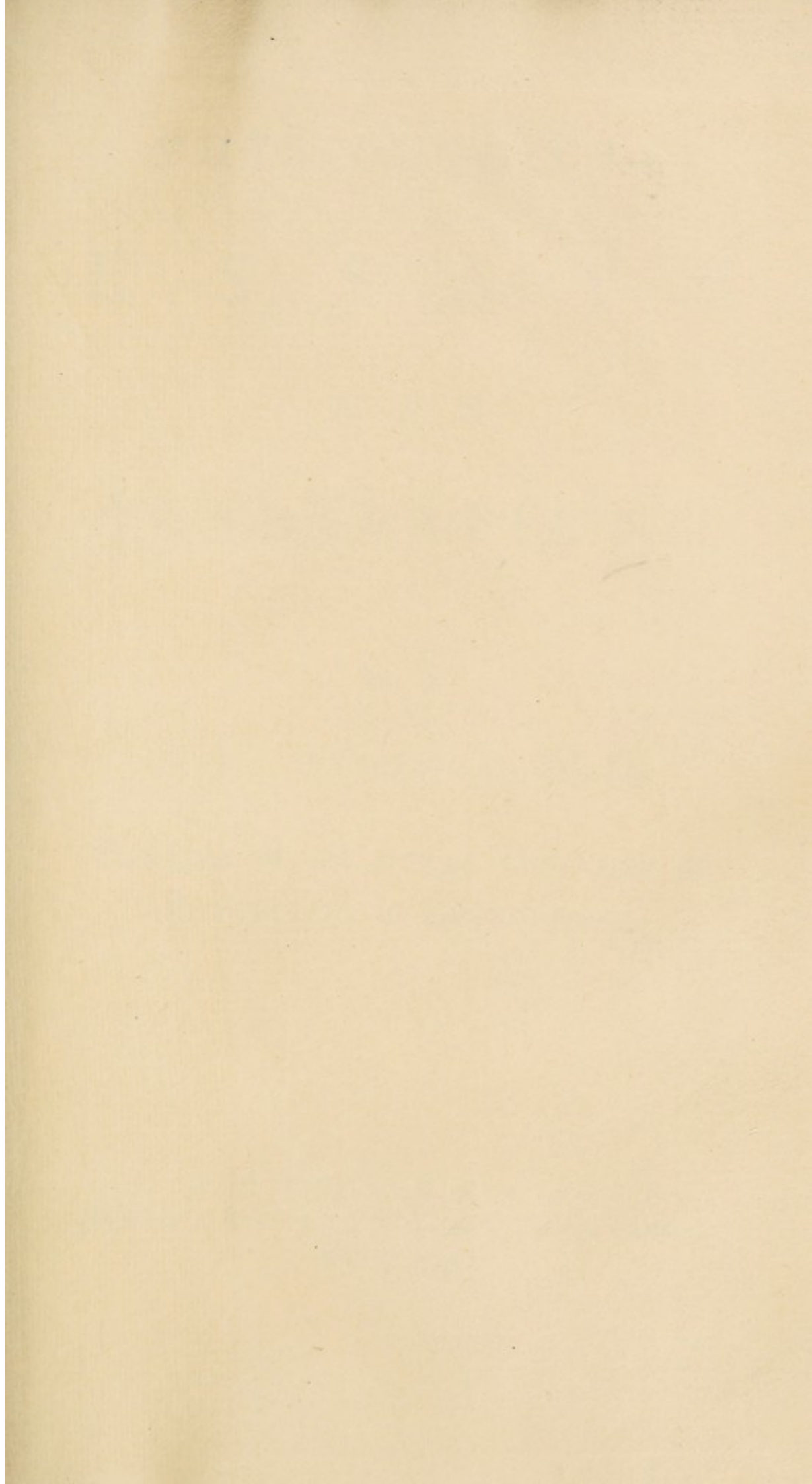
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PHYSIOLOGICAL
ESSAYS

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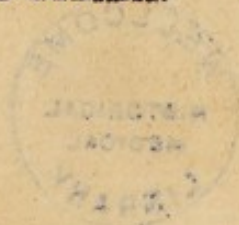
OBSERVATIONS,

BY

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ESSAY I.

OF THE

DIVISIONS

OF

PULSES.

A

E S S A Y I.

Of the DIVISIONS of PULSES.

AMONG the various figns of difeafes, none are more frequently, nor more juftly, attended to than thofe arifing from the pulfe; and though fuch may be, for the moft part, infufficient by themfelves to afcertain the nature of any diftemper, yet we can feldom, with fafety, proceed to the cure, without taking fome indication from the ftate of the pulfe.

OF the different conjectures which we are enabled to form from the pulfe, the moft obvious are, the increafed or diminifhed velocity of the blood, when either of thefe are in a confiderable degree; the changes in the action of the heart and arteries, and the comparative force of thefe organs. From the pulfe likewife we are frequently enabled

A 2

to draw indications relating to the quality of the blood. But thofe who have been moft attentive to the fymptoms of difeafes, and are acquainted with the animal œconomy, will judge beft of what importance an accurate examination of every circumftance relating to the pulfe muft be in the practice of medicine.

THE multiplicity of definitions, and the too minute divifions of pulfes, have, inftead of perfpicuity, been productive of fome degree of obfcurity. Many authors have mentioned the GREAT, the STRONG and the FULL pulfe indifcriminately, though thefe may be eafily diftinguifhed. It is hoped, therefore, that an attempt to correct thefe, with fome other improprieties and defects in this part of pathology, will not be deemed unfeafonable.

BELLINI, who hath written explicitly on this fubject, makes the firft divifion to confift of twelve kinds; or of fix, each having

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ing its oppofite correfponding pulfe: thefe are the PULSUS MAGNUS and PARVUS; FORTIS and DEBILIS; PLENUS and VACUUS; CELER and TARDUS; FREQUENS and RARUS; MOLLIS and DURUS.

SOME of thefe are feldom, if ever, expreffed in Englifh; for which reafon they are here, and fhall be throughout this effay, mentioned under Latin names.

WHEN we confider in what refpects a pulfe may deviate from its natural ftate, we fhall thereby be led to make the firft great and fimple divifion: after which it will be eafy to conceive what is meant by compounded pulfes.

AN artery may differ from its natural action by being too much, or too little, dilated; or in its pulfations being too frequent or too flow.

IT is evident that many divisions may be conceived, from the various dilatations of an artery, independent of the frequency of the pulsations; and likewise some from the frequency independent of the other. But, in making the first and simple division, it will be proper to distinguish, as much as possible, these different pulses by the greater or less frequency of the pulsations; that is, when the pulse exceeds, or falls below, its standard number in a given time. The reason is evident, when we consider, that we can be sure of the number of pulsations; whereas the various degrees of dilatation of an artery cannot be ascertained with such precision as to establish accurate divisions.

IT may be observed here, that, in mentioning the standard number of pulsations, it is not to be understood as if this could be restricted to a precise number. But if, in a matter so delicate, we can come within six, eight, or, in some people, ten pulsations, it will be sufficient for all the purposes wanted.

As

As a deviation from the natural dilatation of an artery rarely, if ever, happens, at leaſt from an internal morbid cauſe, without the pulſe likewiſe changing from its ſtandard number, we may, from hence, be led to deduce the four following pulſes.

1. WHEN the artery, in its vibration, exceeds its natural dilatation, the number of pulſations being equal to, or falling below, the ſtandard.

2. WHEN the artery falls below its natural dilatation, the number of pulſations being above the ſtandard.

3. WHEN the artery exceeds the ſtandard both in the dilatation and number of pulſations.

4. WHEN it falls below its natural dilatation, the number of pulſations being equal to, or below, the ſtandard.

THE

THE first of these I call the PULSUS MAGNUS; the second, the PULSUS PARVUS; the third, the PULSUS FORTIS; and the fourth, the PULSUS DEBILIS. The first of these differs from the second, and is opposite to it, both in the dilatation and number of pulsations; and the third differs from the fourth in the same respects.

THOUGH the differences in the dilatations of the artery, and the differences in the number of pulsations, generally, perhaps always, attend one another; yet, as the former are often wholly undistinguishable by us, we must therefore add to the first class the PULSUS FREQUENS and RARUS; that is, when the number of pulsations exceeds, or falls below, the standard, while the extension of the artery is, to our feeling, unchanged. Could we discover the various extensions of an artery with the same accuracy as we can reckon the number of pulsations, these two pulses, the FREQUENS and RARUS, might be neglected.

ALL

ALL thefe pulfes may be better conceiv-ed from the figure *, where *a b*, the di-ftance betwixt the parallel lines, expreffeth the difference betwixt the fyftole and dia-ftole of the artery in the pulfes defcribed a-bove: *a c*, the times: and the undulations, diftinguifhed by the numerical figures, fhew the number of pulfations in equal times. From the figure, this clafs of pulfes may be conveniently compared with the mean or natural ftate of the pulfe.

THE reafon why the PULSUS FORTIS is thus diftinguifhed from the PULSUS MAG-NUS, will be obvious when we confider, that, in order to make the artery ftrike againft the fingers with vigour, it is not only ne-ceffary that it exceed its ufual dilatation, but likewife that the number of pulfations, in equal times, be increafed.

WE may have a juft idea of this from a pendulum; for, if the ofcillations of the pen-
B dulum

* Plate I. Fig. 1.

dulum be wide, but flow, thefe correfpond to the PULSUS MAGNUS. But, if the ofcillations of the fame extent be accelerated, thefe will give a proper idea of the PULSUS FORTIS: for the force with which the pendulum would ftrike againft any refifting body is increafed according to the degree of acceleration.

THE PULSUS PARVUS is fo named from the diminifhed time of each pulfation, and likewife from the vibrations of the artery being more contracted than in a natural ftate. The PULSUS DEBILIS conftantly indicates an unnatural weaknefs in the action of the heart. Thefe two pulfes are frequently mentioned indfcriminately: but, as they may be diftinguifhed with eafe and certainty, and as they correfpond with propriety to the two preceding pulfes, it is hoped that this divifion will be admitted.

THERE remains another kind of pulfe in this divifion; this is when the artery, in the fyftole, doth not return to its natural ftate

of contraction; or rather, when, in the fy-
ftole, the diameter remains more extended
than it ought. This is the PULSUS PLE-
NUS; and, as it indicates a *plethora*, may
properly be termed the plethoric pulfe.
In this cafe there feems likewife to be, for
the moft part, an uncommon dilatation in
the diaftole, and the artery is felt full, foft
and obtufe, though its vibrations be feeble.
The PULSUS PLENUS is fo named, not
from a great, or ftrong, vibration of the ar-
tery, but from the indication of an unnatu-
ral fulnefs in the veffel.

THIS pulfe is often confounded with the
PULSUS MAGNUS, as the learned M. de
Haller obferves; and yet they may with-
out difficulty be diftinguifhed: for the vi-
bration of the artery, in the PULSUS PLE-
NUS, is weak and confined, though the ar-
tery be really full and extended: whereas,
in the PULSUS MAGNUS, the vibration is
greater and more free. In the PULSUS

PLENUS,

PLENUS, the artery is frequently found to recover its elasticity by bleeding.

SOME authors, in the division of regular pulses, feem to think that each ought to have an oppofite correfponding one. Thus, having defcribed the PULSUS PLENUS, we find likewife a PULSUS VACUUS mentioned. But, upon confidering the matter with great attention, I prefume to think that there can be no fuch pulfe diftinct from thofe already defcribed *.

FOR

* The Greeks, among other pulfes, mention the Σφυγμὸς κένος. But it appears, that they did not underftand by this, a low or empty pulfe, as contradiftinguifhed from the *pulfus plenus*. Thus Aretæus, in defcribing a beginning peripneumony, Lib. II. de acut. morb. Σφυγμοὶ τὰ πρῶτα μεγάλοι, κενοὶ, &c. Now the *pulfus magnus* and *pulfus vacuus* can never be fuppofed to coincide, in the fenfe in which the moderns underftand the latter. By Σφυγμὸς κένος nothing more can be meant than a foft pulfe, yielding readily to the touch, the artery feeling as if it were full of air rather than blood; fuch as that defcribed by Galen in the fame difeafe. ὁ δ περιπνευμονικῶν (σφυγμὸς) μέγας ἐςι καὶ κυματῶδὶς τι ἔχων ἢ ἀμυδρὸς ἢ μαλακὸς ὁμοίως τῷ τῶν ληθαργικῶν. &c. Ifagog. pulfuum. The *pulfus vacuus* then of the ancients feems to have been the *pulfus plenus* of the moderns.

For, if we fuppofe the greateft degree of inanition, without deftroying the action of the heart altogether, the pulfe, in this cafe, will properly come under the denomination, either of the PULSUS PARVUS, or of the PULSUS DEBILIS, though, before this evacuation, it had been a PULSUS PLENUS.

It hath been thought, in making thefe diftinctions, that a pulfe, which is defined from excefs, whether in the quantity of blood, or in the action of the heart, ought to have an oppofite pulfe from an oppofite caufe *.

But we may obferve, that an artery can admit of more divifions from its dilatations than from its contracted ftate: for the arteries are not fuppofed to contract beyond the fyftole, which is their natural ftate, or that which

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* Cum igitur unaquæque res dupliciter a naturali ftatu recedere poffit, vel deficiendo, vel excedendo; omnis pulfus, a mediocri deficiens, vel excedens, appellabitur non naturalis. Bellin. de pulf.

which they aſſume when they ſuffer no vio-
lence.   But their diameters may be extend-
ed beyond their natural degree, in the ſy-
ſtole, as well as in the diaſtole, as is the caſe
of a *plethora*; and, in ſo far, an artery may
deviate from nature in more reſpects by ex-
ceſs than by defect.

It hath been obſerved, that the PUL-
sus MAGNUS and the PULSUS FORTIS de-
note much blood *. When theſe are under-
ſtood as natural pulſes, they may indicate
that the veſſels contain a ſufficient quantity.
But, when they indicate a morbid ſtate of
the body, they are the reſult of the quality,
rather than of the quantity of the blood. It
is true, that, in inflamatory caſes, the diſeaſe
may be moderated by bleeding, and is often
cured by repeating that evacuation; but,
in theſe caſes, as the fever abates, the blood
is obſerved to change its quality; and, when
the diſeaſe is removed, the patient is found

to

* Id. ibid.—Boerhaave inſtitut. § 959. 961.

to be weakened in proportion to the quantity of blood loft. But, in true plethoric cafes, one acquires ftrength and alacrity from the evacuation; which is the CRITERION of a true *plethora*, or a fign that the morbid caufe lies folely in the quantity of blood.

THE PULSUS CELER and PULSUS TARDUS, are not fuppofed to relate to an increafed or diminifhed number of pulfations in a given time; but to the artery receding more quickly, or flowly, from the fingers in feeling the pulfe. Thefe pulfes feem not to differ from the MOLLIS and DURUS, but might be better expreffed by OBTUSUS and ACUTUS, without any further diftinction.

UPON the whole, the primary or moft fimple divifion of pulfes confifts of feven kinds, *viz* the PULSUS MAGNUS and PARVUS; FORTIS and DEBILIS; FREQUENS and RARUS; and the PULSUS PLENUS or PLETHORICUS.

ALL

ALL these pulses, or the most part of them, are sometimes to be met with in the different stages of the same disease; but there are other diseases to which particular pulses are more peculiar. The PULSUS MAGNUS frequently attends a STUPOR, COMA, VERTIGO, LETHARGY, and other disorders of the head, where there is little or no fever. It is likewise not uncommon in HYPOCONDRIACISM and MELANCHOLY, and often presages a MANIA. In this respect the hypocondriacal disorders, in men, generally differ from the hysterical; as the latter are commonly attended with the PULSUS PARVUS: and, in general, the PULSUS MAGNUS is rarely to be met with in women; their manner of life and habit of body rendering the sex more liable to the opposite pulse.

