

tree, &c. as far as they are not applied to an individual and determinate being. Again, it is the most certain principle of all our knowledge, that whatever can be truly affirmed of the genus, must be true of all the individuals comprehended under it. If therefore all bodies are extended, all the properties belonging to extension must belong to each body in particular. Now all bodies are extended, and extension is divisible to infinity; therefore every body must be so likewise. This is a syllogism of the best form; and as the first proposition is indubitable, all that remains, is to be assured that the second is true, that is, whether it be true or not that bodies are extended.

The partisans of monads, in maintaining their opinion, are obliged to affirm that bodies are not extended, but have only an appearance of extension. They imagine that by this they have subverted the argument adduced in support of the divisibility in infinitum. But if body is not extended, I should be glad to know from whence we derived the idea of extension; for if body is not extended, nothing in the world is, as spirits are still less so. Our idea of extension, therefore, would be altogether imaginary and chimerical.

Geometry would accordingly be a speculation entirely useless and illusory, and never could admit of any application to things really existing. In effect, if no one thing is extended, to what purpose investigate the properties of extension? But as geometry is beyond contradiction one of the most useful of the sciences, its object cannot possibly be a mere chimaera.

There is a necessity then of admitting, that the object of geometry is at least the same apparent extension which those philosophers allow to body; but

this very object is divisible to infinity: therefore existing beings, endowed with this apparent extension, must necessarily be extended.

Finally, let those philosophers turn themselves which way soever they will in support of their monads, or those ultimate and minute particles divested of all magnitude, of which, according to them, all bodies are composed, they still plunge into difficulties, out of which they cannot extricate themselves. They are right in saying, that it is a proof of dulness to be incapable of relishing their sublime doctrine; it may however be remarked, that here the greatest stupidity is the most successful.

5th May 1761.

LETTER XI.—REFLECTIONS ON DIVISIBILITY IN INFINITUM, AND ON MONADS.

In speaking of the divisibility of body, we must carefully distinguish what is in our power, from what is possible in itself. In the first sense, it cannot be denied, that such a division of body as we are capable of, must be very limited.

By pounding a stone we can easily reduce it to powder; and if it were possible to reckon all the little grains which form that powder, their number would undoubtedly be so great, that it would be matter of surprise to have divided the stone into so many parts. But these very grains will be almost indivisible with respect to us, as no instrument we could employ will be able to lay hold of them. But it cannot with truth be affirmed that they are indivisible in themselves. You have only to view them with a good microscope, and each will appear itself a considerable stone, on which are distinguishable a great many points and inequalities; which demon-

strates the possibility of a farther division, though we are not in a condition to execute it. For wherever we can distinguish several points in any object, it must be divisible into so many parts.

We speak not, therefore, of a division practicable by our strength and skill, but of that which is possible in itself, and which the Divine Omnipotence is able to accomplish.

It is in this sense, accordingly, that philosophers use the word 'divisibility;' so that if there were a stone so hard that no force could break it, it might be without hesitation affirmed that it is as divisible in its own nature as the most brittle of the same magnitude. And how many bodies are there on which we cannot lay any hold, and of whose divisibility we can entertain not the smallest doubt? No one doubts that the moon is a divisible body, though he is incapable of detaching the smallest particle from it: and the simple reason for its divisibility, is its being extended.

Wherever we remark extension, we are under the necessity of acknowledging divisibility, so that divisibility is an inseparable property of extension. But experience likewise demonstrates that the division of bodies extends very far. I shall not insist at great length on the instance usually produced of a ducat: the artisan can beat it out into a leaf so fine, as to cover a very large surface, and the ducat may be divided into as many parts as that surface is capable of being divided. Our own body furnishes an example much more surprising. Only consider the delicate veins and nerves with which it is filled, and the fluids which circulate through them. The subtilty there discoverable far surpasses imagination.

The smallest insects, such as are scarcely visible to the naked eye, have all their members, and legs on which they walk with amazing velocity. Hence

we see that each limb has its muscles composed of a great number of fibres; that they have veins and nerves, and a fluid still much more subtle which flows through their whole extent.

On viewing with a good microscope a single drop of water, it has the appearance of a sea; we see thousands of living creatures swimming in it, each of which is necessarily composed of an infinite number of muscular and nervous fibres, whose marvellous structure ought to excite our admiration.* And though these creatures may perhaps be the smallest which we are capable of discovering by the help of the microscope, undoubtedly they are not the smallest which the Creator has produced. Animals probably exist as small relatively to them, as they are relatively to us. And these after all are not yet the smallest, but may be followed by an infinity of new classes, each of which contains creatures incomparably smaller than those of the preceding class.

We ought in this to acknowledge the omnipotence and infinite wisdom of the Creator, as in objects of the greatest magnitude. It appears to me, that the consideration of these minute species, each of which is followed by another inconceivably more minute, ought to make the liveliest impression on our minds, and inspire us with the most sublime ideas of the works of the Almighty, whose power knows no bounds, whether as to great objects or small.

* A class of animals of superior magnitude, called Medusæ, has been found so numerous as to discolour the ocean itself. Captain Scoresby found the number in the Olive Green Sea to be immense. A cubic inch contained 64, and consequently a cubic mile would contain 23,868,000,000,000,000. The same eminent navigator remarks, that if one person could count a million in seven days, it would have required that 80,000 persons should have started at the creation of the world, to have completed the enumeration at the present time.—See Scoresby's *Account of the Arctic Regions*, vol. xvi. p. 461.—Ed.

