CHAPTER IX.

RECENT POPULAR SCIENTIFIC AND OTHER JOURNALS.

The "Mechanics' Magazine," which commenced in 1823, gave great facilities to artizans and others to communicate their views; and the following abstracts of lectures, papers, letters, and editorial notices, evidence how much this subject has been discussed in the pages of that journal. For convenience, in perusing them, they are given both in the order of their dates and arranged under the following heads:—First, all relating to the Possibility, and, secondly, those asserting the Impossibility, of Perpetual Motion; then, thirdly, Plans; fourthly, Alleged Discoveries; and, fifthly, Impostures. Two papers from American journals are appended to these in their proper places, a review of Sir William Congreve's pamphlet, and a notice relating to Hendrickson.

SECTION I.—*Its Possibility Asserted.*

T. H. Pasley (vol. 2) writes, June, 1824:—

I feel no hesitation in standing up in support of this grand desideratum—this almost forsaken friend of science,—whether the thing be practicable or not.

[Under the impression that this problem is of great value to science in general, and that there is no occasion to dishearten those who try to find it out, he says:—]

On the contrary, "Persevere" should be every one's advice; to do so, or discontinue, every one's own pleasure. And why should the impossibility of anything be pronounced unless it be established wherein the limits of possibility consist?

[He has much original reasoning, and not very *apropos*, such as—]

It is puerile in the extreme to be foretelling defeat when so many other objects may be gained by the highly laudable pursuit, perhaps of greater advantage to society at large than the discovery in question. * * * * * In a word, were the perpetual motion discovered to-morrow, it would be wise of all the governments of the world to offer a very high reward for some species of discovery that would be universally sought after, although it might never be found out. * * * * [Adding:—] The effects of industry are—enlargement of the mind, accumulation of knowledge, and rendering ourselves ignorant of the torments which idleness and dulness always engender. * * In the next place, there are no solid grounds for the assertion that the discovery of a perpetual motion is an impossibility. In the present state of human knowledge respecting the powers of nature, it is not demonstrable one way or another. * * * [And again:—] The study of what relates to the perpetual motion has this great advantage, that it directs to the discovery of error as well as of truth; whereas, what are they which are called truths of science at present but vacillating human opinions, or erroneous assumptions of what we call natural causes? What are they but such as consist in mere assumption, sanctioned by time, and admitted by existing authorities in science, and of course generally acquiesced in, without previous investigation?

[Speaking of the "stern conditions on which alone the student in science can have his opinion listened to," he says:—]

So far, then, from being guided in our decision respecting what is possible by the "unerring laws of nature," by "mathematical demonstration," and by "experimental proofs," we are continually misled by an erroneous faith in the nonentity, attraction.

[He attempts to show our acquaintance with "motion," and the "cause" wherein "continued motion consists;" then says:—]

On such an imperfect knowledge of the causes of phenomena,

who should say he knows what can or what cannot be discovered?

[He seems to think there is some "true motion-making cause" which may be employed to produce perpetual motion on some species or other of mechanism.]

A plan designed to accelerate the discovery of Perpetual Motion (vol. 4, 1825):—

[The writer remarks—"All that has or can be said will not amount to a proof of its impossibility." He then examines how, what were once thought impossibilities have of late been accomplished, as:—]

We can now, however, soar above the clouds, explore the depths of the ocean, and skim over its surface. * * And be it remembered that we owe these and many other advantages to a few persevering individuals who were, in all probability, stigmatised as chimerical visionaries by those who seem to have an unconquerable propensity to condemn everything above the level of their own understanding.

If by perpetual motion nothing more is meant than the putting in motion some of the most durable substances with which we are acquainted, in such a manner as to ensure a continuance of motion as long as those substances will resist the effects of time and friction, I do not despair of seeing it accomplished. * * [He thinks there is] reasonable ground to hope that the time is not far distant when even this impossibility must yield to persevering ingenuity. In the present state of public opinion with regard to its practicability, it would be looked upon as an empty boast, were I to assert that the discovery is already made.*

J. Welch (vol. 5, 1825) confesses himself a believer in the existence, or rather possibility of discovering, perpetual motion:—

Those who condemn the notion altogether seem to have

* The person who can raise a weight of 6 oz. to the height of 13½ inches, merely by the descent of 4 oz. only 12 inches, ought to be allowed to assert that the discovery is made.

taken but a very confined view of the subject. What they say about mere matter is right enough; but they seem to forget that there are other active agents in nature which possess wonderful powers, that have nothing to do with either bulk, weight, or form. Such are electricity, magnetic attraction, capillary attraction, and the irregular pressure of the atmosphere. The powers of electricity are great, and, indeed, it seems to be the *primum mobile* that gives life and motion to the animated part of the creation. Dr. Franklin shows us how to give a circular coated plate, revolving on an axle, sufficient power to roast a chicken, merely by once changing (charging?) it. Could not a plate of this kind be made to turn a small electrical apparatus, so situated as to keep the charge in the plate always at its maximum? The whole might be kept dry by having it enclosed in a glass case.