THE PULSUS PARVUS is to be found in most part of fevers, either through the whole disease, or in some of the stages. Towards the end of inflamatory fevers, this

pulse

pulfe is an unfavourable fign. It is a patho-
gnomic fign in hectic fevers. The low, ma-
lignant, bilious and peftilential fevers are
commonly attended with this pulfe through-
out. It is almoft a conftant concomitant
of the PHTHISIS PULMONALIS. It is
likewife common with women, who have
weak nerves, and who are fubject to fudden
tremors, palpitations, and to the well known
tribe of hyfterical fymptoms. In general,
this pulfe is more frequently met with than
any other arifing from morbid caufes.

THE PULSUS FORTIS commonly intro-
duceth inflammatory fevers, efpecially thofe
proceeding from inflammations in the THO-
RAX. This pulfe, more than any other,
indicates bleeding; being a cerain indica-
tion of an increafed velocity in the circula-
tion, and frequently of a cohefive ftate of
the blood. But though, in inflammatory fe-
vers, attended with this fymptom, we bleed
with fafety and advantage; yet there are
fevers, in fome periods of which we meet

with

with this pulse, and then ought to be cautious of bleeding. This is the case in fevers of the remitting and intermitting kind, where the PULSUS FORTIS precedes critical sweats.

THE PULSUS DEBILIS always indicates a diminished velocity in the circulation, and is, of all kinds, the most dangerous; and the more so, if, with the diminished extension of the artery, the pulse fall considerably below its standard number: for the blood, not being sufficiently agitated, soon loseth its natural texture. This pulse is frequently unequal, and interrupted *.

I. S. a man aged about fifty five years, of a slow speech, and slow in all his motions, whose profession and genius confined him to mechanical studies, and arithmetical computations,

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* Qui pulsus has malignitatis notas omnes conjunctas habet, certum lethi signum est; neque talem hominem evasisse exemplum extat. Haller in institut. § 966.

computations *, fell into a flow fever, attended with a deep STUPOR, from which the moft ftimulating medicines were infufficient to roufe him. His pulfe, which, for the firft day or two, had been ftrong and frequent, for thirteen days afterwards, in the courfe of the difeafe, did not exceed forty eight in a minute; which, for fuch a length of time, was the floweft pulfe I had ever felt. Though the pulfations were not very fmall, I was informed by the furgeon, that they were fomewhat fmaller than in a natural ftate; and that, in health, his pulfe ufed to beat about fixty five in a minute.

ABOUT two days before death, his pulfe became lower and more frequent; and both it and other fymptoms foon gave evidence of a refolved ftate of the blood.

C 2 SUPPOSING

* Thefe characters are particularly mentioned, as I have frequently obferved that people of this conftitution are fubject to diforders of the head, attended with a flow pulfe.

SUPPOSING then the artery, when beating fo flow, to have loft, in the diaftole, one tenth of its natural diameter ; and that, in the fyftole, there remained feven tenths ; then was the velocity of the blood in the difeafe to that when in health, as twenty-three to fifty-one.   Had there been no difference in the dilatation of the artery, the proportion, depending only on the number of pulfations, would have been as eight to eleven. But though we fuppofe the artery to have loft only fo much of its extenfion as, with the diminifhed number of pulfations, to have made the circulation in the difeafe, to that in health, as thirty to fifty one ; there is reafon to believe that even this would have been infufficient to preferve the proper texture of the blood for any confiderable time.

IN this cafe, we have an example of the pulfe paffing from a natural ftate to the PULSUS FORTIS, from that to the PULSUS DEBILIS, and from that again to the PULSUS PARVUS. It may be obferved that,

that, though the number of pulfations in the PULSUS PARVUS may fometimes balance the lofs of dilatation in the artery, fo as to preferve the fame degree of velocity in the circulation; yet this pulfe feems always to indicate, either the weaknefs, or the labour and difficult action of the moving power.

THE PULSUS PLENUS is frequently met with in women, when the periodical return of the MENSTRUA approacheth; particularly in thofe women who menftruate with difficulty. This pulfe is likewife to be found in people of a thin habit, and pale complexion, fubject to hemorrhages, whether from the nofe, lungs, or hemorrhoidal veffels.

THE PULSUS PLENUS, not being diftinguifhed by any increafe or diminution of pulfations, may be attended either with a quick, or flow circulation, and therefore could not be well expreffed in a figure.

HAVING

HAVING thus propofed the great or primary divifion, it will be eafy to refer the reft of the pulfes to it, fo as to diftinguifh what hath been called the compounded pulfes. Thus, the MOLLIS and DURUS, CELER and TARDUS, ACUTUS and OBTUSUS *, DICROTOS, INTERMITTENS or INTERCURRENS, may fall in with any of the pulfes defcribed above.

MANY names have been affixed to pulfes, which are merely figurative, and may well be difpenfed with. Thus, the PULSUS FORMICANS, or fluttering pulfe, is nothing but

the

* The pulfes *durus* and *mollis*, *celer* and *tardus*, *acutus* and *obtufus*, which may be confidered as not differing from one another, may be conceived from figure 2. plate 1. where, if *a c* reprefent the furface of an artery in the diaftole, the numbers 1, 2, 3, will give an idea of the *durus*, *celer*, or *acutus*; and 4, 5, 6, of the *mollis*, *tardus*, or *obtufus*. Thefe pulfes, being diftinguifhed by the proportions of time betwixt the *fyftole* and the *diaftole* in each pulfation, may coincide with any of the pulfes in the firft divifion, which are all diftinguifhed, either by the velocity of the pulfe, or by the dilatation of the artery differing from a natural ftate, or by both thefe together; to which two diftinctions the three pulfes here defcribed have no reference.

the PULSUS PARVUS in its loweſt ſtate; the VERMICULARIS is the PULSUS DEBILIS; the PULSUS UNDOSUS is that kind which is ſaid to be felt fuller under one finger than another; but which cannot be owing to any difference in ſo ſmall a portion of an artery, but either to the greater preſſure of one finger than of another, or to one part of the artery lying more ſuperficial, or deeper, than another. This kind, therefore, as well as the PULSUS MYURUS and CAPRIZANS, ſeem to be only a deception. But every kind of pulſe, having ſome reſemblance to a wave may, without impropriety, be termed UNDOSUS. Now, as the idea of ſome of theſe pulſes appears to have ariſen from an unequal application of the fingers to the radial artery, the method of feeling pulſes to the greateſt advantage, may not be unworthy the attention of young practitioners.

AN artery being but a very little more or leſs ſuperficial gives the idea of a ſtrong, or of a weak pulſe: hence it is, that, in the

fame

same perfon, we often feel the pulfe in one arm different from that in the other; and Boerhaave juftly obferves that the pulfe is frequently deceitful in fat people *.

WHEN the pulfe is not diftinct, the moft certain method of judging of it is, to prefs the fingers fo much that the circulation in the artery may feem to be ftopped; and, raifing the fingers gradually, let the touch at laft become quite fuperficial. By this method we may judge with more certainty of the action of the artery, than by an uniform preffure of the fingers: and as, in feeling the pulfe, when our fingers are cold, we are apt to believe the pulfe to be weaker than it really is, it is of fome confequence to preferve the natural heat of the hand.

IT hath been believed, that there is an exact proportion between the quicknefs of the circulation and animal heat; or that the

* Boerhaave inftitut. § 960.

the degree of heat increaſeth in proportion to the attrition, and *momentum* of the blood; and the pulſe, being the only indication of changes in the circulation, hath likewiſe been believed to indicate greater or leſs degrees of animal heat *.

WHETHER thoſe, with whom the natural *momentum* of the blood is greateſt, be likewiſe poſſeſſed of the greateſt degree of vital heat, in the ſenſe in which the ancients underſtood vital or internal heat, I ſhall not pretend to determine. But we now know that nothing more was underſtood by this, than the principle of life, in an higher, or lower degree, independent of real or abſolute heat.

BUT though the conſtitutions of animal bodies be ſuppoſed to be, *cæteris paribus,* better, the greater the natural force of the moving power is, this hath no relation with abſolute heat, or animal heat, taken in a

D   literal

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* Boerhaave Inſtitut. § 968.

literal fenfe, which doth not appear from obfervation to depend upon the *momentum* of the blood, attrition, or the refiftance occafioned by the denfity of the fluids; for it is known from experiments, that the heat of the human body is frequently above the ftandard, while the *momentum* of the fluids is confiderably below its natural ftate; particularly when the texture of the blood is fo much refolved that we have reafon to believe the refiftance at the capillaries is lefs than ufual. This is, for the moft part, found to be the cafe in the laft ftage of putrid, bilious, and peftilential fevers.

PROFESSOR de Haen obferves, that the *momentum* of the blood, or attrition, is fo far from being the caufe of animal heat, that, even after the motion of the fluids hath ceafed altogether, heat hath been found to increafe; and accordingly obferved the thermometer to rife when applied to human bodies immediately after death. When the thermometer is fuddenly expofed to heat of a confiderable

fiderable degree, the mercury is obferved to fall a little, and then to rife. The glafs ball of the inftrument being fomewhat enlarged by the heat, before it hath had time to act upon the mercury, is the caufe of this defcent. For the fame reafon, when the inftrument begins to cool, the ball is contracted before the mercury hath loft any degree of its rarefaction, and, confequently, it will afcend in the tube, even while the ambient heat diminifheth *. This experiment therefore, meant to prove the increafe of heat after death, would have been more fatisfactory, had the learned author fignified that he was aware of thefe effects of heat and cold on the thermometer.

IT is not improbable that heat, whether of itfelf a pofitive body, or merely the modification of other bodies, may be poffeffed of different qualities, as well as it is fufcep-

D 2   tible

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* This hath been afcertained by various experiments, particularly by thofe of Bulfinger. Comm. Acad. Petropolitan. vol. 3. p. 242.

tible of different degrees.   Thofe who have been accuftomed to touch fick people, efpecially when under the fpecies of fevers laft mentioned, muft have been fenfible of a pungent heat, affecting the fingers in a manner different from the heat of the body when in health, though then raifed to an high degree by exercife, or otherwife.   Galen was particularly attentive to this circumftance, and defcribes the difference betwixt a vital or natural, and a morbid heat, as a fymptom of great confequence *.

THE pulfes hitherto defcribed are meant as indicating a morbid ftate of the body, and are fuppofed to refer to every perfon's natural pulfe; for what is a natural pulfe with one perfon, may indicate a morbid
ftate

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* Siquidem eft fubftantia caloris genuini (τȣ ἐμφύτȣ θερμȣ) temperata; ignea adventitii (τȣ Επικτήτȣ.)   Sanorum enim calor vaporofus eft, blandus, et ad tactum familiaris, gratufque, nihil quod moleftum, afperumve, et mordax fit, habens.   Contra febricitantium calor, præfertim fi febris fit hectica, aut ex humorum orta putredine, acris, ingratufque eft, mordax etiam, ac tangentem manum pertundens, atque pungens.   Galen in Hippocrat. Aphorifm. 14. fect. 1.

ftate of the body with another. One of a gigantic fize, and of an athletic habit, hath not naturally the fame kind of pulfe with a dwarf; nor can either of thefe be fuppofed to have a pulfe equal to that of the other, without a difeafe; and we often meet with people, feemingly of the fame habit and con-ftitution, who have neverthelefs pulfes of different kinds; from which it appears of what advantage it is to be acquainted with the conftitutions of people in health, to be able to judge with greater certainty of the nature of difeafes.

But, when one is faid to have naturally a great or little, a ftrong or weak, a quick or flow pulfe, thefe are fuppofed to refer to an univerfal mean pulfe; an idea of which every phyfician muft form to himfelf, from a frequent examination of a variety of pulfes. Thus, when Boerhaave fays that the pulfe which is ftrong, great and flow, is, of all kinds, the beft, we muft underftand this as referred to an univerfal mean pulfe, or the

expreffion

expreſſion can have no meaning: for where any perſon's pulſe is ſaid to be great, ſtrong and ſlow, with reſpect to the mean or natural ſtate of that perſon's pulſe, then are we to underſtand theſe characters of the pulſe as indicating a morbid ſtate of the body.

ESSAY II.

ESSAY II.

OF

MENSTRUATION.

ESSAY II.

Of MENSTRUATION.

THE monthly evacuations of women being one of the moſt curious cir-cumſtances in the animal œco-nomy, ſeveral learned phyſiologiſts have exerted themſelves to account for them. Some would aſcribe them wholly to a pe-riodical addition of blood, without ad-mitting any change in its quality, while others would have them proceed from a fermentation, or ſome other change in the fluids.

DOCTOR Freind, among others, having treated this ſubject with his uſual elegance and perſpicuity, and his hypotheſis having been generally adopted, I ſhall here examine, (though with the regard that is due to the me-mory of ſo reſpectable an author,) whether his

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method

method of accounting for the menſes by mechanical laws be ſufficient, and agreeable to the operations of nature; or what other principles can aſſiſt us in explaining this branch of the animal œconomy.

I. A MONTHLY PLETHORA, ariſing from a defective perſpiration, is the ground work of Doctor Freind's hypotheſis. But it doth not ſufficiently appear, whether the learned author means that a greater proportion of blood, and a leſs proportion of perſpirable matter is generated in women than in men; or, ſuppoſing the proportion to be the ſame in both, whether the diſcharge by the pores of the ſkin be leſs in the female ſex than in the male.

THAT this laſt was Doctor Freind's opinion, appears more probable from ſeveral paſſages in his *Emmenologia*, particularly where he quotes the fifty ſecond aphoriſm, ſect. 1. of Sanctorius, in ſupport of his own hypotheſis, *viz.* that want of ſtrength is a cauſe

of

of a defective perspiration; that the force of the heart in females, being less than in males, is insufficient to discharge all the perspirable fluid, and that the quantity retained proves the cause of a periodical PLE-THORA *.

ACCORDING to Doctor Freind, the quantity of the monthly discharge may amount to about twenty ounces †. Hence one thirtieth part of this quantity, or even of two pounds, every day, comes to be but an inconsiderable diminution of perspiration, and will sufficiently account for the monthly PLETHORA ‡.

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* Quid enim est robur, nisi vis illa quæ a sanguine et spiritibus in membra derivatur? ea vero quomodo derivari potest, nisi cor validius contrahatur?—Ad hunc modum a viribus imbecillis orietur perspirationis defectus. Emmenol. cap. 3.

† According to others, particularly Sydenham, it is much less. Astruc makes it extend from 8 to 16 oz. De Haen from 4 to 10, or 11.

‡ Igitur satis esset sanguinis plethorici ut lib. 1. ¼ quæ vulgaris est catameniorum mensura, singulis mensibus effundi possit, si non ultra 5 ½ drachm. quod perpaucillum est, pe rdiem imminueretur perspiratio. Emmenol. cap. 7.

THAT there is a redundance of blood every month is abundantly evident. But that the cauſe of this PLETHORA is a deficient perſpiration, may be called in queſtion for the following reaſons.