To imagine, that after having divided a body into a great number of parts, we arrive at length at particles so small as to defy all farther division, is therefore the indication of a very contracted mind. But supposing it possible to descend to particles so minute as to be, in their own nature, no longer divisible, as in the case of the supposed monads; before coming to this point, we shall have a particle composed of only two monads, and this particle will be of a certain magnitude or extension, otherwise it could not have been divisible into these two monads. Let us farther suppose that this particle, as it has some extension, may be the thousandth part of an inch, or still smaller if you will—for it is of no importance; what I say of the thousandth part of an inch, may be said with equal truth of every smaller part. This thousandth part of an inch, then, is composed of two monads, and consequently two monads together would be the thousandth part of an inch, and two thousand times nothing a whole inch; the absurdity strikes at first sight.

The partisans of the system of monads accordingly shrink from the force of this argument, and are reduced to a terrible nonplus when asked how many monads are requisite to constitute an extension. Two, they apprehend, would appear insufficient, they therefore allow that more must be necessary. But, if two monads cannot constitute extension, as each of the two has none; neither three, nor four, nor any number whatever, will produce it; and this completely subverts the system of monads.

9th May 1761.

LETTER XII.—REPLY TO THE OBJECTIONS OF THE MONADISTS TO DIVISIBILITY IN INFINITUM.

THE partisans of monads are far from submitting to the arguments adduced to establish the divisibility of body to infinity. Without attacking them directly they allege that divisibility in infinitum is a chimera of geometers, and that it is involved in contradiction. For if each body is divisible to infinity, it would contain an infinite number of parts, the smallest bodies as well as the greatest; the number of these particles to which divisibility in infinitum would lead, that is to say, the most minute of which bodies are composed, will then be as great in the smallest body as in the largest, this number being *infinite* in both; and hence the partisans of monads triumph in their reasoning as invincible. For if the number of ultimate particles of which two bodies are composed is the same in both, it must follow, say they, that the bodies are perfectly equal to each other.

Now this goes on the supposition, that the ultimate particles are all perfectly equal to each other; for if some were greater than others, it would not be surprising that one of the two bodies should be much greater than the other. But it is absolutely necessary, say they, that the ultimate particles of all bodies should be equal to each other, as they no longer have any extension, and their magnitude absolutely vanishes, or becomes nothing. They even form a new objection, by alleging that all bodies would be composed of an infinite number of nothings, which is a still greater absurdity.

I readily admit this; but I remark at the same time, that it ill becomes them to raise such an objection, seeing they maintain, that all bodies are

composed of a certain number of monads, though, relatively to magnitude, they are absolutely nothings: so that by their own confession several nothings are capable of producing a body. They are right in saying their monads are not nothings, but beings endowed with an excellent quality, on which the nature of the bodies which they compose is founded. Now, the only question here is respecting extension; and as they are under the necessity of admitting that the monads have none, several nothings, according to them, would always be something.

But I shall push this argument against the system of monads no farther: my object being to make a direct reply to the objection founded on the ultimate particles of bodies, raised by the monadists in support of their system, by which they flatter themselves in the confidence of a complete victory over the partisans of divisibility in infinitum.

I should be glad to know, in the first place, what they mean by the *ultimate particles* of bodies. In their system, according to which every body is composed of a certain number of monads, I clearly comprehend that the ultimate particles of a body are the monads themselves which constitute it; but in the system of divisibility in infinitum, the term ultimate particle is absolutely unintelligible.

They are right in saying, that these are the particles at which we arrive from the division of bodies, after having continued it to infinity. But this is just the same thing with saying, after having finished a division which never comes to an end. For divisibility in infinitum means nothing else but the possibility of always carrying on the division, without ever arriving at the point where it would be necessary to stop. He who maintains divisibility in infinitum, boldly denies, therefore, the existence of the ultimate particles of body; and it is a manifest con-

tradiction to suppose at once ultimate particles and divisibility in infinitum.

I reply, then, to the partisans of the system of monads, that their objection to the divisibility of body to infinity would be a very solid one, did that system admit of ultimate particles; but being expressly excluded from it, all this reasoning, of course, falls to the ground.

It is false, therefore, that in the system of divisibility in infinitum, bodies are composed of an infinity of particles. However closely connected these two propositions may appear to the partisans of monads, they manifestly contradict each other; for whoever maintains that body is divisible in infinitum, or without end, absolutely denies the existence of ultimate particles, and consequently has no concern in the question. The term can only mean such particles as are no longer divisible—an idea totally inconsistent with the system of divisibility in infinitum. This formidable attack, then, is completely repelled.

12th May 1761.

LETTER XIII.—PRINCIPLE OF THE SUFFICIENT REASON, THE STRONGEST SUPPORT OF THE MONADISTS.

You must be perfectly sensible that one of the two systems, which have undergone such ample discussion, is necessarily true, and the other false, seeing they are contradictory.

It is admitted on both sides, that bodies are divisible; the only question is, Whether this divisibility is limited? or Whether it may always be carried farther, without the possibility of ever arriving at indivisible particles?