It has often been attempted to give motion to a wheel by the power of a loadstone, but hitherto without effect; no substance in nature being found to have the power, by interposition, of cutting off its attractive property. Still I think it should be further investigated. Is a small piece of steel in the form of a wedge as strongly attracted at the smaller end as at the thicker? And would not twenty or thirty pieces of steel, of that form, placed round the circumference of a circle, the point of one towards the head of the other, cause a magnet placed in the centre, to revolve in the direction in which their points lie? I think, perhaps not; but still such experiments should be tried.

In capillary attraction we have a power that at once raises fluids above their level. It is this which carries the oil up the wick of a lamp as fast as the flame consumes it. Water and other fluids rise through cotton even quicker than oil; and he who can contrive to collect them as they arrive at the top will discover perpetual motion. Would not water run constantly through a syphon, one leg of which was made of a collection of capillary tubes, and the other in the usual way? or would the water above and below the tubes neutralise and destroy their power?

I now come to the pressure of the atmosphere, a thing easily understood. * * * * Make a cast-iron barometrical tube, with a top sufficiently large to contain 2 cwt. of mercury; invert it in a basin large enough to contain 2 or 3 cwt. more, and let a piece of iron of 10 or 12

stones weight float on the mercury in this basin, so as to rise and fall along with it at every change of the weather. We have here both motion and power. The motion, indeed, will sometimes stand still, but then it can easily be regulated, and made a constant quantity in the machine to be attached. I have no doubt but clocks, &c., may be made to derive their chiming principle from a contrivance of this nature.

H. Todd (vol. 8, 1827) says :—

* * * Many of your readers seem to have imbibed very erroneous opinions on this grand desideratum, both as regards its utility and its practicability.

First, It is supposed by many that, when it can be found, very many useful and entirely new effects will be produced. This is an error; for, if it should be discovered, no advantage of this kind would follow, as it is the regularity of motion, not the perpetuity of it, that would be advantageous or useful. Mere motion in perpetuity would be of no avail, or, at least, not worth the expense of erecting any machine to continue it in another form. The determination of the longitude, which many so fully anticipate, would be as far distant as ever. Perpetual motion can, in fact, be obtained by a common watch, by winding it regularly up (for it is perpetual if it never stops till the works are worn out); but the chronometer is no nearer perfection on that account. Some also seem to entertain an idea that a reward from the English Government awaits the discoverer of the perpetual motion. This is only imaginary, as no such reward ever was or could be offered for what would benefit no one. True it is, that the person who discovers a certain way of finding the longitude, in any or every place (chiefly on the sea), will be entitled to a reward from the Commissioners of Longitude, let that method be what it may; and as perfect regularity of motion would make a perfect chronometer in itself, such perfect regularity, if found, would be the means of obtaining the longitude, setting aside perpetuity, as of little or no consequence in the affair. Hence, the makers of chronometers turn their attention always to the perfection of the regulation part of the machine; for if a common watch, to be wound up daily, could be made to show mean time truly, it would be infinitely superior to any chronometer, or

timepiece wanting regulation, though it required to be wound up once in seven years, or in one hundred years, or went perpetually without being wound up at all.

Next, as to the practicability of perpetual motion, though so many doubt it, I, with several others, not only assert that it is practicable, but that it has already been found out, or discovered, and, as appears to me, in the most satisfactory manner possible: I do not mean by mechanical powers alone, but with their assistance, conjoined with the powers of nature. We need not examine into the pretended inventions, whether patent or otherwise, of those authors who assert the discovery by mechanism alone.

[He then copies, as "the complete reason" of this, from "the celebrated B. Martin, in his 'Philosophical Grammar,' p. 125."]

The incredulous on this head, though zealous in the cause, have nevertheless pursued their desires this way; and the Patent Office at Washington, in the United States of America, is adorned with models patented as perpetual motions, but standing there *motionless* as the models of all the other patents about them.

[After describing the wheel by Dr. Shiviers,* he says:—]

Of this, nothing more was heard of (as I can find) from the time of its discovery or publication; but this does by no means forbid the employment of mechanics united with other means. There are several parts of nature which of themselves are perpetual motion, and require only mechanics to regulate them. First, there is the rise and fall of the tides; second, the waves of the sea; third, the wind; fourth, the variation of weight of the atmosphere; fifth, electricity; sixth, expansion and contraction, by heat and cold, &c., &c.; nor does the art appear so much in applying them to machines, as the regulating the motions when so applied. Of the practicability, however, there can be no doubt. By perpetual motion, as it is generally understood, I mean a machine once set in motion, that will go without any further human assistance till the works are worn out by time or its materials

* Read—Schwiers.

decay. Now, this, I again repeat, has already been accomplished, and that by a Mr. Coxe, a celebrated mechanist, and, I believe, maker of various other automata, as to have a museum formed of them. As this was exhibited to the public, about the middle of the last century, for several years, it must have been generally known at that time. (I think this was the most celebrated of his works.) The only account I can at this time give of it is this:—it was a watch, capped, jewelled, and protected from friction in every part as much as possible; without any main-spring, the inventor so applied it to the mercury in a barometer attached to it, that the rise and fall of the mercury gave motion to the timepiece or watch; and the best part of the invention was, that if the barometer were taken away, the timepiece would go a year without it,—if applied, the power would continue it; and it had a contained self-regulator, to let off or adjust all excess of power caused by the rise and fall of the barometer.