1. THE quantity of perſpirable matter retained in the blood every day, according to the above computation, being only 6. 4 drachms, cannot be ſuppoſed to produce bad conſequences, provided it be not retained in the body many days. But, if this quantity goes on accumulating to two pounds, or nearly ſo, in thirty days, it cannot fail to have bad effects, long before the expiration of that time, according to all the accounts we have of obſtructed perſpiration. Sanctorius every where declares the danger of a ſtopped perſpiration, and ſays, that twelve ounces, (which is little more than one half of the above-mentioned quantity,) retained in the body for twenty four hours only, muſt either be diſcharged by ſome ſen-

fible,

ſible, and critical evacuation, or quickly oc-
caſion a diſeaſe *.

2. IF the final cauſe of the PLETHORA
in women be the nutrition of the fœtus,
as hath been generally believed, it is not
probable that nature, in order to attain this
end, would have recourſe to a real defect,
that is, the want of power to expel an ex-
crementitious fluid. Nor can we well be-
lieve that this ſame fluid, which is found to
be ſo hurtful to the body when retained in
it, can be the ſource of milk, a nouriſhment
ſo neceſſary for children after birth.

3. IF Doctor Freind conſiders the menſes
as the effect of diminiſhed perſpiration, it
might naturally have been expected, that,
in order to make one part of his hypotheſis
ſquare with another, the learned author
would have ſuppoſed, with ſome others, that
this monthly evacuation is the means of pur-
ging the blood; whereas he ſays that the
menſtrual

* Sect. 14. aphor. 31. and 37.

menstrual fluid is the pureft, and moft fra-
grant arterial blood *.

4. WHEN women come to that term of
life, in which the menfes ceafe, as the vital
functions then become weaker, the power of
carrying on perfpiration muft likewife dimi-
nifh: this both Sanctorius and Dodart found
by ftatical experiments †.

IN what manner then can we fuppofe the
perfpirable matter to be difpofed of, at a pe-
riod of life when an outlet ought to be more
neceffary than ever? If it be faid, by ftool,
or urine; why not by thefe channels before?
If it be not carried off at all; then ought
women, in the latter part of life, to increafe
in weight at the rate of 16, or 20 ounces
every month: which is fo far from being
true,

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* Neque enim in fanis fanguis ille qui ejicitur impurus eft, aut
vitiofus, fed optimus et fragrantiffimus.

† Senfim enim ab ætate conftanti et integra, ad ætatis flexum
minuitur perfpiratio, et quo magis ingravefcit ætas, eo minor fit
evacuatio. Dodart Medicin. Stat. Gall.

true, that, for the moſt part, they diminiſh after that period.

We are told of women, in the moſt nor-thern inhabited latitudes, who do not men-ſtruate in winter, having that evacuation on-ly during the ſummer *. According to Doctor Freind's theory, it ought to be quite other-wiſe; ſince it is found, by ſtatical experi-ments, that we perſpire more in ſummer than in winter; and, in theſe cold climates, the difference of perſpiration, in the two oppo-ſite ſeaſons, muſt be conſiderable.

It would therefore ſeem prepoſterous to ſuppoſe, that the paſſages by which the veſ-ſels uſed to unload themſelves ſhould be ſhut up, when the neceſſity for the diſcharge in-creaſeth.

Upon the whole, ſince a greater quantity of blood is neceſſary in females than is ſuffi-cient for nouriſhment, it appears more ana-logous

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* Linnæi Flor. Lappon. p. 324.

logous to the other operations of nature, to have endued them with a greater power of making blood than the males: and, as a larger proportion of blood is generated, the perſpirable, as well as all the ſenſible evacuations, muſt be proportionally leſs.

II. The next thing to be conſidered is a PLETHORA, and its effects on the circulation. Doctor Freind obſerves that, in a PLETHORA, the animal ſpirits are increaſed, by which means the action of the heart becomes ſtronger; and, in conſequence of that, the velocity of the blood is likewiſe increaſed.

That there is always an addition of animal ſpirits, upon an increaſe of blood, may be doubted: for thoſe, who labour under a PLETHORA, ſeem not to gain, but rather to loſe animal ſpirits; for, in this ſtate, it is commonly obſerved that we become more ſluggiſh, and not more active.

THAT

THAT the ſecretions may be regularly carried on, there ought to be a juſt quantity of blood. If its velocity be increaſed, and if, at the ſame time, there be too great a proportion of it, then is it probable that the *impetus* on the glands, being greater than it ought, will prove the cauſe of crude ſecretions; and that this may be the caſe with the brain, as well as with the other glands, we have no reaſon to doubt,

NOR is it likely that the perſpirable matter retained ſhould furniſh freſh ſupplies of animal ſpirits: and this agrees well with what Doctor Freind obſerves in another place, *viz.* that, about the time of menſtruation, women are affected with a *languor,* from the too great weight of the body, and from the dilatation of the finer blood veſſels of the brain, whereby the paſſage of the nervous fluid into the nerves is obſtructed, and hence the members of the body are

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deprived of their due quantity of animal ſpirits *.

But, however plauſible this reaſoning may appear, it is to be preſumed, that, in a PLETHORA, *cæteris paribus*, the velocity of the blood will not be increaſed, but, on the contrary, will be diminiſhed.

To preſerve the animal œconomy, a certain *ratio* betwixt the quantity of blood, and the elaſtic power of the heart and arteries, is neceſſary : ſo that an additional quantity of blood is not always to be ſuppoſed neceſſary to conſtitute a PLETHORA ; for this ſtate may ariſe as well from the diminiſhed force of the heart, the quantity of blood remaining unchanged, as from an increaſed quantity of blood with the ſame force of the heart.   Thus, in conſumptions, the ſolids

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* Languor vero invadit, quia in plethora nimio pondere laborat corpus, et tenera cerebri vaſcula ita turgeſcunt, ut compreſſu ſuo, omnes pene in nervos aditus præcludunt, hinc in membra minor derivatur ſpirituum copia. Emmenol, cap. 8.

lids waſting, and the heart becoming weaker, occaſion a PLETHORA, the proportion of blood being too great for the force of the heart; ſo that bleeding, by reſtoring the balance, gives a temporary relief to the patient; and the power of the heart ſtill diminiſhing, the ſame evacuation becomes again neceſſary. But in this eſſay, a PLETHORA is to be underſtood as proceeding from an increaſe of blood.

THE natural ſtate of an artery is ſuppoſed to be its ſyſtole: any degree of extenſion beyond this ſtate is owing to force. When there is a redundance of blood, it is to be believed that the arteries cannot return entirely to their natural ſtate, but muſt ſuffer ſome degree of extenſion even in the ſyſtole. This, as I ſaid, we muſt call a PLETHORA, in the ſtricteſt ſenſe, and ſeems to be the ſimpleſt idea we can form of a PLETHORA ariſing from a redundance of blood. For, could the arteries act with a full vibration, and return from their diaſtole to their natu-

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ral ſtate with entire freedom, it could not be ſaid that there was more blood in the body than juſt enough.

IT hath been found that a ſmall difference in the dilatation of an artery requires a great number of pulſations to compenſate it. And as, in a PLETHORA, the vibrations of the arteries muſt be more confined than uſual, a proportional acceleration of the pulſe becomes neceſſary to preſerve an equal degree of velocity in the blood; but, to increaſe the velocity of the blood to any conſiderable degree, the pulſe muſt be greatly accelerated,

THUS, it is evident that the heart and arteries act with great diſadvantage in keeping up a due degree of velocity in a redundance of blood; and if there be any additional ſtimulus, whether from an increaſe of animal ſpirits, or otherwiſe, the effect will not ſhew itſelf in the contraction of the arteries, (fluids being of too incompreſſible a

nature

nature to admit of that,) as in the accelera-
tion of the pulfe.

IT appears further from common obfer-
vation, that, when there is a general PLE-
THORA near the time of menftruation,
(which is the cafe with fome women about
that period,) the circulation is flower than
ufual. For, befides that there is then either
no acceleration of the pulfe at all, or an in-
confiderable one with women otherwife in
health, the vibrations of the arteries are ge-
nerally obferved to be more confined than
when there is no PLETHORA. And it hath
been found that the arteries are relieved,
and recover their elafticity, by bleeding in
a PLETHORA. We fhall fee afterwards
that this is wifely ordered, fince the eruption
of the menfes is fafely brought on by an in-
creafed quantity of blood, and a diminifhed
velocity, and that this difcharge could not
have happened without danger had there
been an increafe of both.

III. THUS

III. Thus far with respect to the effects of a general PLETHORA upon the circulation. But when we come to consider the structure, number, and disposition of blood-vessels belonging to the UTERUS, and neighbouring parts, it will appear that every thing is contrived, not only to prevent the rapid motion of the blood, but to make the circulation in these parts remarkably flow, even with a common quantity of blood, but much more so in a PLETHORA.

THAT this may appear the better, we are to consider that the capacities of any number of branches coming off one trunk, when taken together, being greater than the capacity of that trunk, the motion of the blood in these branches will be proportionally flower than that in the trunk. Thus, if six branches come off one trunk, and if the diameter of each branch be two thirds of that of the trunk, then will the velocity in the branches be to that in the trunk as three to eight, the capacities being as the

squares

ſquares of the diameters, and the velocity reciprocally as the capacities.

THE blood ſent to the UTERUS, OVA-RIA, and VAGINA, is conveyed in the hy-pogaſtric, and ſpermatic arteries, of which two veſſels the ramifications are very re-markable for number and ſize: for not only a great many large branches are ſpread every where upon the UTERUS *, and VAGINA; but the LIGAMENTA ROTUNDA are little more than a *congeries* of blood veſſels.

WE cannot pretend to form a conjecture about the ſize and number of theſe branches, in proportion to the trunks from which they are derived; and, conſequently, what the preciſe *ratio* of the velocity in the branches to that in the trunks may be: but it is evi-dent, in general, that the motion of the blood in theſe parts muſt be very ſlow †.

HAD

* Uterus arteriarum et venarum tela eſt et complicatio. Haller prælect.

† Doctor Keil found by an accurate menſuration, and computa-tion, that the velocity in the thirtieth branching from any trunk is to the velocity of the blood in the trunk as unit is to 615.

HAD an extraordinary velocity of the blood been neceſſary to produce the monthly eruption, the blood would have been conveyed to theſe parts by many trunks; and theſe trunks would have been large in proportion to their branches.

BUT when we find the circumſtances quite different, that is, few and very moderate trunks, with large and numerous ramifications, we muſt conclude that nature hath intended that there ſhould be a very languid circulation in theſe branches.

BESIDES the ſlow circulation, the accumulation of the blood in the uterine veſſels, in a PLETHORA, is readily accounted for by attending to the three following circumſtances.

1. IN animal bodies, the coats of the arteries are, in general, found to be thinner, and weaker the more theſe veſſels are ramified,

fied, and the further they are removed from the original trunk.

2. THE larger the diameter of any artery is, or the greater its capacity in proportion to the thickneſs and ſtrength of its coats, or to its elaſticity, the leſs will the power of that artery be in carrying on the circulation.

3. THE more ſuſceptible any artery is of a great and ſudden diſtenſion from a minute and contracted ſtate, the weaker muſt that artery be.

BY comparing the numberleſs ramifications, and remarkable ſize of the uterine veſ-ſels with what hath been ſaid above about a PLETHORA, it appears that the elaſtic power of theſe veſſels muſt ſoon yield to any additional force; and, conſequently, that, in a PLETHORA, there muſt be an uncommon determination of blood to theſe parts, and a collection of it there. To this likewiſe

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the ferpentine difpofition of the veffels con-
tributes not a little.

THE arteries of the UTERUS, before pu-
berty, or foon after menftruation, are fo
fmall as to be invifible, and do not admit
red blood: but about the time of the erup-
tion they are greatly diftended *. This
expanfion being fo fudden, the elaftic power
of thefe arteries muft be very inconfiderable,
when compared with that of the other ar-
teries of the body of the fame fize, whofe
growth hath been flow, and in proportion
with that of the body.

BUT it may be further obferved, that
the fpermatic vein, being large in proportion

to

* De Graaf tells us, that, in a woman whom he diffected,
near the time of menftruation, he found the uterine veffels en-
larged to fuch a degree as to admit his finger. The elaftic power
of the arteries in fuch a ftate muft be almoft entirely overcome.

Maxima arteria uteri non diftenti, invifibilis eft, fi cum arte-
ria rubra comparatur: et hæc tamen invifiblis arteria, adeo mag-
na fit in utero pregnante, ut initium calami fcriptorii admittat.
Haller. prælect.

to the artery, and having no valves, muſt reſiſt the action of the arteries; ſince the column of blood in the vein is large, is to be raiſed almoſt perpendicularly, and is not ſupported by valves.

THESE obſervations would ſeem abundantly to ſhew how every thing is contrived to collect a great proportion of blood in the uterine arteries in a PLETHORA; and, by comparing all circumſtances, it is evident that, as the time of the menſtrual diſcharge approacheth, the circulation muſt be extremely ſlow in the larger veſſels of the UTERUS; and, if ſo, its motion in the finer branches, whoſe orifices open into the UTERUS and VAGINA, muſt be inconceivably languid: or, which is not improbable, there muſt be an abſolute ſtagnation in theſe ramifications for ſome little time before menſtruation.

THE effects then of a very ſlow circulation, or of a ſtagnation of the blood in

any

any part of the body, comes next to be confidered.

IV. To preferve the texture and foundnefs of the blood, a due degree of velocity, according to the fize of the veffels, is requifite. When this fails, and the motion of the blood becomes much flower than it ought, it is obferved to change its nature.

It hath been found that blood out of the body, and kept in the degree of animal heat, doth not coagulate, but foon tends to a putrid and difolved ftate *.

The *halitus*, too, which flies off when blood is expofed to the air, being the moft putrefcent part of it, muft promote this tendency to putrefaction more while in the body than when out of it.

From this we may judge what change the blood undergoes in the body, when the circulation

* Thefes de fanguinis feparatione fpontanea, Auct. Martin. Butt.

circulation fails, or becomes ſo ſlow as to
be next to ſtagnation: for the blood being
pent up in the uterine veſſels, and the circu-
lation being ſloweſt, or probably ceaſing in
the laſt ramifications of the arteries, that is,
in theſe which open into the cavity of the
UTERUS and VAGINA, this blood, I ſay, in
them, muſt tend to a diſſolution; and, by
putrefying, muſt contract an acrimony ſuf-
ficient for irritating the containing veſſels,
while the impulſe from behind ſtill in-
creaſeth.

THESE two cauſes, co-operating, muſt
at length produce an oozing from the
uterine arteries into the cavity of the
UTERUS and VAGINA; and this effect
muſt continue ſo long as the cauſe; that
is, till the PLETHORA ceaſe; the ute-
rine veſſels collapſe or recover their tone;
and till a due degree of velocity be re-
ſtored to the fluids paſſing through theſe
organs.

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IT may not be improper to obſerve here the analogy between the menſtrual and hemorrhoidal flux, eſpecially in thoſe with whom the latter is periodical. As the veſſels in the RECTUM gradually ſwell, the blood circulates ſlower in that part, and at length ſtagnating there, an acrimonious *ichor* then tranſudes, and, with ſome, blood breaks out, and continues to ooze till the veſſels be ſufficiently emptied.

OTHERS, whoſe blood is of a looſer and weaker conſiſtence, and its quality acrimonious and ſcorbutic, have large and obſtinate hemorrhages this way; and women of the ſame conſtitution are no leſs ſubject to immoderate floodings from the UTERUS.

IN this manner is the menſtrual flux carried on gently and ſafely: whereas, had a PLETHORA, and an increaſed velocity of circulation combined to make an eruption of arterial blood, it could not have happened without a ſudden and dangerous hemorrhage;

morrhage; as is known to be the caſe when the blood finds vent through the arteries where the circulation is rapid.