The system of monads is established in the former case, since after having divided a body into indivisible particles, these very particles are monads, and there would be reason for saying that all bodies are composed of them, and each of a certain determinate number. Whoever denies the system of monads, must likewise, then, deny that the divisibility of bodies is limited. He is under the necessity of maintaining, that it is always possible to carry this divisibility farther, without ever being obliged to stop; and this is the case of divisibility in infinitum, on which system we absolutely deny the existence of ultimate particles; consequently the difficulties resulting from their infinite number fall to the ground of themselves. In denying monads, it is impossible to talk any longer of ultimate particles, and still less of the number of them which enters into the composition of each body.

You must have remarked, that what I have hitherto produced in support of the system of monads is destitute of solidity. I now proceed to inform you, that its supporters rest their cause chiefly on the great principle of the *sufficient reason*, which they know how to employ so dexterously, that by means of it they are in a condition to demonstrate whatever suits their purpose, and to demolish whatever makes against them. The great discovery made, then, is this, *That nothing can be without a sufficient reason*: and to modern philosophers we stand indebted for it.

In order to give you an idea of this principle, you have only to consider, that in every thing presented to you, it may always be asked, Why it is such? And the answer is, what they call the *sufficient reason*, supposing it really to correspond with the question proposed. Whenever the *why* can take place, the possibility of a satisfactory answer is taken for

granted, which shall, of course, contain the sufficient reason of the thing.

This is very far, however, from being a mystery of modern discovery. Men in every age have asked *why*—an incontestable proof of their conviction that every thing must have a satisfying reason of its existence. This principle, that *nothing is without a cause*, was very well known to ancient philosophers; but unhappily this cause is for the most part concealed from us. To little purpose do we ask *why*; no one is qualified to assign the reason. It is not a matter of doubt, that every thing has its cause: but a progress thus far hardly deserves the name; and so long as it remains concealed, we have not advanced a single step in real knowledge.

You may perhaps imagine, that modern philosophers, who make such a boast of the principle of a sufficient reason, have actually discovered that of all things, and are in a condition to answer every *why* that can be proposed to them; which would undoubtedly be the very summit of human knowledge: but in this respect they are just as ignorant as their neighbours; their whole merit amounts to no more than a pretension to have demonstrated, that wherever it is possible to ask the question *why*, there must be a satisfactory answer to it, though concealed from us.

They readily admit, that the ancients had a knowledge of this principle, but a knowledge very obscure; whereas they pretend to have placed it in its clearest light, and to have demonstrated the truth of it; and therefore it is that they know how to turn it most to their account, and that this principle puts them in a condition to prove that bodies are composed of monads.

Bodies, say they, must have their sufficient reason somewhere; but if they were divisible to infinity,

such reason could not take place; and hence they conclude, with an air altogether philosophical, that *as every thing must have its sufficient reason, it is absolutely necessary that all bodies should be composed of monads*—which was to be demonstrated. This, I must admit, is a demonstration not to be resisted.

It were greatly to be wished that a reasoning so slight could elucidate to us questions of this importance; but I frankly confess, I comprehend nothing of the matter. They talk of the sufficient reason of bodies, by which they mean to reply to a certain *wherfore*, which remains unexplained. But it would be proper, undoubtedly, clearly to understand, and carefully to examine a question, before a reply is attempted; in the present case, the answer is given before the question is formed.

Is it asked, Why do bodies exist? It would be ridiculous, in my opinion, to reply, Because they are composed of monads; as if they contained the cause of that existence. Monads have not created bodies; and when I ask, Why such a being exists? I see no other reason that can be given but this, Because the Creator has given it existence; and as to the manner in which creation is performed, philosophers, I think, would do well honestly to acknowledge their ignorance.

But they maintain, that God could not have produced bodies, without having created monads, which were necessary to form the composition of them. This manifestly supposes, that bodies are composed of monads, the point which they meant to prove by this reasoning. And you are abundantly sensible, that it is not fair reasoning to take for granted the truth of a proposition which you are bound to prove by reasoning. It is a sophism known in logic by the name of a *petitio principii*, or begging the question.

16th May 1761.

LETTER XIV.—ANOTHER ARGUMENT OF THE MONADISTS, DERIVED FROM THE PRINCIPLE OF THE SUFFICIENT REASON. ABSURDITIES RESULTING FROM IT.

THE partisans of monads likewise derive their grand argument from the principle of the sufficient reason, by alleging that they could not even comprehend the possibility of bodies, if they were divisible to infinity, as there would be nothing in them capable of checking imagination; they must have ultimate particles or elements, the composition of which must serve to explain the composition of bodies.

But do they pretend to understand the possibility of all the things which exist? This would savour too much of pride; nothing is more common among philosophers than this kind of reasoning—I cannot comprehend the possibility of this, unless it is such as I imagine it to be: therefore it necessarily must be such.

You clearly comprehend the frivolousness of such reasoning; and that in order to arrive at truth, research much more profound must be employed. Ignorance can never become an argument to conduct us to the knowledge of truth, and the one in question is evidently founded on ignorance of the different manners which may render the thing possible.