[He begs some reader to forward an account of it, and adds:—]

I do not know whether Coxe's Museum was exhibited before or after Martin's Museum, which I believe also consisted of automata.

Thus was perpetual motion discovered,—for such it was in every sense of the word; and that it is feasible in other ways, I think no one can doubt. The chief ingenuity in Mr. Coxe was in applying the perpendicular difference of height in the column, caused by the variations of the atmosphere's weight, with a self-regulator. I do not recollect whether it was regulated to that perfection as to keep to mean time: its being perpetual motion did not of necessity imply this, though, perhaps, it came as near it as any other chronometer on the steel-spring construction.

[He says:—"The engraving showed, chiefly, the front view."]

The waves of the sea could certainly be applied to produce a regulated perpetual motion; and I have read somewhere, though my memory at this instant does not assist me in particulars, that a Frenchman had made a mill or some machine to be wrought by the waves only. I think it is related

in some of their Society Transactions. The rise and fall of the tides would also make a constancy or perpetuity of motion, wanting a self-regulator. There are tide-mills on the Thames and other places. And I now hear that a Frenchman has invented a timepiece set in motion by the wind, which, on the principle of Coxe's barometer-watch above-mentioned, probably has sufficient wind in any one week, or month, to supply it for a year, and a kind of self-adjusting escape to let off the surplus power; and which is to all intents and purposes actual perpetual motion. I might refer to many other things, more curious than useful, causing differences by themselves; as of contraction and expansion by cold and heat—accumulation and exhaustion, as by rain and evaporation, as to a variety of natural causes; any of which, if the necessary self-regulating mechanism were applied, would perform a similar continuity of action, and which would as certainly be perpetual motion, though of no use. For the winding up of a clock, as a prime mover, can be regulated much easier than any other machine yet known. Metals are found to expand every way, but wood only in the width of the fibre; hence, a wooden pendulum has not yet been found, I believe, to expand only across the grain (which is of no consequence), and not in length.

[He concludes with advising "not to attempt perpetual motion *alone;* next, that perpetual motion, of itself, is of little or no use unless it can be duly or properly regulated; and that a regulation of any of the present known powers will be of more service than perpetual motion itself, when alone found."]

* * * * * *

I remain, your constant reader,

H. TODD.

REVIEW OF PAPERS ON PERPETUAL MOTION (vol. 11, 1829). By an anonymous correspondent:—

[His review is necessarily abridged, and is only given in consequence of its author professing to be a practical mechanic of some experience.]

To begin, then, I boldly affirm that to be possible which is

now universally denied to be so—namely, perpetual motion by mechanism. * * * Having made this bold assertion, I shall proceed to make some remarks on what has been said to the contrary.

[He commences with vol. 4, and notices the several schemes therein. Also Emerson's Proposition 118, Corollary.]

I believe it was Emerson's idea, and I conceive it to be a general one, that if a body, or a system of bodies, could be made to revolve on an infinitely small axis, or a point of suspension placed in its centre of gravity, without any friction whatever, and that the body or system were put in motion in an unresisting medium, that motion would be continued by its *vis inertia*, even when that motion proceeded from a momentary impulse; but as the effect of friction and the resisting medium is, in practical mechanism, an insurmountable obstacle, his corollary holds good thus far, and no farther.

[After noticing the Finch Lane imposition, Philo-Montis, and T. Bell, he states:—]

I have looked into Dr. Hutton's "Mathematical Recreations," referred to by T. B. Dr. Hutton generally observes:—"The perpetual motion has been the quicksands of mechanicians, as the quadrature of a circle, the trisection of an angle, &c., has been that of the geometricians; and as those who pretend to have discovered the solution of the latter problem are persons scarcely acquainted with geometry, those who search for the perpetual motion are always men to whom the most certain and invariable truths in mechanics are unknown."

[He does not like the style here adopted, saying:—"It falls heavy on smatterers—a character I never professed to exceed."]