AFTER impregnation, the blood, going to form the fœtus and ſecundines, circulates through both in the ſame manner as through the mother; and, having its due degree of motion, undergoes no change in its quality.

UTERINE hemorrhages, after impregnation, are juſtly reputed dangerous: and yet it is well known that many women continue to menſtruate two or three times, or oftener, after impregnation. Whether the veſſels communicating with both the UTE-RUS and VAGINA, and paſſing from the one to the other, are intended to relieve the UTERUS, by throwing off part of the blood through the ſides of the VAGINA, when there is more than is neceſſary for the nouriſhment of the embrio, I leave to others to determine.

THE *naufea*, to which moft women are fubject during the firft weeks of impregnation, feems alfo to be a wife intention of nature. For, as they are able to take but little food, while in this condition, lefs blood is proportionally generated, the derivation of blood to the UTERUS muft likewife be lefs, and, confequently, there muft be lefs danger of hemorrhages from the uterine veffels, and of abortion from that caufe.

IT may be objected, that the menftrual flux, according to Hippocrates *, Doctor Freind †, and others, confifts of the fineft and pureft arterial blood.

BUT this doth not follow becaufe it comes immediately from the arteries. Blood, if deprived of motion, and of a proper degree of conquaffation, will contract a putrid and acrimonious

* Morb. Mulier. lib. 1. fect. 15.

† Sanguis ille qui ejicitur—ex capillaribus arteriis erumpit; ideoque naturam arteriofi, h. e. puriffimi fanguinis retinet. Emmenol. cap. 2.

acrimonious quality in the arteries, as well as in the veins: and, though it become ſomewhat more liquid than in a natural ſtate, and contract a degree of acrimony, ſo as to irritate the containing arteries; yet ſtill it may retain the florid appearance of pure blood. Nor can we conclude from the browniſh, or duſkiſh colour of the menſtrual blood, that therefore it comes from the veins, as Aſtruc obſerves; ſince blood, becoming putrid from ſtagnation, or otherwiſe, contracts that colour *.

Were the menſtrual blood pure, and abſolutely ſound, then might it be expected that ſudden obſtructions of the menſes, eſpecially from external cauſes, as putting the legs into cold water, ought not to be productive of ſuch troubleſome conſequences as commonly follow. Theſe effects are known to be, for the moſt part, obſtinate and untractable, continuing for many

H   months,

* See Sir John Pringle's experiments on the blood.

months, ſometimes for years, and are fre-
quently attended with ſymptoms indicating
the maſs of blood to be tainted.

But if the menſtrual blood hath con-
tracted a degree of putridity, and the ſame
acrimonious quality that is found to be the
conſequence of ſtagnation; then may this
blood, in caſe of uterine obſtructions, be
ſuppoſed ſoon to affect the maſs, and to pro-
duce the various evils which follow theſe ob-
ſtructions. A ſmall quantity of blood, tend-
ing to a putrid ſtate, being taken up, and
circulating with the fluids, inſtead of paſs-
ing off by the natural chanels, may well
be ſuppoſed to ſpread its noxious quality
through the animal frame, or to fall upon
ſome particular member.

In this way the effects of theſe obſtruc-
tions ſeem to be more naturally accounted
for, than by ſuppoſing a few ounces extraor-
dinary of ſound blood to circulate through
the body. A PLETHORA of this kind, we

may

may reaſonably believe, ought to be cor-
rected by bleeding. This evacuation, how-
ever, hath, for the moſt part, but little effect in
removing diſorders ariſing from obſtructions
of the menſes.

WE are told, by ſeveral authors, of ſound
blood being extracted from the UTERUS,
after having been long confined there, by
membranes obſtructing the paſſage, or by
ſome unnatural formation of the parts.

BUT, though this blood might ſtill retain
its fluidity, it doth not therefore follow
that it was ſound, and free from acrimony.
On the contrary, there are, generally, circum-
ſtances mentioned, which prove blood thus
retained to have contracted a greater, or leſs,
degree of putridity.

ANTHONY BENEVOLI * extracted, from
the UTERUS of a young woman, ſeveral
pounds of blood which had been accumu-
lating

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* Diſſertazioni et obſervazioni, p. 79, &c.

lating there upwards of three years; and obſerves that it was ſtill ſo liquid as to paſs through the catheter, but had contracted a duſkiſh colour, and had the appearance of lees of wine.

RUYCH tells us, that, having extracted four pounds of blood from the UTERUS of a woman of twenty years of age, by piercing a membrane which totally obſtructed the paſſage, he was ſurpriſed to find the blood neither coagulated, nor fetid; but obſerves that it was of a blackiſh hue *.

ANOTHER caſe is told † of a great quantity of blood diſcharged from the UTERUS of a young woman, by the inciſion of a ſimilar membrane, where the blood is ſaid to have been of a good colour, very fluid, and no ways fetid. But, being expoſed to the air, it ſoon began to ferment, and flow-

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* Obſervation. anatom. chirurg. cent. obſ. 32.

† Holl. Maatſchap. te Harlem. tom. 5. p. 424. & ſeq.

ed over the veffel, though its edge was three inches above the furface of the blood, when firft put into it. This was a certain proof of a very high degree of acrimony, notwithftanding the appearance of found blood when firft difcharged *.

THUS it appears, from different examples, that blood may remain long in the UTERUS without coagulating, though it lofe the quality of found blood; and in fo far thefe, and fimilar cafes, ftrengthen this theory of menftruation, as likewife by fhewing that the blood may be very acrimonious, and yet have the appearance of found blood; and further, that this blood, notwithftanding its putrid and acrimonious quality, may remain in the UTERUS a long time, without hurt to that organ. But this laft circumftance might be

* Sanguis, incifa membrana hac, erumpens, boni coloris erat, admodum fluidus, et nullum fpirabat fœtorem: dum in vafe receptus reponeretur, incepit rarefcere et fermentari, ita ut tranfcenderet margines vafis, quamvis illi tribus digitis tranfverfis, eminerent fupra contentum in vafe fanguinem. V. Commentar. B. Van Swieten in aphor. Boerhaave 1290.

be proved from many examples, which ſhew the blood to have been putrid upon its firſt eruption *.

It was perhaps from ſome examples of this kind that the ancients had contracted the opinion of the baneful quality of menſtrual blood. But, with women in health, according to this theory, an high degree of acrimony is not ſuppoſed: ſo much as to ſtimulate the veſſels gently, and promote the fluidity of the blood, can hardly fail to bring on the diſcharge with greater advantage, than merely a plenitude of the veſſels.

Nor is this ſtate of the UTERUS to be deemed morbid, notwithſtanding this acrimonious quality of the blood. For this change in the blood, being the neceſſary conſequence of a defect of motion and agitation, it becomes an excrementitious fluid,

and

* Hildan. centur. 3. obſerv. 60. exempl. 2. Saviard. obſerv. 4.—For ſome other examples ſee Smellies Midwifery, vol. 2. collect. 2.

and would infect the maſs, were it again to
be taken up, and to circulate with it, as the
ſaliva, or urine, would affect the ſoundneſs
of the blood, were they to be mixed with
it, after having ceaſed to flow through the
body with the general maſs.

IF it be objected, that an acrimonious and
reſolved ſtate of the menſtrual blood would
endanger too ſudden, or too great an erup-
tion; it may be obſerved, that, even with
women who have the menſes ſo diluted as
to appear pale, and like water tinged with
blood, the diſcharge is frequently as gra-
dual, as when the blood is of a better con-
ſiſtence.

THUS far the theory of menſtruation
ſeems to be a natural deduction of cauſes and
effects. But there are ſome circumſtances
relating to the menſes, the cauſes of which
cannot be ſo eaſily traced; and particularly,
why this evacuation doth not happen before
the age of puberty,

THE

THE reaſon why the menſes do not flow till this period, is commonly ſaid to be, becauſe the blood is expended in the increment of the body.

IT hath been obſerved, that, in the earlier periods of life, the ſolids, being ſoft and pliable, make leſs reſiſtance to the momentum of the blood, and therefore admit of expanſion and increment; but as the ſolids acquire a greater degree of firmneſs, they make greater reſiſtance to the action of the heart, and force of the blood. And as women approach their full growth, more blood being ſtill prepared than can be expended in any further increment, this exceſs muſt be diſpoſed of in ſome other way; and the UTERUS, it is ſaid, is a fit receptacle and emunctory for it *.

THE

* We may judge of the harmony of nature, in the œconomy of female bodies, by comparing the quantity of the menſtrual flux with the increment of the body, ſtill making allowance for the uncertainty of a computation of this kind. Let a woman of fifteen years of age weigh 130 pounds, the mean increment of each month in fifteen years is 8.66 ounces.

THE reaſon why the body ceaſeth to in-creaſe, after a certain period of life, hath been believed to be the firmneſs of the parts, and the reſiſtance thereby made to the mo-tion of the fluids.

BUT the true cauſe is different from this; nor doth it depend upon the firmneſs of the parts, that the body ceaſeth to grow, but upon its ſize and weight in proportion to the force of the moving power. For, though the body were actually ſofter, and the parts more pliable at the age of puberty, or there-by, than when in a ſtate of childhood, it would not increaſe, or but very inconſider-ably, from that cauſe.

IT may be obſerved that the univerſal law, with reſpect to the power and magni-tude of machines, obtains likewiſe in animal bodies. Now, as the power of the firſt mover, in an animal body, increaſeth in a lower *ratio* than the incumberance and reſi-ſtance ariſing from the bulk and weight of

I the

the machine, independent of the ſoftneſs, or
hardneſs of its parts; therefore, ſo long as
the moving power can do more than merely
ſupport the body, or keep up the motion of
the fluids, ſo long will the body continue to
increaſe.   But when the weight or magni-
tude of the body comes to be a juſt balance
on the heart, it will do no more than pre-
ſerve the machine, by keeping up the circu-
lation, without any further increment.

BUT though, about the age of puberty,
the greater firmneſs of the parts ſhould occa-
ſion a reaction from the more ſuperficial
parts of the body upon the internal organs,
it doth not appear that this would be ſuffi-
cient to produce the menſes at that period.
The firmneſs which the ſolids acquire, as the
body encreaſeth, is gradual; and the effect
of the reaction of the fluids upon the uterine
veſſels ought likewiſe to be ſo: whereas the
accumulation of blood in theſe veſſels is
ſudden; the UTERUS being of a firm con-
ſiſtence, its veſſels appearing to be totally

<div align="right">void</div>

void of blood not many days before, and after menſtruation, as hath been obſerved in the bodies of women who have been cut off by ſudden or violent deaths. Beſides, the body frequently continueth to grow remarkably after the firſt menſtrual eruption, nor doth it appear that the menſes are interrupted by this increment.

THOUGH therefore the above mentioned cauſe may co-operate, in ſome degree, with others, it is probable that there muſt likewiſe be a natural aptneſs, or diſpoſition in the UTERUS to receive the menſtrual blood, with which diſpoſition it had not been endued before this time, like many other changes which happen to the human body at particular periods of life, of which none are more remarkable than thoſe which both ſexes undergo about the time of puberty, the cauſes of which we are frequently unable to diſcover.

WHETHER the lymphatic fluid in the milky veſſels of the UTERUS, by acquiring a thicker conſiſtence about the time of puberty, and ſo compreſſing the uterine veins, may thus force the blood through the APPENDICES VENOSAE, according to Aſtruc's hypotheſis *, I ſhall not pretend to determine. But it doth not appear that the moſt expert anatomiſts have diſcovered ſufficient foundation for this theory.

IT remains now to enquire whether a general PLETHORA be neceſſary, or a partial one ſufficient to produce the menſes.

HAD all the arteries of the body been endued with an equal degree of elaſtic power, according to their capacities, in this caſe there could not have been any cauſe for a partial PLETHORA; for all the arteries acting with equal force, according to their diameters, muſt be ſuppoſed to have made an equal diſtribution of the blood : nor could there

* Maladie des femmes,

there have been any reafon why a greater collection fhould be in one part of the body than in another.

But if the arteries in any particular part of the body be fo conftructed as to admit of a quicker, and greater degree of dilatation than the reft, in proportion to their elaftic power, the blood muft be collected in thefe veffels, and muft produce a PLETHORA in them, though there be none in any other part of the body, the reft of the arteries propelling the blood with their ufual energy.

If we compare the aorta, and iliac arteries with thofe of the UTERUS, which admit of a fudden, and great dilatation, it will appear that the blood, being impelled by the ftrong vibrations of the former arteries into the latter, muft be collected there; for the uterine arteries, not being poffeffed of an equal degree of elaftic power, according to their capacities, cannot propel the blood fo

quickly

quickly as it is conveyed to them. By this mechaniſm, joined with the diſpoſition to imbibe blood from the neighbouring arteries, with which the UTERUS is ſuppoſed to be endued at particular times, there muſt be ſuch a derivation of blood to theſe parts, as, with the change in its quality, ſhall at length be ſufficient to overcome the reſiſtance of the veſſels.

THAT a partial PLETHORA may take its riſe from a natural cauſe, and may ſubſiſt without a general PLETHORA, appears ſufficiently from the ſtate of the UTERUS after impregnation ; the blood veſſels, during that period, particularly in the laſt months, being diſtended greatly beyond their uſual dimenſions *. Nor do pregnant women,

if

* Quamvis autem uterus in junioribus puellis, et in adultis virginibus, ad tactum firmus et ſolidus deprehendatur ; tamen graviditas docet hæc vaſa facile cedere poſſe, et in magnam amplitudinem dilatari, cum ultimo graviditatis tempore, uterus inſtar ſpongiæ ſanguine plinæ appareat, cum vaſa ante vix conſpicua in utero non gravido, jam digiti minoris apicem quandoque capiant. Van Swieten.

if in health, diſcover any ſymptoms of a ge-
neral PLETHORA, though the womb be
then in a plethoric ſtate : on the contrary,
many women, who enjoy perfect health dur-
ing that period, look leaner, and leſs plethoric
than before impregnation.

IT is to be obſerved, that, in inveſtiga-
tions of this kind, we ought not to take ob-
ſervations from women who are in any de-
gree pained about the time of menſtruation.
There are many women, particularly of the
middle rank of life, who live in the coun-
try, and who, from the benefit of freſh air,
ſufficient exerciſe, ſimple diet, and tranquil-
lity of mind, feel no inconvenience, nor
have any ſymptoms of a general PLETHO-
RA about the time of the menſes.

BUT, though we daily meet with others
who have evident ſymptoms of a general
fulneſs, and a variety of troubleſome feel-
ings about that period, we ought not there-
fore to conclude that theſe ſymptoms are

more

more neceſſary than the many inconvenien-
ces which are frequently found to attend the
other evacuations. It is from thoſe only
who enjoy perfect health that we can judge
with propriety of the œconomy of nature
in animal bodies.

It may be objected that the uterine veſ-
fels, when they ſuffer ſo great an expanſion
from the impulſe of the menſtrual blood,
muſt, by their reaction, produce a general
PLETHORA in ſome degree.

Something of this nature might be ſup-
poſed to happen did the conveyance of
blood into the uterine veſſels depend ſolely
on the action of the neighbouring arteries:
but the UTERUS, according to this theory,
being, by its particular conſtitution, and at
certain periods, diſpoſed to imbibe blood,
the impelling force of the neighbouring ar-
teries becomes leſs neceſſary, nor can any de-
gree of a general PLETHORA ariſe from the
reaction

reaction of the uterine veſſels, when thus diſ-
poſed to attract the menſtrual blood.