But on the supposition, that nothing exists but that whose possibility they are able to comprehend, is it possible for them to explain how bodies would be composed of monads? Monads, having no extension, must be considered as points in geometry, or as we represent to ourselves spirits and souls. Now it is well known that many geometrical points, let the number be supposed ever so great, never can produce a line, and consequently still less a surface,

or a body. If a thousand points were sufficient to constitute the thousandth part of an inch, each of these must necessarily have an extension, which, taken a thousand times, would become equal to the thousandth part of an inch. Finally, it is an incontestable truth, that take any number of points you will, they can never produce extension. I speak here of points such as we conceive in geometry, without any length, breadth, or thickness, and which in that respect are absolutely nothing.

Our philosophers accordingly admit that no extension can be produced by geometrical points, and they solemnly protest that their monads ought not to be confounded with these points. They have no more extension than points, say they; but they are invested with admirable qualities, such as representing to them the whole universe by ideas, though extremely obscure; and these qualities render them proper to produce the phenomenon of extension, or rather that apparent extension which I formerly mentioned. The same idea, then, ought to be formed of monads as of spirits and souls, with this difference, that the faculties of monads are much more imperfect.

The difficulty appears to me by this greatly increased; and I flatter myself you will be of my opinion, that two or more spirits cannot possibly be joined so as to form extension. Several spirits may very well form an assembly or a council, but never an extension; abstraction made of the body of each counsellor, which contributes nothing to the delusion going forward, for this is the production of spirits only; a council is nothing else but an assembly of spirits or souls: but could such an assembly represent an extension? Hence it follows, that monads are still less proper to produce extension than geometrical points are.

The partisans of the system, accordingly, are not agreed as to this point. Some allege, that monads are actual parts of bodies; and that after having divided a body as far as possible, you then arrive at the monads which constitute it.

Others absolutely deny that monads can be considered as constituent parts of bodies; according to them, they contain only the sufficient reason: while the body is in motion, the monads do not stir, but they contain the sufficient reason of motion. Finally, they cannot touch each other; thus, when my hand touches a body, no one monad of my hand touches a monad of the body.

What is it then, you will ask, that touches in this case, if it is not the monads which compose the hand and the body? The answer must be, that two nothings touch each other, or rather it must be denied that there is a real contact. It is a mere illusion, destitute of all foundation. They are under the necessity of affirming the same thing of all bodies, which, according to these philosophers, are only phantoms formed by the imagination, representing to itself very confusedly the monads which contain the sufficient reason of all that we denominate body.

In this philosophy every thing is spirit, phantom, and illusion; and when we cannot comprehend these mysteries, it is our stupidity that keeps up an attachment to the gross notions of the vulgar.

The greatest singularity in the case is, that these philosophers, with a design to investigate and explain the nature of bodies and of extension, are at last reduced to deny their existence. This is undoubtedly the surest way to succeed in explaining the phenomena of nature; you have only to deny them, and to allege in proof the principle of the sufficient reason. Into such extravagancies will philosophers run rather than acknowledge their ignorance.

19th May 1761.

LETTER XV.—REFLECTIONS ON THE SYSTEM OF MONADS.

It would be a great pity, however, that this ingenious system of monads should crumble into ruins. It has made too much noise, it has cost its partisans too many sublime and profound speculations, to be permitted to sink into total oblivion. It will ever remain a striking monument of the extravagance into which the spirit of philosophizing may run. It is well worth while, then, to present you with a more particular account of it.

It's necessary, first of all, to banish from the mind every thing corporeal—all extension, all motion, all time and space—for all these are mere illusion. Nothing exists in the world but monads, the number of which undoubtedly is prodigious. No one monad is to be found in connexion with others; and it is demonstrated by the principle of the sufficient reason, that monads can in no manner whatever act upon each other. They are indeed invested with powers, but these are exerted only within themselves, without having the least influence externally.

These powers, with which each monad is endowed, have a tendency only to be continually changing their own state, and consist in the representation of all other monads. My soul, for example, is a monad, and contains in itself ideas of the state of all other monads. These ideas are for the most part very obscure; but the powers of my soul are continually employed in their farther elucidation, and in carrying them to a higher degree of clearness. Other monads have, in this respect, a sufficient resemblance to my soul; each is replete with a prodigious quantity of obscure ideas of all other monads, and of their state; and they are continually exerting

themselves with more or less success in unfolding these ideas, and in carrying them to a higher degree of clearness.

Such monads as have succeeded better than I have done are spirits more perfect; but the greater part still remain in a state of stagnation, in the greatest obscurity of their ideas; and when they are the object of the ideas of my soul, they produce in it the illusory and chimerical idea of extension and of body. As often as my soul thinks of bodies and of motion, this proves that a great quantity of other monads are still buried in their obscurity; it is likewise when I think of them, that my soul forms within itself the idea of some extension, which is consequently nothing but mere illusion.

The more monads there are plunged in the abyss of the obscurity of their ideas, the more is my soul dazzled with the idea of extension; but when they come to clear up their obscure ideas, extension seems to me to diminish, and this produces in my soul the illusory idea of motion.

You will ask, no doubt, how my soul perceives that other monads succeed in developing their obscure ideas, seeing there is no connexion between them and me? The partisans of the system of monads are ready with this reply, that it takes place conformably to the perfect harmony which the Creator (who is himself only a monad) has established between monads, by which each perceives in itself, as in a mirror, every development produced in others, without any manner of connexion between them.