Dr. H. goes on to observe (and it will be necessary to dissect his arguments, to get at his meaning):—"It may be demonstrated to all capable of reasoning in a sound manner on those sciences, that a perpetual motion is impossible." How? Why, "it is necessary the effect should become the cause, and the cause the effect." Assertion to prove assertion. Perhaps it is necessary—perhaps not; but then we

have an example:—"A weight raised to a certain height by another weight, should, in its turn, raise the second weight to the height from which it descended." Be it so; still, it does not follow that this is necessary to perpetual motion. "According to the laws of motion, all that a descending weight can do, in the most perfect machine the mind of man can conceive, is to raise another weight in the same time to a height proportioned to its mass"—that is, by the most perfect machine the mind of man can conceive; so that the argument comes to this:—human ingenuity has not hitherto been able to go beyond this point, which is necessary to produce perpetual motion. But, whether it is necessary or no, the Doctor extends it to this:—it is impossible to produce perpetual motion by any means the mind of man can conceive; so that the Doctor, it seems, has made a discovery equal, perhaps, to the one in question—namely, a knowledge of the utmost extent of the energies of the mind of man! But he has not yet drawn his conclusion, as he goes on to explain why a machine cannot continue its motion when acted on by equal weights on each side the centre of motion (as I assume his arguments are confined to that view of the question); and he evidently falls into the common error before noticed, of applying his maxima beyond their sphere of applicability, building his argument on the corollary of Emerson's, already alluded to.

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[After alluding to the schemes of "T. B.," "P.," and "H. Todd," he goes on to say:—]

I have mentioned these three schemes together, introductory to an inquiry I wish to make respecting a principle which I conceive they embrace. Their projectors seem to have assumed that if two equal weights be placed at the end of a lever or balance of unequal arms, and be made to move on a centre or axis, the descending weight always moving in the circumference of a circle whose radius is equal to the longest arm, then, if by any means the ascending weight could be carried up through the perpendicular diameter, or near to it, by the action of the lever, the descending weight would always preponderate after it had once left its perpendicular direction, and the equilibrium which would take

place at the perpendicular be destroyed by a succession of similar levers and weights. I ask, would this be the case? I am aware of arguments that may be used to show that there would be no more than an equilibrium when the actions of the different levers are combined at equal distances from one another, and the weights made to preserve an uniformity in their angular velocity; but if those arguments are no other than what I can anticipate, I have doubts of their applicability. I will venture to ask two questions:—The first is: What is the difference, or is there any, in the effective force or the momentum of a weight falling through the perpendicular diameter of a circle, and of the same or an equal weight falling through the semi-circumference of the same circle, at the end of a lever moving freely on the centre, without any counterpoise? The second is: What am I to understand by the expression, "The cycloid is the curve of swiftest descent; or a heavy weight will fall from one given point to another, by the way of the arc of a cycloid, in a less time than by any other route?" and does it admit that these points may be perpendicular to a horizontal line?

* * * * * *

Now comes our champion, Sir Wm. Congreve, of whose plan I shall say but little; it meets my ideas in almost every point.

[After commenting on the Baronet's plan, he adds:—]

As to the words that, in mechanical operations, "no duty can be performed without a correspondent loss of efficiency," though they may be the words of one of our most celebrated mathematicians, I cannot help being so uncourteous as to say * * * they "are not worth a rush." No one can have more respect for men who excel in scientific pursuits than myself—they are to me as demigods; but when I look up to them for instruction, and receive it in unintelligible language, I cannot help lamenting the infatuation that should induce them to throw a veil over scientific subjects, as though they were (like some others) thoughts too sacred for the eye or the ear of the multitude; and, by this means, when they would wish to convey information, run the risk of proving the maxim in a literal sense—perform a duty with a corresponding loss of efficiency.

[He proceeds to notice other schemes, and then gives the following :—]

PROPOSITION.—In what way may a body, or rather a system of bodies, be impelled or made to move on an horizontal plane by the force of pressure alone, the source of pressure being within the system, or the first mover being a weight, or weights, forming a part thereof?

I do not presume to say that such a thing is possible, though I have dreamt such a conclusion may be drawn from the composition and resolution of forces. I should like to see a demonstration of the contrary. If this proposition is a possibility, perpetual motion easily follows.

When a subject is involved in uncertainty, the greater the number of opinions that are taken on it the more likely is the system to be unravelled; even though many of those opinions may be in the greatest part erroneous, still, they tend to place the subject considered in so many different points of view as to add materially to the facility of its investigation.

[On Mr. Nicholson's remark that he has "met with no clear enunciation of this project so general as to include every possible scheme," he says :—]

Certainly not; nor will any one else, until every possible scheme be produced, which is not likely to be very soon the case.