It doth not appear that any ſatisfactory
account of the conveyance of the menſtrual
blood to theſe parts can be given, without
having recourſe to an abſorbing quality in
the uterine veſſels. For, if the determina-
tion of blood to the UTERUS depended
wholly upon the action of the neighbouring
arteries, then ought the menſtrual flux to
increaſe, or diminiſh, as the action of theſe
arteries, and the momentum of the blood
become greater or leſs ; which doth not
agree with common obſervation : for nei-
ther the times, nor quantities of the menſes
are affected by exerciſe and reſt, or by the
ſtronger, or weaker action of the heart, ſo
much as they ought, if the periodical col-
lection of blood in theſe parts depended
wholly on its momentum being increaſed by
the addition of a few ounces.

K　　　　　　There

THERE ſeems to be ſome analogy be-
tween the ſeeds of plants and the UTERUS
of animals. Seeds have a remarkable at-
tracting, and abſorbing quality, ſo that, when
they are expoſed to warmth and moiſture,
more or leſs, according to the nature of the
ſeeds, they ſoon imbibe, ſwell, and germi-
nate: and, though the external preſſure of
the ambient moiſture may have its effect in
forwarding this change in the ſeed, yet doth
its internal motion ariſe chiefly from its at-
tracting, or abſorbing virtue, depending up-
on its original organization. The efficient
cauſe of this is unknown to us. On this
natural diſpoſition of the ſeed the nouriſh-
ment and growth of the future plant, in a
great meaſure, depends; and ſeeds which
have reached maturity imbibe more readily,
and more plentifully, than others which have
never come to a full ripeneſs: accordingly,
the latter produce either weakly plants, or
none at all.

IN like manner may the UTERUS, at a particular period of life, or when come to a certain degree of maturity, acquire a power of abſorbing the menſtrual blood, allowing ſtill the adjacent arteries to have their ſhare in forwarding this accumulation of blood; for which, however, the action of theſe arteries ſeems to be of itſelf inſufficient, without the abſorbing power of the uterine veſſels.

BUT, though a partial or local PLETHO-RA be here allowed, it can only be underſtood to be ſo on certain conditions. A PLETHORA is commonly ſuppoſed to include ſomething morbid. But, in the preſent caſe, it can have no meaning of this kind, ſince the uterine veſſels, in collecting, and voiding the menſtrual blood, diſcharge their natural functions, as much as the liver in ſecreting bile, or the urinary bladder in collecting, and diſcharging the urine.

BUT, if by a partial PLETHORA be meant ſuch a quantity of blood collected in

any

any particular organ, as cannot be propelled in the common courſe of circulation, whether this proceed from the peculiar dilatability of the veſſels, and their ſmall elaſtic power in proportion to their ſize, or from whatever other cauſe, then muſt the UTE-RUS be allowed to be in a plethoric ſtate about the time of menſtruation.

By a general PLETHORA, as hath been obſerved above, is underſtood a greater quantity of blood than the moving power is able conveniently to circulate : but the blood cannot thus exceed the mean quantity without a morbid ſtate of the body. Now it would be prepoſterous to ſuppoſe a natural effect, or ſuch as is indiſpenſible in the animal œconomy, to depend neceſſarily upon a morbid, or unnatural cauſe *.

THIS

* It may be proper to obſerve, that, by a natural cauſe, or effect, nothing more is meant here than what is neceſſary or conducive to the preſervation of the animal œconomy, without regard to the general or abſtract ſenſe of cauſe and effect. Thus, poiſon, taken into the ſtomach, may deſtroy the animal frame by reducing the blood to a putrid ſtate. This, with reſpect to the

animal

THIS is a difficulty in which thoſe muſt be involved who ſuppoſe a general PLE-THORA neceſſary to produce the menſes. And with reſpect to a partial, or local PLE-THORA, that name may be aſſigned to it, or not, according to the ſenſe affixed to the word.

IT hath been ſaid that the erect poſture of women is one cauſe, among others, of menſtruation : and that the horizontal po-ſture of brutes contributes to prevent it in them.

BUT, though the internal parts of gene-ration in women be perpendicular, or nearly ſo, the veſſels belonging to theſe parts are
moſtly

animal œconomy, is an unnatural, or morbid effect, produced by a cauſe of the ſame kind. But the reſolution of the blood is a natural effect of the poiſon, when conſidered in an abſtract ſenſe, and without regard to the animal œconomy. This obſervation is the more neceſſary, that the words *nature*, and *natural*, being variouſly applied, have ſometimes been miſunderſtood. Natural actions are mentioned ſometimes as contradiſtinguiſhed from vital, and animal actions ; at other times in oppoſition to unnatural actions.

moftly horizontal, or obliquely lateral ; which direction is the moft commodious for collect- ing the blood, and for preventing its too fud- den eruptions. And, though the perpendi- cular column of blood betwixt the heart and the UTERUS may have fome effect in pro- moting the menfes, this can be but incon- fiderable, when compared with the impelling force of the aorta, iliacs, and hypogaftric arteries, and with the aptnefs of the uterine arteries to abforb the menftrual blood at thefe periods ; hence it is common for wo- men, confined to beds, to menftruate as re- gularly as others in health, who ufe an erect pofture.

THE difeafes incident to the UTERUS are known to be numerous, nor is any other part of the body fo immediately affected by the paffions of the mind. ' Uterus nullum ' fibi præter animi pathemata hoftem novit,' fays Van Helmont ; and it is remarkable that the fame paffions are frequently productive of oppofite effects. A violent emotion of the

the mind, from grief, or anxiety, from a
ſudden fright, or from an immoderate fit of
anger, ſometimes ſtops the menſes; and, at
other times, proves the cauſe of an immode-
rate flux. It muſt be owned, however, that
the mutual influences of the mind and body
upon each other is ſo intimately connected
that it is frequently difficult, if not impoſ-
ſible, to diſtinguiſh which is the cauſe, and
which the effect. But it is certain that ex-
travagant emotions of the mind are often
the immediate cauſe of irregularities in men-
ſtruation.

WOMEN, who live in indolence, and deli-
cacy, having for the moſt part weak ſyſtems
of nerves, the common effect of too little
exerciſe, the mind thereby contracts an im-
becillity, which diſcovers itſelf by a too great
quickneſs, and ſenſibility of the paſſions;
a ſtate of the mind rarely to be found among
women who lead active lives, or who are much
accuſtomed to labour. From too great an
irritability of the nerves, from a defective
                                    perſpiration,

perſpiration, and other effects of indolence, follow irregularities in the digeſtions, ſecretions, and, in general, in the circulation. Accordingly, women who are naturally indolent, or whoſe buſineſs reſtricts them to ſedentary lives, are obſerved to be ſubject to palpitations of the heart, ſoundings in the ears, indiſtinct viſion at times, giddineſs, tenſion about the hypochondria, yawnings, ſighings, quick breathing upon uſing motion, laſſitude, coldneſs ſometimes in one part of the body, and ſometimes in another, as in the ſcalp, nap of the neck, or ſpine of the back, and particularly in the feet and legs. Beſides theſe ſymptoms, flatulency and coſtiveneſs are evils attending this kind of life. Theſe ſymptoms, when met with in female conſtitutions, are commonly ranked among hyſterical diſorders, though they do not always proceed immediately from any fault in the UTERUS; they are, however, for the moſt part attended with irregular menſtruation.

WHATEVER

WHATEVER regimen invigorates the bo-
dy, and contributes to animation, will be
found to correct, or remove theſe diſorders,
and to forward the operation of medicines.
Hence the ſucceſs of attending mineral wells.
For, though the waters may have their
ſhare in rectifying enfeebled conſtitutions,
there are many other circumſtances which
prove no leſs ſalutary. On theſe occaſions,
exerciſe, rarely neglected at the wells, new
and agreeable company, change of air, a va-
riety of ſcenes, in travelling to and from
the Spaws, regularity in diet, and proper
food, commonly attended to during the uſe
of the waters, and abſence from buſineſs, or
from whatever may be productive of care
and anxiety in the mind; theſe circum-
ſtances, I ſay, by amuſing and ſupporting
the mind, and invigorating the body, co-
operate to repair the conſtitution. Thus,
as immoderate menſtruation, and likewiſe
obſtructions, are frequently effects of the
ſame cauſe, ſo are theſe effects, however

L   oppoſite;

oppoſite, often corrected by the ſame method.

In obſtructions of a more obſtinate nature, the UTERUS ſeems entirely to loſe the faculty of abſorbing blood from the adjacent arteries, ſo that, in theſe caſes, the ſymptoms which uſed to precede the monthly flux are not at all felt. But though the uterine veſſels may, in ſome degree, retain or recover this abſorbing quality, it frequently happens that they are unable to diſcharge the menſtrual blood. This is known to be the ſtate of the UTERUS, when, at the expected period, but without any ſubſequent menſtrual diſcharge, there is a ſenſation of the ordinary ſymptoms which uſed to indicate the approach of the periodical flux. In this caſe it is to be preſumed that medicines of a warm and ſtimulating quality may be given with greater advantage, and ſafety, than in the former, in which the uterine veſſels, being in a collapſed ſtate, cannot be ſuppoſed to be affected by the virtues of medicines,

dicines, with the ſame advantage, as when theſe veſſels admit a proportion of the menſtrual blood. I had lately an opportunity of knowing the caſe of two women under uterine obſtructions, who, for ſeveral months, not having felt any ſymptoms indicating a derivation of blood to the UTERUS, were, by the uſe of an empiric medicine, given as a certain deobſtruent, thrown into conſiderable diſorders, as throbbings about the *præcordia*, a quick low pulſe, faintiſhneſs, and the like ſymptoms: others, with whom the menſes flowed very ſparingly, uſed the ſame medicine with advantage.

WHEN the menſtrual blood is received into the uterine veſſels, and is not diſcharged, but retained there ſome time, being again taken up in the courſe of circulation, and mixing with the other fluids of the body, it creates numberleſs diſorders in the conſtitution.

FOR the diſorders of the UTERUS there is hitherto no medicine known, which can be properly termed a ſpecific, or whoſe effects are equally certain in theſe diſorders, as the bark in intermitting fevers, or as mercury in exciting a ſalivation.

ALOES having been found effectual, in opening the hemorrhoidal veſſels, hath therefore been uſed as an emmenagogue. But it may be doubted whether it doth not, by this effect, divert the uterine flux, ſince, by increaſing one diſcharge, we generally find others to be diminiſhed. Nor is it improbable that the communication betwixt the uterine and hemorrhoidal veſſels may have been intended to relieve the UTERUS upon occaſions. When women reach that period of life, in which the menſes begin to ceaſe, they are often ſubject to a diſcharge of blood by ſtool, the hemorrhoidal veſſels, in ſo far, carrying on that flux, when the UTERUS becomes unfit for it; and there is reaſon to believe that, in the early periods of pregnancy,

nancy, miscarriages have sometimes been prevented by an hemorrhoidal flux, when not immoderate, the uterine vessels being thus relieved, when a less proportion of blood was sufficient for the nutrition of the embryo than was perhaps conveyed to the UTERUS and neighbouring parts. But, as purgatives are frequently necessary in uterine obstructions, aloes may be preferable to many other cathartics, being of a warm and stimulating nature; and, as such, hath been used ever since the days of Celsus *.

MERCURY, from its weight and divisibility, proves, in many cases, a powerful deobstruent, and gives an *impetus* to the mass of blood. But, from the soft and loose texture of female bodies, it hath been found either to run off by stool, or to affect the glands of the mouth, before it overcome the uterine obstructions. Opium, steel, castor, colocynth, and many other medicines are

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* Sed medicamenta stomachum fere lædunt, ideoque omnibus catharticis aloe miscenda est. Lib. 2. cap. 12.

are known to have virtues in hysterical disorders, when properly applied.

It hath been proposed, by some, as a problem, why phlebotomy doth not answer the purposes of a discharge of blood by the UTERUS.

Had the cause of the menses been a general PLETHORA, an equal quantity of blood taken from any other part of the body might have prevented the uterine flux; but, in this event, nature would have been defective with respect to the final cause; since every accidental hemorrhage, though from parts of the body remote from the UTERUS, would have endangered, if not destroyed the fœtus. There are many instances which tend to prove that phlebotomy hath little, if any influence, either in promoting, or in stopping the menstrual flux.

When we consider that the blood is conveyed to the UTERUS by large and elastic

arteries,

arteries, and to this when we add the particular difpofition, or abforbing quality, with which the uterine veffels are fuppofed to be endued, it will appear that this organ muft be fupplied with blood, fo long as the heart acts, and the UTERUS retains that faculty. Accordingly, many women menftruate regularly, notwithftanding profufe hemorrhages from other parts of the body ; and it hath often been found that tedious and wafting difeafes do not prevent the monthly flux.

AN antipathy to phlebotomy, or a natural timidity, may, with fome women, affect the menftrual flux. But this effect muft be afcribed to a paffion of the mind, which, as hath been already obferved, hath no fmall influence on the UTERUS. Phlebotomy hath been often found neceffary and fuccefsful in correcting other diforders, not only during menftruation, but during the flux of the *lochia* *.

FURTHER,

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* Van Swieten. comm. in aphor. Boerh. de pleurit. Tulp. obferv. med, lib 2. cap. 2. La Motte traite des accouchem. liv. 2. cap. 21.

FURTHER, by obferving final caufes, which merit our attention, while we inveftigate the operations of nature, there is reafon to believe, from the œconomy of female bodies, that the prefervation and nutrition of the fœtus, from its firft rudiments to its birth, are of fo great importance as to render it neceffary that the UTERUS fhould be endued with a temperament peculiar to itfelf, fo as to act, in fome refpects, independent of the other parts of the body: and that, though a plentiful fource of blood be in conftant readinefs in the neighbouring veffels, yet that the action of thefe arteries is infufficient to impel the menftrual blood into the UTERUS, till it be prompted to admit that blood by a ftimulus, or faculty within itfelf, and independent of any external *impetus.* So that all thefe neighbouring arteries are fubfervient to the UTERUS, to fupply it with blood ; though infufficient, by their own action, to extend its veffels beyond their invifible ftate, till they be difpofed, by their natural and peculiar

faculty,

faculty, to abſorb the menſtrual blood, or ſo much as ſhall be ſufficient for the nutrition and increment of the fœtus *.

IT may be further obſerved in ſupport of this theory of an innate power of attracting blood, that the UTERUS is moſt plentifully ſupplied with blood, when the arteries are in a direction the leaſt favourable for conveying it : for in the laſt period of geſtation, when the UTERUS is ſo raiſed as to bear up the abdominal *viſcera*, many of theſe arteries, inſtead of their former depending ſituation, are now bent upwards; and yet their ramifications, ſpread over the UTERUS, are never more turgid with blood, than when they are in this direction. But the weight of the fœtus and ſecundines at birth, compared with that of the menſtrual flux of nine months, is likewiſe a proof of the ex-

M   traordinary

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* Van Helmont had an idea of the *uterus*, as endued with a faculty, or power of this kind, independent, in ſo far, of the other parts of the body. 'Cum ſit uterus, perigrini hoſpitis inſtar, a 'corpore non niſi alimentaliter dependens, prout viſcus ab arbore 'cui innaſcitur. Cæterum uterus quadra vivit propria,' &c.

traordinary quantity of blood conveyed to theſe parts during geſtation.