It is to be hoped, then, that all monads may at length become so happy as to clear up their obscure ideas, and then we should lose all ideas of body and of motion; and the illusion, arising merely from the obscurity of ideas, would entirely cease.

But there is little appearance of the arrival of this blessed state; most monads, after having acquired the capacity of clearing up their obscure ideas, suddenly relapse. When shut up in my chamber, I perceive myself but of small extension, because several monads have then unfolded their ideas; but as soon as I walk abroad, and contemplate the vast expanse of heaven, they must all have relapsed into their state of dulness.

There is no change of place or of motion; all that is illusion merely: my soul remains almost always in the same place, just as all other monads. But when it begins to unfold some ideas, which before were but very obscure, it appears to me then that I am approaching the object which they represent to me, or rather that which the monads of such idea excite in me; and this is the real explanation of the phenomenon, when it appears to us that we are approaching to certain objects.

It happens but too frequently, that the elucidations we had acquired are again lost; then it appears to us that we are removing from the same object. And here we must look for the true solution of our journeyings. My idea, for example, of the city of Magdeburg is produced by certain monads, of which at present I have but very obscure ideas; and this is the reason why I consider myself as at a distance from Magdeburg. Last year these same ideas suddenly became clear, and then I imagined I was travelling to Magdeburg, and that I remained there several days. This journey, however, was an illusion merely, for my soul never stirs from its place. It is likewise an illusion when you imagine yourself absent from Berlin, because the confused representation of certain monads excites an obscure idea of Berlin, which you have only to clear up, and that instant you are at Berlin. Nothing more is neces-

sary. What we call journeyings, and on which we expend so much money, is mere illusion. Such is the real plan of the system of monads.

You will ask, is it possible there ever should have been persons of good sense who seriously maintained these extravagances? I reply, there have been but too many, that I know several of them, that there are some at Berlin, nay, perhaps at Magdeburg.

23d May 1761.

LETTER XVI.—CONTINUATION.

THE system of monads, such as I have been describing it, is a necessary consequence from the principle, that bodies are compounded of simple beings. The moment this principle is admitted, you are obliged to acknowledge the justness of all the other consequences, which result from it so naturally, that it is impossible to reject any one, however absurd and contradictory.

First, these simple beings, which must enter into the composition of bodies, being monads which have no extension, neither can their compounds, that is bodies, have any; and all these extensions become illusion and chimeras, it being certain that parts destitute of extension are incapable of producing a real extension; it can be at most an appearance or a phantom, which dazzles by a fallacious idea of extension. In a word, every thing becomes illusion; and upon this is founded the system of pre-established harmony, the difficulties of which I have already pointed out.

It is necessary then to take care that we be not entangled in this labyrinth of absurdities. If you make a single false step over the threshold, you are

involved beyond the power of escaping. Every thing depends on the first ideas formed of extension; and the manner in which the partisans of the system of monads endeavour to establish it, is extremely seductive.

These philosophers do not like to speak of the extension of bodies, because they clearly foresee that it must become fatal to them in the sequel; but instead of saying that bodies are extended, they denominate them compound beings, which no one can deny, as extension necessarily supposes divisibility, and consequently a combination of parts which constitute bodies. But they presently make a wrong use of this notion of a compound being. For, say they, a being can be compounded only so far as it is made up of simple beings; and hence they conclude that every body is compounded of simple beings. As soon as you grant them this conclusion, you are caught beyond the power of retreating; for you are under the necessity of admitting, that these simple beings, not being compounded, are not extended.

This captious argument is exceedingly seductive. If you permit yourself to be dazzled with it, they have gained their point. Only admit this proposition, bodies are compounded of simple beings, that is, of parts which have no extension, and you are entangled. With all your might, then, resist this assertion—*every compound being is made up of simple beings*; and though you may not be able directly to prove the fallacy, the absurd consequences which immediately result would be sufficient to overthrow it.

In effect, they admit that bodies are extended; from this point the partisans of the system of monads set out to establish the proposition, that they are compound beings; and having hence deduced that bodies are compounded of simple beings, they

are obliged to allow, that simple beings are incapable of producing real extension, and consequently, that the extension of bodies is mere illusion.

An argument, whose conclusion is a direct contradiction of the premises, is singularly strange: this reasoning sets out with advancing, that bodies are extended; for if they were not, how could it be known that they are compound beings—and then comes the conclusion, that they are not so. Never was a fallacious argument, in my opinion, more completely refuted than this has been. The question was, *Why are bodies extended?* And, after a little turning and winding, it is answered, *Because they are not so.* Were I to be asked, *Why has a triangle three sides?* and I should reply, that it is a mere illusion—would such a reply be deemed satisfactory?

It is therefore certain that this proposition, 'Every compound being is necessarily made up of simple beings,' leads to a false conclusion, however well-founded it may appear to the partisans of monads, who even pretend to rank it among the axioms, or first principles of human knowledge. The absurdity in which it immediately issues, is sufficient to overturn it, were there no other reasons for calling it in question.

But as a compound being here means the same thing as an extended being, it is just as if it were affirmed, 'Every extended being is compounded of beings which are not so.' And this is precisely the question. It is asked, Whether, on dividing a body, you arrive at length at parts unsusceptible of any farther division, for want of extension; or, Whether you never arrive at particles such as that the divisibility should be unbounded?