[He has been speaking of the "want of direct and concise demonstrations of the fundamental principles of the lever, &c." Then comes an extract "from a short essay in a scarce volume of tracts, by H. Hamilton, D.D., F.R.S., and Professor of Philosophy in the University of Dublin. He says :"—]

"The many useful instruments that have been so ingeniously invented and so successfully executed, and the great perfection to which the mechanic arts are now arrived, would incline one to think that the true principles on which the efficacy and operations of the several machines depend must long since have been accurately explained; but this is by no means a necessary inference, for, however men may differ in their opinions about the true method of accounting

for the effects of the several machines, yet the practical principles of mechanics are so perfectly known by experience and observation, that the artist is thereby enabled to contrive and adjust the movements of his engines with as much certainty and success as he could do were he thoroughly acquainted with the laws of motion, from which the principles may be ultimately derived. However, though an inquiry into the true method of deducing the practical principles of mechanics from the laws of motion should not contribute much to promote the progress of the mechanic arts, yet it is an inquiry in itself useful, and in some measure necessary; for, since late authors have used very different methods of treating this subject, it may be supposed that no one method has been looked on as satisfactory and unexceptionable. The most noted theorem in mathematics is this: 'When two heavy bodies counterpoise each other by means of any machine, and are then made to move together, the quantities of motion with which one descends and the other ascends perpendicularly will be equal.' An equilibrium always accompanying this equality of motion bears such a resemblance to the case where two moving bodies stop each other when they meet together with equal quantities of motion, that many writers have thought that the cause of an equilibrium in the several machines may be immediately assigned by saying that since one body always loses as much motion as it communicates to another, two heavy bodies counteracting each other must continue at rest, when they are so circumstanced that one cannot descend without causing the other to ascend at the same time, and with the same quantity of motion; for then, should one of them begin to descend, it must instantly lose its whole motion by communicating it to the other. This argument, however plausible it may seem, I think is by no means satisfactory; for when we say that one body communicates its motion to another, we must necessarily suppose the motion to exist first in the one and then in the other; the descending body cannot be said to communicate its motion to the other, and thereby make it ascend; but whatever, we should suppose, causes one body to descend, must be also the immediate cause of the other's ascending, since, from the connexion of the bodies, it must act on them both together, as if they were really but one. And, therefore, without contradicting the laws of

motion, I might suppose the superior weight of the heavier body, which is in itself more than able to sustain the lighter, would overcome the lighter, and cause it to ascend with the same quantity of motion with which the heavier descends, especially as both their motions taken together may be less than what the difference of the weights, which is here supposed to be the moving force, would be able to produce in a body falling freely. However, as the theorem above mentioned is a very elegant one, it certainly ought to be taken notice of in every treatise on mechanics, and may serve as a very good index of an equilibrium in all machines; but I do not think that we can from thence, or from any one general principle, explain the nature and effects of all the mechanic powers in a satisfactory manner, because some of these machines differ very much from others in their structures, and the true reason of the efficacy of each of them is best derived from its particular structure."

As these remarks perfectly agree with my own ideas on this subject, I may be allowed to draw this conclusion, that from hence it follows it may be possible to construct a machine whose effects are not to be easily or satisfactorily explained on any one general principle; and that, after all, experience must take place of theory.

[Of the wind, the tides, &c., he remarks:—"as I before observed, are an approximation, but not a solution, of the problem."]

In vol. 12 (1829-30) appears the annexed communication:—

The following is an extract from the letter of an esteemed correspondent, to whom our readers have been indebted for many valuable contributions to our pages:—

I now send you a copy of a memorandum I have placed among a great number of papers, diagrams, notes, &c., on the subject of perpetual motion, but all unintelligible to any one but myself. "Infatuation all," you will say; but though I might not be able to deny this charge *in toto*, yet this I will say, I can demonstrate the possibility of perpetual motion by the action of material bodies on one another, aided by the con-

stantly existing powers of nature, made available to that purpose. The memorandum is as follows:—

Query—What ought to be the reward for the invention of a continual self-acting power which may be increased at pleasure and without limitation, excepting that of the strength of materials acted upon by their own weight? That this is possible and practicable I am now convinced, and that there is no law of nature or even theorem in the science of mechanics which goes to controvert the assertion. But the principles on which it may be effected, and particularly the practical means, have hitherto eluded the researches of the ingenious of all ages to the present hour, and now lie concealed in the breast of an individual who may possibly, from neglect and want of encouragement, be induced to relinquish a pursuit the developement of which would confer an incalculable benefit on mankind, and the loss of which may require ages yet to come to recover.

That the above is the unequivocal and sincere opinion of the writer is attested by his own hand this 25th of February, 1829.

In vol. 13 (1830) there is a conditional engagement to construct twenty models:—

The submitter of the following proposals having, for some years, been prepossessed with an idea of being able to invent a self-moving machine, or, at least, one moved by the power of gravity, acting obliquely over the centre or axis of its motion, and having now the most sanguine hopes of success, but not the pecuniary means of carrying on his experiments, which he has hitherto done with his own hands to a great extent, on scientific principles, according with original practical ideas (arising from experience) to the best of his knowledge, exclusively his own, begs leave to submit to encouragers of ingenuity the following proposal:—He solicits a subscription of £20, for which he would engage to produce 20 experimental models of machines illustrative of his ideas, differing in form and appearance, but each equally curious. In case of non-success in his attempts, the models to be presented to the London Mechanics' Institution, or disposed of as a majority of the subscribers may direct. In case of success, ample remuneration would be in his power, and the subscription

returned, or a model of the successful machine furnished to each subscriber of £1.