AFTER impregnation the fœtus ſeems to be ſupplied with nouriſhment preferable to any part of the mother's body. Women, labouring under waſting diſeaſes, particularly pulmonary conſumptions, are frequently delivered of children, whoſe full and healthy appearance bears no proportion to the emaciated ſtate of the mothers. This ſhews the circulation in the body of the fœtus to have been more natural, and regular, than that in the mother's, with whom the action of the heart is, ſometimes in theſe caſes, ſo weak, that the circulation is, with difficulty, kept up *. When we compare this with

what

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* This more natural circulation in the body of the fœtus, than in that of the mother, may be accounted for, in ſome meaſure, from the moving power in the child's body being greater, than that of the mother's, in proportion to the ſize of the two bodies, according to the univerſal law, which obtains in mechanics: for, of ſimilar machines, the ſmaller do more, in proportion to their magnitudes, than the larger. In the preſent caſe, the fœtus can have no nouriſhment but the tainted blood of the mother; and

yet

what hath been obferved, with refpect to menftruation during thefe difeafes, we may judge of the abforbing power of the uterine veffels.

M 2   E s s a y III.

yet we frequently fee children reach a certain age and fize before thefe difeafes difcover themfelves, though the children muft have had the morbid *fomes* in their original *ftamina*. Something of the fame nature may be obferved in vegetables, and probably from a fimilar caufe. Many plants decay, after having come to a certain fize, with an healthy appearance; and the blights and mildews in corns are believed to be owing to a vitiation in the the feed, which is faid to be corrected by foaking the feed in nitrous and other *lixivia*. But, with refpect to the foetus, perhaps the blood, which is conveyed to it, may undergo fuch a percolation, in paffing from the uterine veffels to thofe of the *placenta*, as to render it purer than that circulating in the mother's body; and thus it may contribute to the more falutary ftate of the child.

Essay III.

Of

Measuring Proportional Quantities of Heat.

E S S A Y III.

O F

MEASURING PROPORTIONAL QUANTITIES OF HEAT.

IT is about a century and an half since philosophers began to measure the degrees of heat by means of instruments constructed for that purpose, nor is it certain to whom we owe this discovery. Galileo, Sanctorius, Father Paul, and Drebbel have their respective advocates *. It is not improbable that these instruments might have

been

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* The Dutch authors, particularly M. Hennert, one of the latest writers on this subject, make Drebbel the inventor. L'honneur de cette Decouverte, says M. Hennert, appartient aux Hollandois.—Je ferai voir que Sanctorius n'est pas l'inventeur des thermometres. Drebbel is said to have invented his thermometer at Prague, during the siege of that town by the king of Bohemia, or afterwards in England. The siege of Prague was in the year 1620. It is probable, from Sanctorius's aphorisms, that he had used a thermometer during his experiments. The aphorisms

were

been contrived by different inventors about the fame time, fince that was a period in which experimental philofophy began to be a ferious ftudy.

THE illuftrious Sir Ifaac Newton, obferving lintfeed oil to admit of confiderable degrees of expanfion by heat, conftructed a thermometer with that liquor: and, fuppofing the freezing point to be the limit betwixt heat and cold, graduated the thermometer upwards, making 12 degrees the heat of the human body: fo that the heat of boiling water was fomething more than 34 of thefe degrees *.

SIR

were firft publifhed at Venice in 1614; that is, fix years fooner than M. Hennert fays that Drebbel had invented his thermometer. It may be further obferved, fince Drebbel's and Sanctorius's thermometers were of the fame conftruction, that Drebbel might have had the idea of his from that of Sanctorius.

* To make Sir Ifaac Newton's thermometer coincide with Farenheit's, boiling water ought not to be quite fo high as 34.— $\frac{12-32}{54-32} \times 1 = 33.75$, which is the degree of boiling water in Sir Ifaac's fcale, that of animal heat being 12. But Sir Ifaac found that from the firft boiling to the moft violent ebullition, the thermometer moved from 33 to 34.5 degrees in his fcale, which, in Farenheit's, is no lefs than 8 degrees.

SIR ISAAC, suppofing equal dilatations of the fluid to indicate equal quantities of heat, makes the heat of boiling water to be nearly equal to thrice the heat of the human body.

WERE it certain that the freezing point is the lowest boundary of heat, and likewife that equal quantities of heat produce equal degrees of rarifaction in the fluids, then would the menfuration of heat become an eafy matter.

BUT it hath not yet been determined whether there be really fuch a thing as frigorific particles effentially diftinct from heat. What we denominate cold, for all that hath been faid on that fubject, may ftill be no more than a diminution, or defect of heat, to certain degrees, according to the feelings of different animals, or of the fame animals at different times, and the various fenfations of heat and cold may depend upon the particular organization of animal bodies; fo

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that

that a medium, yielding a sensation of warmth to animals living in the polar circles, might quickly chill us to death.

WERE we to suppose the first degree of heat to be six divisions of Sir Isaac's scale lower than he hath made it, which is the beginning of Farenheit's, then would the proportion of the heat of the human body be to that of boiling water, only as 3 to 7 nearly: and were the first point to be moved still lower, which, for what we know, ought to be the case, the proportions would vary accordingly.

As we are ignorant, therefore, of the beginning of heat, and probably shall never be able to discover the boundary betwixt heat and cold, or whether there be such a thing in nature as an absolute privation of heat, it is in vain to attempt the mensuration of any certain quantity of absolute heat.

BUT as we may have *data* sufficient to discover the proportion which different quantities bear to one another, without being able to measure any one of these quantities; so may we be able to measure the proportional degrees of heat, though it be not in our power to measure any quantity of absolute heat. Thus we may suppose ourselves able to discover the proportional distances of two, or more planets, from the sun, without being able to measure the real distance of any of them.

THE great difficulty in this attempt is to discover the *ratio* betwixt the dilatations of the fluids and the proportional quantities of heat upon which these dilatations depend. For though it be probable that the rarifactions of different fluids bear different proportions to equal quantities of heat; yet is it uncertain whether there be any fluid which admits of additional rarifactions precisely equal to additional quantities of heat.

THE

THE heat of the human body in a morbid ftate is found fometimes to exceed its natural heat by 10 or 12 degrees *; that is, from 95 or 96, to about 10 or 12 degrees upwards. But we do not know whether the fame additional quantity of heat applied to the thermometer, when the mercury ftands very low, might not raife it twice or thrice as many degrees.

IT hath been demonftrated that the denfity of all rays, iffuing from one common center, is in the inverfe *ratio* of the fquares of the diftances from that center † : and, as heat is propagated in right lines, as is univerfally believed, its ftrength, or intenfity will be in the fame *ratio*.

FROM this well known propofition, a method is pointed out for conftructing thermometers

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* Mr Burton, on his thermometers, makes the natural heat of the blood 97 degrees, and fever-heat 112.; which latter is higher than I have ever found it.

† Keil's phyfics, lecture 1.

mometers fhewing proportional quantities of heat; an inftrument greatly wanted among naturalifts.

IF a thermometer, to be graduated in this manner, be placed at a given diftance from any equal central heat, fuppofe at fix inches; when it will rife no higher, if it be removed to the diftance of twelve inches, the heat in the former ftation will be to that in the latter as 4 to 1. If the thermometer be removed to a third equal diftance, the heat at the firft ftation will be to that at the laft as 9 to 1. That at the fecond to that at the third as 9 to 4; and fo on. The numbers I, II, III, IV, &c. *, being marked on the fcale, to fhew the height of the mercury, correfponding to the different diftances of the artificial heat, marked 1, 2, 3, 4, &c. the intermediate fpaces may be divided indefinitely into fractional parts.

THE

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* Plate II. fig. 1.

THE inftrument being graduated, if experiments are to be made, or the heat of two or more bodies to be compared, if the body or medium A, raife the mercury to a height correfponding to the diftance 1.53, and the body B, to that correfponding to the diftance 2.63 then would the heat of the body A, be to the heat of B, as $\overline{2.63}^2$, to $\overline{1.53}^2$.

SOME have been of opinion that the force of heat is not propagated according to this law; becaufe heat in the focus of a fpeculum, efpecially thofe of the larger kinds, is very intenfe; whereas, at a moderate diftance from the focus, we feel little or no heat.

BUT the reafon of this is evident; for the rays diverging very quickly, foon become as rare as before they were collected. Thus the rays reflected from the fpeculum A B *, having paffed the focus F, become as rare as the parallel rays which fell on the fpeculum, when thefe diverging rays are at the fame diftance from the focus as the fo-

cus

* Plate II. fig. 2.

cus itfelf is from the fpeculum. So that the diftance betwixt the focus and D, C, or E, is too little for experiments of this kind.

IT may be further obferved, that, though the rays iffuing from a center would affect a thermometer according to this law, yet, if we were to apply the thermometer to the ignited body, or to immerfe it in the flame from which the rays are emitted, this law would ceafe, the heat of the ignited body being much beyond the higheft proportion of heat in the rays. But the focus of a fpeculum is to be confidered, with refpect to the intenfenefs of heat, as an ignited body, from the great collifion of the particles of heat at the decuffation of the rays; fo that the heat of the rays, at a very fmall diftance from the focus, are found to bear no proportion to the heat in the focus.

ONE difficulty, which attends this conftruction of thermometers, is to find an equal central heat: for, if the heat were to

vary

vary but in a small degree, the proportions would be lost. Did concave mirrours form pencils of rays of a sufficient length for experiments of this kind, they would perhaps be less exceptionable than any other method: but they are open to the objections just mentioned. Ignited metals cool according to a certain *ratio*; but to make allowance for this *ratio*, if it be really known, or to take it into the computation, would render the operation difficult, if at all practicable. The flames of candles seem to yield the most invariable heat, provided it were strong enough to procure a scale of any considerable extent. But, till a better method shall be discovered, candles may be used with advantage in the following manner.

In place of making experiments of this kind by heat emitted from any central body, several candles may be placed at equal distances from the thermometer, and the proportional degrees of heat discovered by

moving

moving the candles towards the inſtrument. For this purpoſe let a frame be conſtructed in the following manner.

Two beams, or pieces of wood, A B, and C D *, each two inches thick, four inches broad, and four feet four inches long, are to be fixed or ſunk into one another at the middle, E, ſo as to form four equal branches, making ſo many right angles with one another at the middle. In each branch muſt be a ſlit wide enough to receive a ſquare wooden ſocket, e, in which muſt be a cylindrical hole ſufficient to receive a large candle. The ſlit in each branch muſt be ſo long that the centers of the ſliding ſockets may be moved from the diſtance of 24 inches to that of 2 inches from the central point E. On each branch are to be marked croſs lines, or diviſions, at the diſtance of two inches from each other, as in the figure, and that next the center being two inches from it, the diviſion next the extremity of each

O   branch

* Plate III.

branch will be 24 inches from the fame central point. Each of the fliding fockets muft likewife be marked with a line parallel to thofe on the branches, and paffing through the center of the cylindrical hole; fo that, as the fliding fockets are moved along the flits, this line, falling in with the lines on each fide, will fhew exactly the diftance of the axis of each candle from the center of the frame.

It will be further proper that the divifions on the branches be fubdivided into tenths, twentieths, or as many fractional parts as may be convenient; that, in moving the candles towards the thermometer, allowance may be made for the thicknefs of the ball. Thus, if the diameter of the ball be fix tenths of an inch, then, in place of moving the fliding focket fo far forward as to make its crofs line coincide with that of the great divifion, it muft be three tenths of an inch fhort of that divifion.

<div align="right">The</div>

THE frame ought to be supported by four feet, one at the extremity of each branch; and, that the reflexion of heat from the table or floor, on which the frame stands, may not affect the mercury, these feet ought to be four inches high at least.

THE frame being thus prepared, the four candles, fixed in the sockets, are to be placed at the divisions next to the extremities of the branches, and a thermometer to be hung, precisely over the central point of the frame, so high that its ball may be in an horizontal plane with the flames of the candles. Having observed the precise height at which the mercury stands by the heat of the candles at the most distant station, let the sockets and candles be moved to the next station, and so on through the twelve stations. But in this process there are several precautions which ought to be carefully attended to.

I. THE

1. THE tube, or ſtem of the thermometer to be graduated, muſt be fitted to a plate having Farenheit's diviſions on one ſide*; the other ſide to be left open for the new ſcale: the ball of the thermometer muſt be open on all ſides, that the heat from the four candles may act upon it without interruption.

2. THE obſerver muſt not touch the thermometer during the operation, leſt he give it a vibratory motion, and muſt hold an handkerchief over his mouth, while he obſerves the height of the mercury, that his breath may not communicate any additional heat to the air about the inſtrument; nor ought more than two perſons to be in the room during the operation.

3. THE interval betwixt each obſervation muſt be of a ſufficient length, that the obſerver may be ſure that the mercury will riſe

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* Plate II. fig. 1.

rife no higher before he move the candles to the next ftation.

4. THE thermometer muft be fo hung that it may be let lower as the flames of the candles become lower: for the ball of the thermometer muft be conftantly in an horizontal plane with the flames of the candles.

5. THE candles muft be exactly cylindrical from top to bottom; they ought likewife to be thicker than ordinary candles, that their flames may yield the greater heat; and they muft ftand precifely perpendicular, for which purpofe the fockets muft be pretty deep. They ought to be made of the fineft tallow; for though waxen candles yield a purer flame, their heat is not fo great. They muft be regularly fnuffed during the operation.

6. THIS operation ought to be in a large room, and the *apparatus* muft be in a

part of the room where there is no current or circulation of air.

7. THERE ought to be one or more thermometers in the room, at fome diftance from the *apparatus,* to fhew that the air of the room without the fphere of the candles retains the fame degree of heat from the beginning to the end of the procefs; and when this is the cafe, then will the rifing of the thermometer be the effect of the heat of the candles only, and the various heights of the mercury will be in the proportion mentioned above.

FROM fome experiments made to this purpofe, it appears that four candles of an ordinary fize make a fenfible impreffion on the mercury at the diftance of two feet; and that the fame candles, when brought to the diftance of three inches from the ball of the thermometer, raife the mercury to 86°. in Farenheit's fcale, when the thermometer, by the heat of the air, ftands about 40°. fo that, by

larger

larger candles, and thefe brought fo near as two inches, it is to be believed that the mercury may be raifed confiderably above 100°. and if the ftate of the air be fuch that the thermometer ftands about the freezing point, a fcale of the extent of 70, 80, or perhaps 90°. of Farenheit's thermometer may be procured ; and, confequently, we may, by this method, be enabled to compare proportional degrees of heat, from the freezing point to the heat of the human body, and upwards.

But, if more heat be wanted, a frame may be conftructed to receive fix, or eight candles. It may be further obferved, that the afcent of the mercury, upon moving the candles from the moft diftant ftation to the next, may be fo fmall, that it will be advifeable to advance the candles four inches in place of two, for the two or three firft obfervations, that is, from 24 to 20, and from 20 to 16, &c. inches from the ball of the thermometer.

IT is not meant that thermometers, graduated after this manner, ſhould ſuperſede Farenheit's, and other thermometers now in uſe: theſe would ſtill be valuable, as well for their eaſy conſtruction, as for the great extent of their ſcales, and would ſerve all the common purpoſes of regulating heat. Nor is it pretended that this propoſal is, in every reſpect, ſecure againſt objection, or that the execution will be unattended with difficulties. It is, however, worthy of being brought to trial, being an attempt to find the ſolution of a problem which hath been given up as impoſſible: and if the conſtruction of thermometers after this manner be found to anſwer as well in practice as in theory, we ſhould be ſatisfied in many parts of natural hiſtory hitherto unknown, ſuch as the proportion betwixt the mean heat of ſummer and that of winter, betwixt the heat of the human body and that of the air at different ſeaſons, and many other curious problems which cannot otherwiſe be ſolved.