In order to determine this important question, for the sake of argument let it be supposed, that every body is compounded of parts without extension.

Certain specious reasonings may easily be employed, drawn from the noted principle of the sufficient reason; and it will be said, that a compound being can have its sufficient reason only in the simple beings which compose it; which might be true, if the compound being were in fact made up of simple beings, the very point in question; and whenever this composition is denied, the sufficient reason becomes totally inapplicable.

But it is dangerous to enter the lists with persons who believe in monads; for, besides that there is nothing to be gained, they loudly exclaim that you are attacking the principle of the sufficient reason, which is the basis of all certainty, even of the existence of God. According to them, whoever refuses to admit monads, and rejects the magnificent fabric, in which every thing is illusion, is an infidel and an atheist. Sure I am that such a frivolous imputation will not make the slightest impression on your mind, but that you will perceive the wild extravagances into which men are driven, when they embrace the system of monads—a system too absurd to need a refutation in detail; their foundation being absolutely reduced to a wretched abuse of the principle of the sufficient reason.

26th May 1761.

LETTER XVII.—CONCLUSION OF REFLECTIONS ON THIS SYSTEM.

WE are under the necessity of acknowledging the divisibility of bodies in infinitum, or of admitting the system of monads, with all the extravagances resulting from it; there is no other choice—an alternative which supplies the partisans of that system with another formidable argument in support of it.

They pretend that, by divisibility in infinitum, we are obliged to ascribe to bodies an infinite quality, whereas it is certain that God alone is infinite.

The partisans of the system of monads are very dangerous persons; they accused us of atheism, and now they charge us with polytheism, alleging that we ascribe to all bodies infinite perfections. Thus we should be much worse than pagans, who only worship certain idols, whereas we are accused of paying homage to all bodies, as so many divinities. A dreadful imputation, no doubt, were it well founded; and I should certainly prefer embracing the system of monads, with all the chimeras and illusions which flow from it, to a declaration in favour of divisibility in infinitum, if it involved a conclusion so impious.

You will allow, that to reproach one's adversaries with atheism or idolatry, is a very strange mode of arguing; but where do they find us ascribing to bodies this divine infinity? Are they infinitely powerful, wise, good, or happy? By no means: we only affirm, that on dividing bodies, though the division be carried on ever so far, it will always be possible to continue it farther, and that you never can arrive at indivisible particles. It may accordingly be affirmed, that the divisibility of bodies is without limits; and it is improper to use the term *infinity*, which is applicable to God alone.

I must remark, at the same time, that the word 'infinity' is not so dangerous as these philosophers insinuate. In saying, for example, infinitely wicked, nothing is more remote from the perfections of God. They admit that our souls will never have an end, and thus acknowledge an infinity in the duration of the soul, without marking the least disrespect to the infinite perfections of God. Again, when you ask them if the extent of the universe is bounded, are

they very indecisive in their answer? Some of them very frankly allow, that the extent of the universe may very probably be infinite, without our being able, however far our ideas are carried, to determine its limits. Here then is one infinity more, which they do not deem heretical.

For a still stronger reason, divisibility in infinitum ought not to give them the least offence. To be divisible to infinity is not surely an attribute which any one could ever think of ascribing to the Supreme Being, and does not confer on bodies a degree of perfection which would not be far from that which these philosophers allow them, in compounding them of monads, which, on their system, are beings endowed with qualities so eminent, that they do not hesitate to give to God himself the denomination of monad.

In truth, the idea of a division which may be continued without any bounds, contains so little of the character of the Deity, that it rather places bodies in a rank far inferior to that which spirits and our souls occupy; for it may well be affirmed that a soul, in its essence, is infinitely more valuable than all the bodies in the world. But, on the system of monads, every body, even the vilest, is compounded of a vast number of monads, whose nature has a great resemblance to that of our souls. Each monad represents to itself the whole world as easily as our souls; but, say they, their ideas of it are very obscure, though we have already clear, and sometimes also distinct ideas of it.

But what assurance have they of this difference? Is it not to be apprehended that the monads which compose the pen wherewith I am writing, may have ideas of the universe much clearer than those of my soul? How can I be assured of the contrary? I ought to be ashamed to employ a pen in conveying

my feeble conceptions, while the monads of which it consists possibly conceive much more sublimely; and you might have greater reason to be satisfied, should the pen commit its own thoughts to paper, instead of mine.

In the system of monads, that is not necessary; the soul represents to itself beforehand, by its inherent powers, all the ideas of my pen, but in a very obscure manner. What I am now taking the liberty to suggest, contributes absolutely nothing to your information. The partisans of this system have demonstrated that simple beings cannot exercise the slightest influence on each other; and your own soul derives from itself what I have been endeavouring to convey, without my having any concern in the matter.

Conversation, reading and writing, therefore, are merely chimerical and deceptive formalities, which illusion would impose upon us as the means of acquiring and extending knowledge. But I have already had the honour of pointing out to you the wonderful consequences resulting from the system of the pre-established harmony; and I am apprehensive that these reveries may have become too severe a trial of your patience, though many persons of superior illumination consider this system as the most sublime production of human understanding, and are incapable of mentioning it but with the most profound respect.

30th May 1761.

LETTER XVIII.—ELUCIDATION RESPECTING THE
NATURE OF COLOURS.