P.S.—The proposer has several ingenious ideas of inventions of a highly useful nature, which would, at all events, be greatly promoted by the experimental trials for which this subscription is solicited; and for a claim to a talent for ingenious speculation, he begs leave to refer to the Editor of the "Mechanics' Magazine," by whom, and by the publisher of the magazine, subscriptions will be received.

SUBSCRIPTIONS RECEIVED.

The Editor of the "Mechanics' Magazine"	£1	1	0
A few friends of the Editor	1	1	0
T. B.	0	5	0
One of like faith	0	2	6

London, July 9, 1830.

ARGUMENTS FOR AND AGAINST THE POSSIBILITY OF PERPETUAL MOTION; including an Apology for a certain Perpetual Motion Seeker (vol. 14, 1831):—

> "Yes; we shall conquer! All those dangers past
> Will serve to enrich the future story."

A correspondent says:—

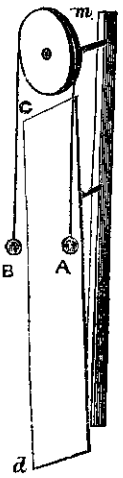
The application to the subject, on my part, has been accompanied by continual experimental elucidations of the subjects considered, and comparisons of these with the axioms, theorems, and demonstrations of one of the best authorities, if I may be allowed so to call my favourite author, Emerson, whose *I says* are generally correct.

I disagree with Mr. B., and do trust that even a perpetual motion seeker might deserve encouragement, if it be found that such a character may exist in a person who is not so ignorant of first principles as Mr. B. supposes *all* are who have this bias; especially if it be found that the person's researches have been connected with subjects of a more tangible nature, relating to the improvement of the useful arts, and particularly to some modern inventions of high importance that are not perfectly correct in their construction.

In this article, Mr. B. advises those who are misspending their time in this pursuit, to consider the question in its most simple form, divested of more complicated operations, which

simple form is that of a pulley accurately constructed so as to reduce the resistance to motion as much as possible. He says, "it will be found, as long as the weights are equal," there will be no motion produced, but wherever the weights are placed they will remain; and to produce vertical motion in the smallest degree, it will be necessary to add a weight to one of the former to create a preponderancy. This weight he calls the mechanical loss, and an insurmountable bar to perpetual motion, &c. We need not follow Mr. B. to his conclusion, as I think this insurmountable bar can be easily removed; and I shall be able to show that this equilibrium, for such it merely is, can be destroyed without adding to one of the weights, or absolutely taking from the other; though this may virtually be considered to be the case, inasmuch as we can at least produce an effect on the system as if the weight were reduced. Mr. B. says, under this arrangement, "wherever the weights are placed they will remain, unless an addition is made to one of them." We will therefore suppose the following diagram to represent the arrangement on a small scale, delicately constructed.

A B are the two weights connected to each other by the string passing over the pulley, and being nicely equalized in their weight, here would, of course, be an equilibrium on the principle of the lever. But take a flat piece of wood, such as a ruler, and place it obliquely in a way so as not to interfere with the pulley *m* in the direction *d*, and then bring the weight to impinge upon it in a way so as not to move the weight A *m*, C *d*, the least, or alter its position. What will be the consequence? Some would say, why, the weight A would then descend, and cause the weight B to ascend. But I should rather say, the re-action of the plane when acted on by the weight B, having destroyed the equilibrium of the forces, motion takes place. Now, if we attribute this motion to the re-action



of the plane on the weight, though we will not go so far as to say motion is generated, yet if we say, by this simple arrangement the equilibrium is destroyed and motion takes place, the least we can admit is, that motion is communicated to the system, and that by the agency of part of the machine itself, the apparatus employed being considered as such. Then, why so much objection to the term self-moving machine in limited sense? But I will not dispute about words, which are but the images of things, and images may be strangely distorted by the medium through which they are received—of which distorting mediums, there is none equal to that of prejudice in favour of abstract notions—which notions perhaps, if rigidly examined, would be found to have no foundation in facts or in common sense.