IT

IT may, at firſt ſight, appear an objection, that the ſcales will be different according to the different degrees of the heat of the air when obſervations of this kind are taken. Thus, in winter, or when the air is very cold, a longer ſcale would be procured, than in ſummer, when the mercury ſtands high, though we uſe the ſame artificial heat, and at the ſame diſtances.

THIS is indeed true. But the difficulty evaniſheth, when we conſider, that, though the one ſcale be more or leſs extenſive than the other, their diviſions will, nevertheleſs, be proportional. Thus, if the heat of the air be at one time as twenty, and at another as thirty; and the additional artificial heat, or its exceſs above the heat of the air, as five in one ſtation, and as ten in another, theſe two numbers, bearing an higher proportion to twenty than to thirty, will affect the thermometer more in the former ſtate of the air, than in the latter; and, conſequently, will make a larger ſcale, when the

P

air

air is cold, than when it is hot, though their divisions will be proportional to one another, as the lines BC, DE, FG *, in the triangle A B C, and the parts of these lines, divided by A *n*, and A *m*, are all proportional to one another.

AGAIN, if BC be one scale, and FG another, then will the heat at *m*, bear the same proportion to that at *n*, as the heat at *o*, to that at *p*. If C be the height of the mercury in a cold state of the air, and when the artificial heat is at the most distant station, and G its height, when the artificial heat is at the same distance; but the air in a warmer state; then will the difference be C *r*: but, when the artificial heat is brought so near as to raise the mercury in the one scale to *p*, and in the other to *n*; then will the difference be *n s*. In general, the less the difference is betwixt the artificial heat and that of the air, the scale and its proportional parts will be the smaller, as H I; and

if

* Plate II. fig. 3.

if the heat of the air be fuppofed equal to the artificial heat, that is, the line A C, to meet the line A B, as at A; then, the difference being deftroyed, no fcale could be obtained; for to mix two fluids of an equal degree of heat, makes no increafe of heat.

Thus, by taking different fcales, when the air, with refpect to heat and cold, is in the moft oppofite ftates, we may be enabled to form a general fcale, fhewing the proportional degrees of heat, in any ftate of the air. For example, when its heat is about twenty-five degrees, the fcale *b d** may be procured; and the fcale *a c*, when its heat is about 77. Thefe two fcales being delineated, or engraved parallel to, and at any proper diftance from one another, as *a c* and *b d*; and lines being drawn from the numbers of the one fcale to the corresponding

P 2   ing

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* Plate IV.—It may be obferved that the example of this general fcale of proportional heats, in the plate, is not digefted from experiments, or according to proportions founded in nature; but only to fhew the form and ufe of fuch a table.

ing numbers of the other, as from I to I, from II to II, from III to III, and so on, a table may be formed which will shew the proportional degrees of heat in any state of the air betwixt these two scales.

Thus the lines *a b*, and *c d*, with the intermediate oblique lines, shew the form of such a general scale: and, having discovered the *ratio* of the distances betwixt these lines, they may be produced to any length; for, as nature constantly acts by some law, it is to be presumed that this law may be ascertained by a sufficient number of experiments.

This table ought to have Farenheit's scale on each side, as A C, and B D, with parallel horizontal lines passing from the numbers of one side to the same numbers of the other, at proper distances, as from 120 to 120, from 100 to 100, from 80 to 80, &c. Thus the height of the mercury in Farenheit's thermometer may be conveniently compared with the table of proportional

tional heats, the parallel lines of the one intersecting the oblique lines of the other.

THE use of this table will appear better from an example. If the heat of the human body is to be compared with that of any other body, or medium of seventy degrees in Farenheit's thermometer, the heat of the air being in some intermediate state betwixt the two scales of proportional heats, as ef; then m, being at ninety six in Farenheit's scale, is the heat of the human body; and n, being at seventy in the same scale, is the heat of the other body. Therefore, m, falling on the scale ef, at IV, and four tenths *, that is, at the number shewing the distance of the artificial heat from the thermometer, and n, falling on the same scale at the distance of VIII, and six tenths, the heat at m, will be to that at n, as $\overline{8.6}^2$ to $\overline{4.4}^2$: that is, the heat of the human body will

<div align="right">be</div>

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* It is sufficient, in this example, to suppose the fractional parts, though none be marked on the scale.

be to that of the other body as 73.96. to 19.36.

In this manner may the heat of two or more bodies be compared. But, if the heats of the fame two bodies are to be compared with the heat of the air when in different ftates, it will be neceffary to find the proportional numbers, fhewing the heats of thefe bodies in the different fcales, before comparing them with that of the air.

If, therefore, the heats of the fame two bodies are to be compared when the air is in a cooler ftate, as in the fcale *g h*, then the numbers, expreffing the proportional heats, will be different, but in the fame *ratio* as the preceding numbers; for the heats ninety fix and feventy, in Farenheit's fcale, falling now at *o*, and *p*, will be in the following proportion; $n : m :: p : \frac{mp}{n} = o$; which is in numbers thus, 73.96 : 19.36 :: 39.69 : 10.39. which laft 10.39, is the proportional heat

at

at *p,* the fquare root of that number being
the diftance of the artificial heat from the
thermometer, correfponding to *o,* in this
fcale; and bears the fame proportion to
39.69, the heat at *o,* as 19.36, to 73.96.

IN comparing the heat of any body with
that of the air, it may be obferved that, of
the two numbers fhewing the proportional
heats, the one will vary as the fcale is larger
or fmaller, the other will be conftantly as
the fquare of the greateft diftance of the
artificial heat from the thermometer, which
will be nearly the natural heat of the air at
the time of the experiment. Thus, when we
compare the heat of the blood with that of
the air, when the thermometer ftands at fixty
degrees, as in the fcale *e f,* the heat at *m,*
will be to the heat at *f,* as 144 to 19.36.
But in the fcale *g h,* that is, when the ther-
mometer ftands at forty degrees, the heat
of the blood will be to that of the air as
144 to 10 39. In the fame manner, the

heat

heat of the other body, or medium of ſeventy degrees, may be compared with that of the air.

ESSAY IV.

Essay IV.

O F

Insalutary Constitutions of the Air, from a Defect of Winds of the higher Degrees.

ESSAY IV.

OF

INSALUTARY CONSTITUTIONS of the AIR, from a Defect of WINDS of the higher Degrees.

IN the regifters of the weather, which have been kept with a view to afcertain the remote caufes of epidemical difeafes, the gravity, heat, and humidity of the air, have been regularly attended to; the quantities of rain, and the direction of winds, have likewife fometimes been noted; but the degrees of winds have frequently been neglected. It is intended, in this fhort effay, to fhew the impropriety of this omiffion, in thefe regifters.

As the caufe of winds hath been frequently a fubject of enquiry among natu-

ralifts

ralifts in general, fo have their effects upon animal bodies more particularly attracted the attention of medical authors ever fince the days of Hyppocrates.

WHEN we endeavour to trace the caufes of epidemical difeafes from journals of the weather, if in thefe journals the degrees of winds have been omitted, we are not only unable to draw any fatisfactory conjecture from them, but are frequently led to believe, either that the ftate of the air, or that of difeafes, ought to have been oppofite to that which appears from the regifters.

THUS, when we find, in a journal of the weather, that the barometer hath been very low for a confiderable time, the humidity and heat being at a mean degree, we are apt to conclude this conftitution of the air to have been unwholefome; which is often the cafe, when a low barometer is attended with continued calms. But when this low ftate of the mercury proceeds from high and

ftormy

ftormy winds, it, for the moft part, indicates a falutary conftitution of the air, and, in fo far, the agitation of the air feems to compenfate its defect of gravity.

As to the directions of winds, independent of their force, thefe which move along the fame climates, though with oppofite directions at different times, have been found to acquire particular qualities, according to the nature of the tracts of land or water over which they pafs. But, in latitudes confiderably diftant from the equator, winds coming from oppofite climates are obferved to poffefs different, and, frequently, oppofite qualities, befides thofe which they acquire from caufes common to all winds. This is the cafe with north and fouth winds in the higher latitudes.

THE ancients univerfally afcribe a baneful quality to fouth winds; and the learned Hoffman, though living in a much more northern climate than the ancient medical authors,

authors, agrees with them in the effects of fouth winds. It muft be owned, however, that fouth winds are not fo much to be feared in thefe northern latitudes, nor have north winds always the fame falutary effects with us, that Hyppocrates, Ariftotle, Celfus, and Galen found them to have in the more fouthern climates. With us the good or bad effects of north winds feem to depend on the period of the year in which they blow : for, about the end of the fpring, or the beginning of fummer, when pinching north winds follow a warm ftate of the air, thefe winds are productive of rheums, coughs, and inflammations, affecting chiefly the pleura, and lungs. But, from the fummer folftice to the autumnal equinox, or fome time after it, northerly winds are obferved to correct that ftate of the air which promotes putrefaction, the caufes of which in the air are heat, humidity, and continued calms, or warm fouth winds. The air, when in this ftate, feems frequently to be impregnated with a fulphureous *gas*, which,

at times, manifefts itfelf by meteors, corufca-
tions, thunders, and luminous appearances
on fwampy grounds.

NORTH winds, in general, check or re-
tard vegetation with us. But, in thofe parts
of Afia and Africa which lie next to the Me-
diterranean fea, thefe winds are favourable
to vegetation, as we are told by thofe who
have vifited thefe countries *.

HIGH winds are no where more neceffary
than in great cities, and chiefly after long
calms; for the feculencies of different kinds,
being collected, contract a more noxious
quality than can be corrected by winds of
the lower degrees.

BY a computation † of the quantities of
winds of particular degrees, made from a re-
gifter

* For the effects of winds depending on their directions, fee
Lord Bacon's *hiftoria ventorum*, and Hoffman's differtation *de phy-*
ficis meditationibus circa ventorum caufam, &c.

† By this computation, it was intended to afcertain the propor-
tion of time which may be reckoned upon for the motion of the
heavier

gifter of the weather, which had been kept for five years, it appeared that feven months, in two years of that period, were remarkable for a defect of winds of the higher degrees, and bore a fmall proportion to winds of thefe degrees in the fame months of the other three years.

THE months and years were from June to December, inclufive of the years 1732 and 1735. In which periods the mean proportion of the winds of the third degree and upwards, was to the whole time of thefe feven months, in each of thefe two years, as unit to 17.1. But in the fame months of each of the other three years, the mean proportion of thefe winds was to the whole time of the months in each year, as unit to 8.2. This was a remarkable difproportion.

GREAT

heavier kinds of wind machines, fuch as are ufed for draining coal-pits by pumps. The regifter was kept by Doctor Jurin's method, the winds being divided into four degrees. It was neceffary for this computation, to find a mean betwixt the fecond and third degrees.

GREAT ftorms, as Doctor Huxham ob-
ferves, frequently give a check to epidemic
fevers. In the feven months of the two
fickly years, there were only four hurricanes,
or winds of the fourth degree. But in the
fame months of the other three years there
were thirty three; that is, the winds of this
degree, in each of the former periods, were
to thofe in each of the latter, as 2 to 11.

THAT I might know the effects of this
conftitution of the air on the human body, I
examined the hiftory of difeafes during the
latter part of thefe months, and the period
following them; for, unlefs the air be noxi-
ous to an uncommon degree, its effects do
not appear on the human body till fome-
time after the caufe; and the diftance of
time, it may be prefumed, will be greater or
lefs, according as the difpofition of the body
to admit, or its power to refift the remote
morbid caufe, are greater.

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To begin with the month of Auguft 1732; the progrefs of the epidemics was according to the following fhort account.

From the beginning of Auguft to the end of October, a fever of the low kind prevailed, chiefly among the inferior rank of people, and foon became mortal. The fever was attended with fevere headachs, ravings, and fometimes with a diarrhœa; in the two latter months, the difeafe became more fatal, the patients dying about the eighth or ninth day, having been attacked early with a ftupor, and lethargic liftlefnefs. Many of the difeafed voided worms of different kinds: which, in fevers, generally proceed from bilious or acrimonious humours lodged in the inteftines.

From the beginning of November to the end of December, aguifh complaints, cholera, quincies, rheumatifms, diarrhœas, befides flow fevers, were common.

About the middle of December, the infleuenza broke out in Edinburgh, and, in a short time, became so general that very few escaped the disease.

Besides the common symptoms, in the beginning of fevers, of a frequent pulse, pain and lightness of the head, aching of the bones, shiverings, and the like, these fevers were attended, or ushered in, with a considerable discharge of *mucus* from the nose and tonsils, and a sharp lymph from the eyes, inflammations of the throat, an incessant cough, and frequently with acute pains in the bowels, followed with looseness and bloody stools *.

Before this fever affected the inhabitants of Edinburgh, the horses had been universally attacked with the disease, manifesting itself by coughs, and a copious discharge of acrid *mucus* from the nostrils.

R 2　　　　　　　Thus

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* For a further account of this disease, see Edin. Med. Essays, vol. 3. art. 2.

THIS is juftly obferved to have been the moft univerfal epidemic on record; having, in the fpace of three months, appeared in Germany, Britain, Flanders, France, Switzerland, Italy, and Spain *. It attacked Ireland fomewhat later. It likewife broke out in the northern parts of America, about the fame time as in Europe, travelling fouthward till it reached the Leeward Iflands.

THE effects of this conftitution of the air feem not foon to have evanifhed; for fevers of various kinds continued through moft part of the year 1733, particularly the fcarlet fever, attended with inflammations in the throat, vomitings and loofenefs. Small pox were likewife frequent; which, towards the decline of the year, became very mortal.

IN

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* I had not an opportunity of knowing the ftate of the weather in thefe countries: but the fame conftitution of the air is known fometimes to prevail over a great part of Europe; this however, paffeth unnoticed, unlefs the attention of the public be attracted by fomething extraordinary, as extreme colds, long and violent frofts, floods of rain, or the like.

IN examining the epidemics from June 1735, which was the beginning of the other period remarkable for a defect of the higher winds, it appears that meafles, gradually increasing, became frequent in the country towards the end of that period. The meafles were followed with dangerous and intractable coughs, peripneumonies, and diarrhœas: and numbers who had had the meafles formerly were taken with a fever fimilar to that of the meafles.

IN July, a fever of the flow kind prevailed, attended with a low pulfe, and diarrhœa, which appeared at one period or other of the difeafe. Afterwards the cholera and chincough became frequent both in town and country.

IN December, the dyfentery began to fpread.

FROM the end of the year 1735, till the following February, a low fever was common.

mon. In this disease, the patients, discovering at first great uneasiness and anxiety, soon became delirious, and were quickly weakened by symptomatic sweats. With others this evacuation proved critical. A third class, with difficulty crept out of the disease without any sensible crisis.

In the month of February 1736, a fever prevailed in some parts of the country, said to be of the pleuritic kind. But, notwithstanding the pungent pain in the side, this fever seems, from the other symptoms, to have been of that species which proceeds from a resolved state of the blood, and which is frequently produced by that constitution of the air which generates putrefaction.

This fever was fatal to many; it was attended with bilious vomitings, and, though the pain about the short ribs seemed to require bleeding, the patients did not well bear that evacuation; their thirst, sickness, and

faintishness

faintishness being increased by it. The pulse was neither frequent nor full, and sunk immediately on bleeding. The blood was of a brownish, yellowish, or greenish colour, and scarcely coagulated. The sick were not sensible of sleeping through the course of the disease, which was from 25 to 32 days.