I AM under the necessity of acknowledging, that the ideas respecting colour, which I have already

taken the liberty to suggest,* come far short of that degree of evidence to which I could have wished to carry them. This subject has hitherto proved a stumbling-block to philosophers, and I must not flatter myself with the belief that I am able to clear it of every difficulty. I hope, at the same time, that the elucidations which I am going to submit to your examination, may go far toward removing a considerable part of them.

The ancient philosophers ranked colours among the bodies of which we know only the names. When they were asked, for example, why such a body was red, they answered, it was in virtue of a quality which made it appear red. You must be sensible that such an answer conveys no information, and that it would have been quite as much to the purpose to confess ignorance.

Descartes, who first had the courage to plunge into the mysteries of nature, ascribes colours to a certain mixture of light and shade, which last being nothing else but a want of light, as it is always found where the light does not penetrate, must be incapable of producing the different colours we observe.

Having remarked that the sensations of the organ of sight are produced by the rays which strike that organ, it necessarily follows, that those which excite in it the sensation of red, must be of quite a different nature from those which produce the sensation of the other colours; hence it is easily comprehended that each colour is attached to a certain quality of the rays which strike the organ of vision. A body appears to us red, when the rays which it emits are of a nature to excite in our eyes the sensation of that colour.

* See Letters XXVII. XXVIII. and XXXI. in Volume I.

The whole, then, results in an inquiry into the difference of the rays which variety of colours produces. This difference must be great, to produce so many particular sensations in our eyes. But wherein can it consist? This is the great question, toward the solution of which our present-research is directed.

The first difference between rays which presents itself is, that some are stronger than others. It cannot be doubted that those of the sun, or of any other body very brilliant, or very powerfully illuminated, must be much stronger than those of a body feebly illuminated, or endowed with a slender degree of light; our eyes are assuredly struck in a very different manner by the one and by the other.

Hence it might be inferred, that different colours result from the force of the rays of light; so that the most powerful rays should produce, for example, red; those which are less so, yellow; and in progression, green, and blue.

But there is nothing more easy than to overturn this system, as we know from experience that the same body always appears to be of the same colour, be it less or more illuminated, or whether its rays be strong or feeble. A red body, for example, appears equally red, exposed to the brightest lustre of the sun, and in the shade, where the rays are extremely faint. We must not, then, look for the cause of the difference of colour in the different degrees of the force of rays of light, it being possible to represent the same colour as well by very forcible as by very faint rays. The feeblest glimmering serves equally well to discover to us difference of colours, as the brightest effluence.

It is absolutely necessary, therefore, that there should be another difference of rays discovered, which may characterise their nature relatively to the

different colours. You will undoubtedly conclude, that in order to discover this difference, we must be better acquainted with the nature of luminous rays; in other words, we must know what it is that, reaching our eyes, renders bodies visible; this definition of a ray must be the justest, as in effect it is nothing else but that which enters into the eye by the pupil, and excites the sensation in it.

I have already informed you, that there are only two systems or theories which pretend to explain the origin and nature of rays of light. The one is that of *Newton*, who considers them as emanations proceeding from the sun and other luminous bodies; and the other, that which I have endeavoured to demonstrate, and of which I have the reputation of being the author, though others have had nearly the same ideas of it. Perhaps I may have succeeded better than they, in carrying it to a higher degree of evidence. It will be of importance, then, to show, in both systems, on what principle the difference of colours may be established.

In that of emanation, which supposes the rays to issue from luminous bodies, in the form of rivers, or rather of fountains, spouting out a fluid in all directions, it is alleged that the particles of light differ in size or in substance, as a fountain might emit wine, oil, and other liquids; so that the different colours are occasioned by the diversity of the subtle matter which emanates from luminous bodies. Red would be, accordingly, a subtle matter issuing from the luminous body, and so of yellow and the other colours. This explanation would exhibit clearly enough the origin of the different colours, if the system itself had a solid foundation. I shall enter into the subject more at large in my next letter.

2d June 1761.

LETTER XIX.—REFLECTIONS ON THE ANALOGY
BETWEEN COLOURS AND SOUNDS.

You will be pleased to recollect the objections I offered to the system of the emanation of light.* They appear to me so powerful, as completely to overturn that system. I have accordingly succeeded in my endeavours to convince certain natural philosophers of distinction, and they have embraced my sentiments of the subject with expressions of singular satisfaction.

Rays of light, then, are not an emanation from the sun and other luminous bodies, and do not consist of a subtle matter emitted forcibly by the sun, and transmitted to us with a rapidity which may well fill you with astonishment. If the rays employed only eight minutes in their course from the sun to us, the torrent would be terrible, and the mass of that luminary, however vast, must speedily be exhausted.

According to my system, the rays of the sun, of which we have a sensible perception, do not proceed immediately from that luminary; they are only particles of ether floating around us, to which the sun communicates nearer and nearer a motion of vibration, and consequently they do not greatly change their place in this motion.