Another demonstrator of the impossibility of perpetual motion, is Mr. Mackinnon (see "Mech. Mag.," vol. 1, p. 363). As no doubt the different attempts to produce, or communicate, continued and perpetual motion, at least, such as are often brought forward by persons unacquainted with the science of mechanics, are generally to those who are acquainted with that science, if not absolutely ridiculous, yet of a nature to excite a smile at their futility: still there are a few (perhaps a very few) who entertain an opinion that such a thing is not impracticable, and who have, from practical experience as well as study, acquired a tolerable insight into the laws of nature (so far as relate to this subject); who in their turn cannot help smiling at the weak reasoning of some other would-be philosophers, who gravely give their dictum in the case. In this class I include Mr. Mackinnon, who very gravely goes to work to prove, &c., and flatters himself he shall, if rightly understood, help to prevent much future waste of time on the subject. He then goes on to give us his definition of inertia, by which he informs us that a body in a state of rest will remain so until it is moved (wonderful!)—that it cannot move itself—that it has not that power—and that no mechanical contrivance can give it that power. (How profound!) * *

INQUIRY INTO THE POSSIBILITY OF PERPETUAL MOTION (vol. 14, 1831):—

PROPOSITION.—That a wheel can be made to possess more

force in its first revolution than is in the spring that moved it (provided the moving power is not too much or too little) by only making it heavy enough and regulating its diameter; and that this increase of power goes on *ad infinitum*. To demonstrate this will be to demonstrate the possibility of perpetual motion.

First, then, "The moment of any moving body may be considered as a sum of all the moments of the parts of that body," and the expansion of a substance increases the resistance of the air to its motion by exposing more surface. Now, a wheel of a ton weight possesses as much force, when put in motion, as a thousand small ones made of its contents would possess, while it is less resisted by the air, as it has less surface exposed to it.

Secondly, The impediment of friction to a wheel's motion increases with the circumference of the axis (as proved by balancing a beam, which, if balanced on a sharp edge, the least touch will move it), and *vice versa*. Now, if a wheel of a ton weight be divided into a thousand small ones, the axis sufficient to support that wheel must be divided as well into a thousand small bars. The large wheel, moved with the collected force of the thousand small ones, while it was less resisted by the friction as the circumference of its axis, was less than a sum of the circumferences of the thousand small ones. Besides, one-thousandth part of the large axis is not sufficient to support one-thousandth part of the wheel's weight, as a beam of four equal sides will support a greater weight than if split into boards and laid flat. So a small wheel must have a greater axis in proportion to its weight than a large one; consequently it possesses more friction in proportion to its power. And as the wheel is increased, the power increases, for "the motion of all matter is as its quantity," without a proportional increase of resistance from the air or friction.

Thirdly, It is granted that when a wheel is put in motion, that motion would be perpetual only for the resistance of the air and friction. Well, all the force it possesses is present in the first revolution, and can be used to reproduce the moving cause while the resistance can be almost avoided, for it only is produced as the wheel revolves.

I was led by this course of reasoning to make the following experiments. 1. Three wheels, of various sizes, were put in

motion by a force equal to the one-eighth of their respective weights; the smallest was stopped in its first revolution by the same weight that moved it ; the next in size took once and a half; and the largest wheel took twice the moving power to stop it. 2. A wheel, two feet in diameter, had various weights fixed alternately to its periphery, and the weight let fall from the perpendicular, the greater the weight on the wheel, the nearer was it brought round toward the point from which it fell, until the weight was increased to two pounds; here the principal began to diminish until the diameter of the wheel was increased—when increase of weight increased the moment as before. So, there is a certain diameter as well as weight to be considered.

ROBERT TWISS, Jun.

P.S.—Much depends on the organic structure in lessening the size of the machine. I have three models (one moved by a spring, and the rest by a weight) for the inspection of any person disposed to put this plan into execution. In one the power of the lever is present in two places, and in another a weight acts on the whole during its entire revolution, and is replaced by being lifted only two or three inches.

A POWERFUL PERPETUAL MOTION. By W. Pearson (vol. 20, 1834):—

If I understand perpetual motion aright, it means that a machine, or other moving body, must be so constructed that it shall continually work itself without intermission.

If my ideas of perpetual motion are correct, I am confident I have discovered it; for I know a machine which will not only work itself, without the assistance of any person, but will also have a sufficient power to spare, to work any kind of machinery required.

However, setting the question of perpetual motion entirely aside, here is a machine which can be applied to all the purposes steam is applied to, and free from any danger whatever —which is ready for starting at any moment, and, except the act of setting in motion and stopping, requires no farther attending to.

The contrivance is so simple that I can calculate the gain and loss of every part of it; and am positive that what is

now considered a very small engine, if constructed on my plan, after deducting sufficient power to keep itself in motion, will have to spare, over and above, about 100 stones pressure, which may be applied to any required work; and, by enlarging its dimension, it may be made of any given power.

It will answer admirably for propelling vessels across the seas, as they are now done by steam; and as no fuel is needed, it certainly is a desideratum. The engine is much more compact, and will be free of that uncomfortable heat which is so much felt in steamers.

I do not think it proper, at present, to explain more particularly the nature of this machine, for I believe there are people in the world who would not scruple to take advantage of my labour and study. This being the case, I have not sent a drawing and description, as I first intended; but if any gentleman, merchant, mechanic, &c., of known integrity, who needs such an engine, or wishes to know if it be possible to make one, will secure me, by a patent or any other sufficient means, an adequate return for the invention, I will prove to him by a drawing (if he knows anything about a machine) that it cannot fail to answer the desired end.