THIS is a general account of the diseases during, and for some time following, these two periods. When we compare the diseases of the other periods of the five years with these, they will appear to have been neither so universal, nor so dangerous in their kinds. For, excepting a pleurisy, in March 1732, the diseases in the other periods were mild and tractable, and such as did not indicate that constitution of the air which is productive of corruption, and which is so dangerous to animal bodies.

THAT the remote causes of the diseases described above was not owing to any thing remarkable in the gravity, heat, or humidity

dity of the air, will appear from the follow-
ing mean ftate of thefe three qualities, in
each of the five years. For the differences,
being inconfiderable, render it it improbable
that they could have been productive of
fuch effects.

Mean height of the Barometer, Thermometer and Hygrofc. for five years *.			
Years, each from June to May, inclufive.	Barom.	Therm.	Hygr.
1731. 1732.	29.5.	11.4.	2.
1732. 1733.	29.7.	11.4	1.9.
1733. 1734.	29.6.	11.7.	1.7.
1734. 1735.	29.5.	11.1.	2.1.
1735. 1736.	29.6.	11.3.	2.1.

THE

* For the mean ftate in each month, fee the Med. Effays.

THE mean quantities of rain, in each of the laſt ſeven months for four years, is as follows.

1731. 1.943.
1732. 2.096.
1733. 1.76.
1734. 1.519.

THE regiſter of rain was not kept from June 1735.

WE frequently hear of the plague being tranſported from one place to another in the cargoes of ſhips, particularly in bale-goods. That infection hath been convey-ed in this way, hath been ſufficiently aſ-certained. But it may be doubted whether ſuch imported infection be very dangerous in the higher latitudes, eſpecially where the air of theſe climates is purified by high winds, which are frequent in mountainous countries. Even in the ſouthern countries of Europe, the devaſtation, that is ſome-

S times

times made by that difeafe, feems to depend chiefly upon the conftitution of the air at the time when the infection is communicated.

THE great plague at Meffina, in 1743, (which was the lateft in Europe fo far weft as that city,) is faid to have been brought thither by a Genoefe Tartana, and the great mortality in that place was believed to have proceeded wholly from this imported infection. But the rapid propagation of the difeafe feems to have been more owing to the ftate of the air for fome time before the arrival of that veffel, and to a predifpofition in the bodies of the inhabitants to receive the infection, than to any other caufe. In the hiftory of that peftilence, it is obferved that fouthern winds, and cloudy weather, had prevailed all that feafon ; and that the hahitants were thus rendered liable to catarrhs, ulcers and tumours about the glands of the throat and *fauces*, tumours in the parotid and inguinal glands, acrid humours in
the

the lungs, and fevers of a bad kind *. From this we may judge how much the body was rendered ſuſceptible of new infection; and it is not improbable that the infection from the Genoeſe ſhip would have had but little, or no effect, had the air been purified by cool and dry north winds, inſtead of the long-continued warm and moiſt ſouth winds. It may be obſerved that the account of this ſtate of the air, and of its effects, coincides entirely with thoſe of Hyppocrates, and other authors living in theſe climates *.

S 2 Now,

* Speſſo dominarono torbidi, e nuvoloſi venti auſtrali. Avvi-cinoſſi indi l' equinozio della primavera dell' infauſto anno 1743, e poco men fredda eſſa moſtroſſi del traſcorſo inverno. Conti-nuarono a ſpirare per lo più gli ſteſſi auſtrali venti, e ſi patirono non pochi, quaſi epidemiali catarri, che da qualche tempo in quà ſi ſono reſi ſoliti in ogn' anno. Fu però fatalità imperſcrutabile, come vedute ſi foſſero in tal tempo le dette innocenti malattie per alcuni accompagnate d' inſoliti accidenti, cioè, oltre della Toſſe, Raucedine, dolor de Petto, gonfiamento della Gola, e delle glan-dole del Collo, ed oltre l' Angine legittime, o ſpurie ne' pazienti, ſi viddero pur tumefarſi ad alcuni le glandole anguinali, e quelle, che ſon dietro l' orecchie dette Parotidi, e recavano anco Febri di mal coſtume. Memoria iſtorica del Contagio della Citta' di Meſſina, da Orazio Turriano. Cap. 3.

* Quum Auſter invaluerit, ejuſmodi in morbis contingunt, ul-cera madentia, os præſertim, pudendum aliaſque partes occupant.

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Now, though the diseases of the two preceding periods might have proceeded from something in the air too subtile for our investigation, yet these few observations seem to be attended with so much probability as may at least suffice to shew the impropriety of neglecting the degrees of winds in journals of the weather: since, in judging of the constitutions of the air, or in tracing the causes of diseases from them, we cannot avail ourselves of these journals, when thus defective; but may be misled by them.

De Humoribus, sect. 11.—and Rhazes to the same purpose; Ventus autem a polo veniens meridiano, corpora dissolvit, sensus turbat, atque dolorem capitis et oculorum ægritudinem facit—febres itidem parit propter suam putredinem.—Est etiam plus omnibus ventis ægritudinem inferre paratus.—De ventis et aere, lib. 3. cap. 5.—This is the *austrina aeris constitutio* of the ancients, by which is frequently understood a warm and moist state of the air, though without winds of any kind. This constitution of the air, with its effects, is thus described by Hoffman: Certissimæ experientiæ est, sub diuturna humidaque austrina aeris intemperie, *præsertim ventis vacua*, magnam ad putredinem morborum generationem proclivitatem fieri: unde frequentius videmus, præcedente paulo longius talismodi aeris statu, magno cum agmine prorumpere morbillos, catarrhales, malignas et petechizantes febres purpuratasque, &c.
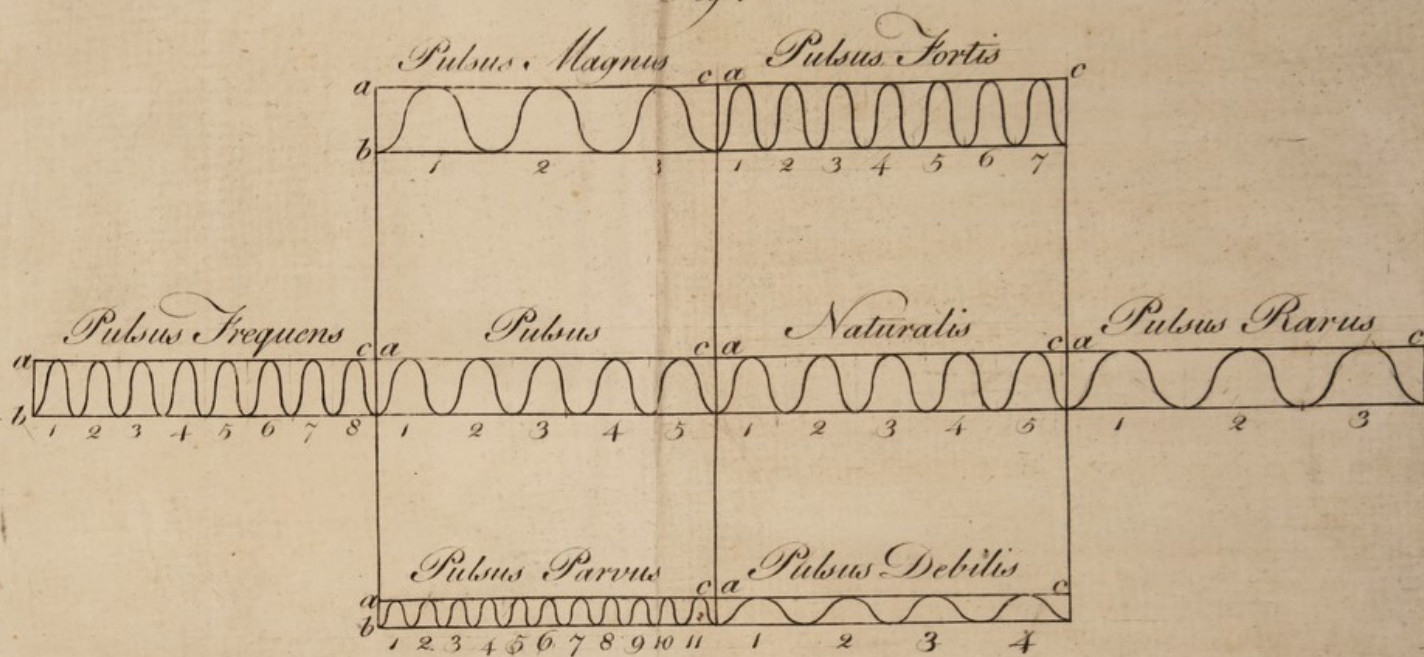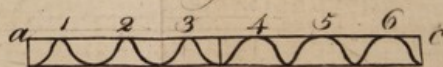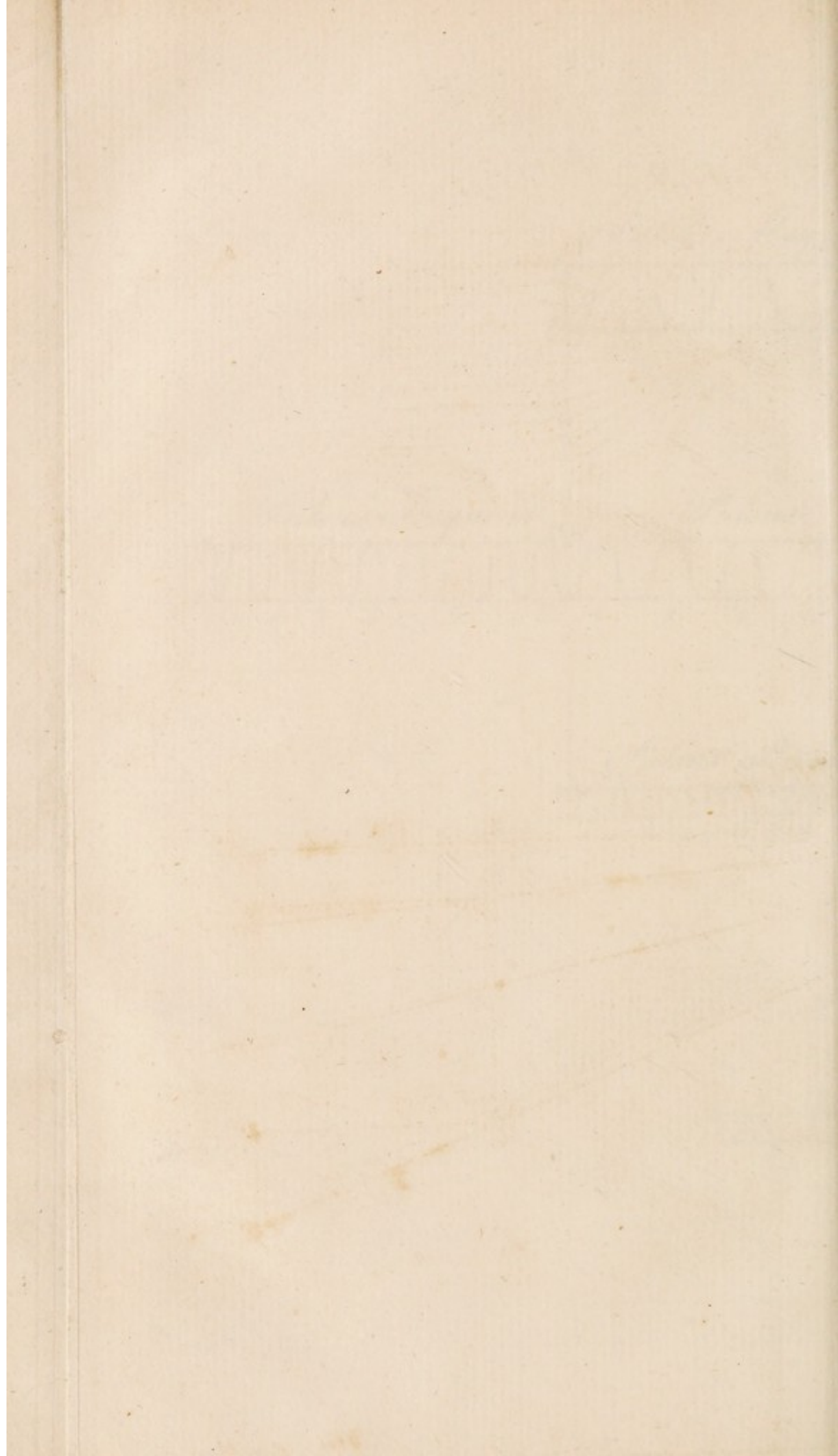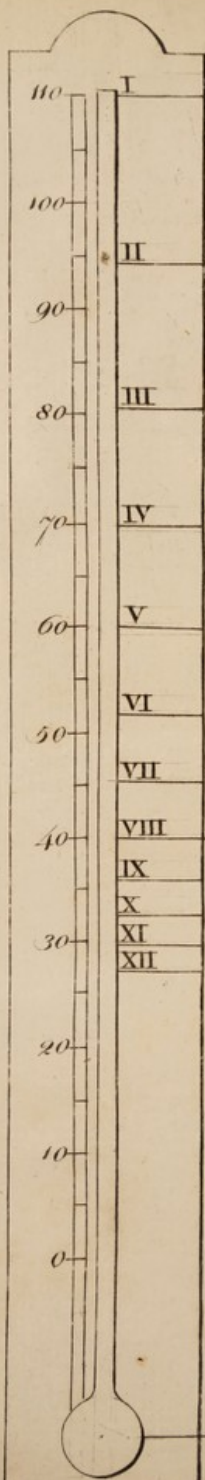
FINIS.

Plate I.

Fig. 1.

Pulsus Magnus — Pulsus Fortis

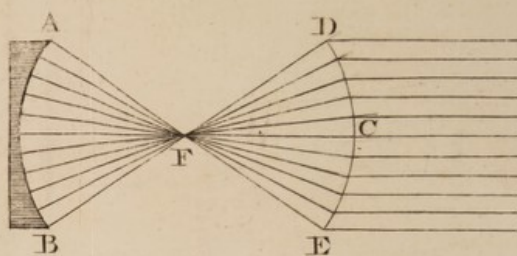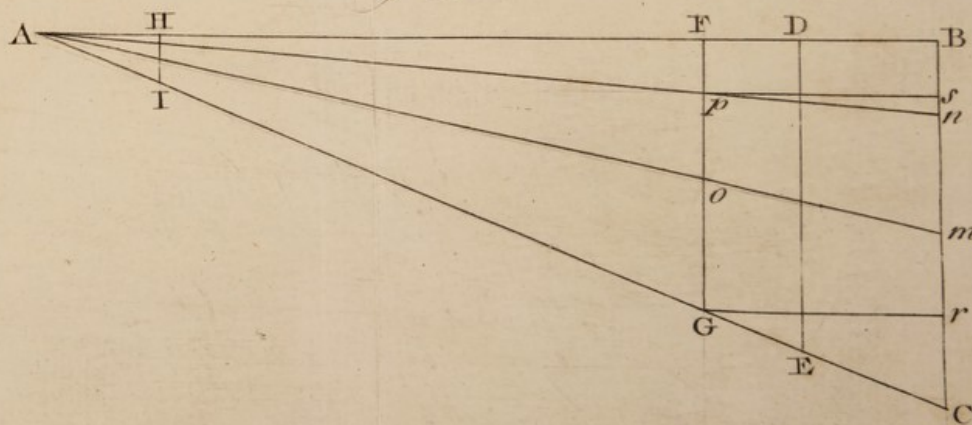Pulsus Frequens — Pulsus — Naturalis — Pulsus Rarus

Pulsus Parvus — Pulsus Debilis

Fig. 2.

Plate II.

Fig. 2.

Fig. 3.

Fig. 1.

Plate III.

Plate IV