This propagation of light is performed in a manner similar to that of sound. A bell, whose sound you hear, by no means emits the particles which enter your ears. You have only to touch it when struck, to be assured that all its parts are in a very sensible agitation. This agitation immediately communicates itself to the more remote particles of air;

* See Letters XVII. and XVIII. in Volume I.

so that all receive from it successively a similar motion of vibration, which, reaching the ear, excite in it the sensation of sound. The strings of a musical instrument put the matter beyond all doubt; you see them tremble, go and come. It is even possible to determine by calculation how often in a second each string vibrates; and this agitation, being communicated to the particles of air adjacent to the organ of hearing, the ear is struck by it precisely as often in a second. It is the perception of this tremulous agitation which constitutes the nature of sound. The greater the number of vibrations produced by the string in a second, the higher or sharper is the sound. Vibrations less frequent produce lower notes.

We find the circumstances which accompany the sensation of hearing, in a manner perfectly analogous, in that of sight.

The medium only, and the rapidity of the vibrations differ. In sound, it is the air through which the vibrations of sonorous bodies are transmitted. But with respect to light, it is the ether, or that medium incomparably more subtle and more elastic than air, which is universally diffused wherever the air and grosser bodies leave interstices.

As often, then, as this ether is put into a state of vibration, and is transmitted to the eye, it excites in it the sentiment of vision, which is, in that case, nothing but a similar tremulous motion, whereby the small nervous fibres at the bottom of the eye are agitated.

You easily comprehend, that the sensation must be different, according as this tremulous agitation is more or less frequent; or according as the number of vibrations performed in a second is greater or less. Hence there must result a difference similar to that which takes place in sounds, when the vibrations are more or less frequent. This difference is clearly

perceptible by the ear, as the character of sounds in respect of flat and sharp depends on it. You will recollect that the note marked C in the harpsichord performs about 100 vibrations in a second; note D 112; note E 125; note F 133; note G 150; note A 166; note B 187; and C 200. Thus the nature of sounds depends on the number of vibrations performed in a second.

It cannot be doubted that the sense of seeing may be likewise differently affected, according as the number of vibrations of the nervous fibres of the bottom of the eye is greater or less. When these fibres vibrate 1000 times in a second, the sensation must be quite different from what it would be did they vibrate 1200 or 1500 times in the same space.

True it is, that the organ of vision is not in a condition to reckon numbers so great, still less than the ear is to reckon the vibrations which constitute sound; but it is always in our power to distinguish between the greater and the less.

In this difference, therefore, we must look for the cause of difference of colour; and it is certain that each of them corresponds to a certain number of vibrations, by which the fibres of our eyes are struck in a second, though we are not as yet in a condition to determine the number corresponding to each particular colour, as we can do with respect to sounds.

Much research must have been employed before it was possible to ascertain the numbers corresponding to all the notes of the harpsichord, though there was an antecedent conviction that their difference was founded on the diversity of those numbers. Our knowledge respecting these objects is nevertheless considerably advanced, from our being assured that there prevails a harmony so delightful between the different notes of the harpsichord and the different

colours; and that the circumstances of the one serve to elucidate those of the other. This analogy accordingly furnishes the most convincing proofs in support of my system. But I have reasons still more solid to adduce, which will secure it from every attack.

6th June 1761.

LETTER XX.—CONTINUATION.

NOTHING is more adapted to the communication of knowledge respecting the nature of vision, than the analogy discoverable, almost in every particular, between it and the hearing. Colours are to the eye what sounds are to the ear. They differ from each other as flat and sharp notes differ. Now we know that flat and sharp in sounds depends on the number of vibrations whereby the organ of hearing is struck in a given time, and that the nature of each is determined by a certain number, which marks the vibrations performed in a second. From this I conclude, that each colour is likewise restricted to a number of vibrations which act on vision; with this difference, that the vibrations which produce sound reside in gross air, whereas those of light and colours are transmitted through a medium incomparably more subtle and elastic. The same thing holds as to the objects of both senses. Those of hearing are all of them bodies adapted to the transmission of sound, that is, susceptible of a motion of vibration, or of a tremulous agitation, which, communicating itself to the air, excites in the organ the sensation of a sound corresponding to the rapidity of the vibrations.

Such are all musical instruments; and, to confine myself principally to the harpsichord, we ascribe to

each string a certain sound which it produces when struck. Thus, one string is named C, another D, and so on. A string is named C, when its structure and tension are such, that being struck, it produces about 100 vibrations in a second; and if it produced less or more in the same time, it would have the name of a different note, higher or lower.

You will please to recollect, that the sound of a string depends on three things—its length, its thickness, and the degree of tension; the more it is stretched, the sharper its sound becomes; and as long as it preserves the same disposition, it emits the same sound; but that changes as soon as the other undergoes any variation.

Let us apply this to bodies which are the objects of vision. The minute particles which compose the tissue of their surface, may be considered as strings distended, in as much as they are endowed with a certain degree of elasticity and bulk, so that being struck they acquire a motion of vibration, of which they will finish a certain number in a second; and on this number depends the colour which we ascribe to such body. It is red, when the particles of its surface have such a degree of tension, that being agitated, they perform precisely so many vibrations in a second as are necessary to excite in us the sensation of that colour. A degree of tension which would produce vibrations more or less rapid, would excite that of a different colour, and then the body would be yellow, green, or blue, &c.

We have not as yet acquired the ability of assigning to each colour the number of vibrations which constitute its essence; we do not so much as know which are the colours that require a greater or less rapidity of vibration, or rather, it is not yet determined what colours correspond with high or low notes. It is sufficient to know, that each colour is