It is not in my power to try it; and yet an engine of this description will cost much less than a steam-engine of the same power, without any running expense for fuel, &c., upon it.

Confident I am not mistaken, I will not shrink behind an anonymous signature, but openly, and at once, acknowledge myself as

Yours, &c.,
WILLIAM PEARSON.

Bishop Auckland, Jan. 6, 1834.

P.S.—Many hold that it is impossible for a machine to expend the same power it works with; but let me inform them that I have brought an ally into the field which does the most material part of the work, and yet requires no outlay of power in return.

SELF-ACTING MACHINERY.—W. Pearson (vol. 23, 1835) again writes:—

The possibility of making a perpetual motion, or machinery to generate the power it works with, is affected to be treated

as an "idle chimera," equally vain and opposed to the well-established laws of nature and mechanics; but in spite of this, perpetual motion seekers are more numerous than any superficial observer may imagine. Having already made an avowal of my confidence of the practicability of making self-acting machinery, I have had occasion to hear much said on the subject. Many with whom I have conversed, after quoting what this or that learned gentleman has said on the impossibility of the thing, have taken "heart of grace" from hearing me still profess my confidence in my plans, and at length acknowledge that they themselves turned their attention to it at one time, and believed they could lay down plans by which self-acting machinery could be made to do such and such particular work! One person, after "beating about the bush" as above, alleged that he could "make a wheel which would be able to turn a *grunstane!*" Thus you see, Sir, perpetual motion seekers abound; and though they pretend to laugh at the idea, yet are they secretly labouring to catch—what is it Bishop Wilkins calls it?—the "chaste wanton."

I believe most of the engineers of the present day have been perpetual motion seekers; but, disappointed by repeated failures, have given up the thing as a false, deluding chimera, unworthy of their study: though I have heard it said (whether true or false I know not, neither is there any offence meant) that Mr. Hancock, of steam-carriage celebrity, remarked once, that "if he had an hundred sons, he would like them all to study perpetual motion; for, if it had no other beneficial effect, it would make them familiar with the various modes of connecting the working parts of machinery."

[After a little pleasantry in the way of proposing some incredible machinery, he proceeds:—]

Sir Isaac Newton, it is said, hinted something about a fool when *he* failed of discovering the perpetual motion. How far *I* may tally with the learned astronomer's ideas of one, I know not; but certainly I have no ambition to contend for the title. Though the veteran mathematician did not express himself in the self-sufficient style of some of our *ci-devant* perpetual motion seekers after they had failed,—"Phoo! it's all fudge; there is no such thing: haven't I tried it *all ways?*"—yet I must say it was rather ungenerous of him to place a

disgraceful bar in the way of the successful student. I am not unaware, however, that many people consider me a downright ninny, for coming forward as I have done, in a plain, open, decisive manner; but how far I may really merit the epithet, remains eventually to be proved. If, after setting up my name as a target for the arrows of criticism to be pointed at, it is clearly demonstrated that I am in error, then, indeed, I cannot but acknowledge the term will be very justly applied. However, it may suffice at present when I say, "I do not fear the result!"

Mr. Mackintosh, in a lecture delivered in October, in relation to the laws and sources of motion (vol. 26, 1836), says:—

All mechanical motion resulting from gravity tends from a circumference to a centre, the time which the motion continues being greater or less as the velocity or distance from the centre is greater or less.

If chemical motion continually tends from the centre to the circumference, a perpetual chemical motion is impossible, because, whatever may be the dimensions of the mass, it must have a centre, at which point chemical action would cease.

If mechanical motion continually tends to a centre, a perpetual mechanical motion is impossible, because, whatever may be the dimensions of a circle, it must have a centre, at which point mechanical motion would cease.

But a perpetual motion may and does exist, and is a necessary result of the two forces, viz., of chemical motion tending *from* a centre, and of mechanical motion tending *to* a centre; and these two forces may and will continue to produce motion for ever.

Section II.—*Its Possibility Denied.*

A correspondent (vol. 1, 1823), speaking of the London Mechanics' Institute, about to be established, observes:—

Amongst the various other important benefits to be derived from the proposed institution, will be that of demonstrating,

in intelligible terms, the total fallacy and inutility of certain pursuits after the chimera of perpetual motion, in search of which so many have sunk their little capital and many of their best years of existence, which might have been prevented by an acquaintance with the first elements of mechanics.

In some recent cases which have come to my knowledge, the visionary mechanics have been objects of pity, from the encouragement given to them by persons who ought to have been qualified to have given better advice. These dark and golden dreams, the seeds of fruitless patents, will, it is to be hoped, be diminished by a more general diffusion of mechanical knowledge.

[He concludes his letter with:—]

Perhaps some of your correspondents will favour the public, through the medium of your Magazine, with a short history of some of the most specious attempts to produce a generating power, or a machine capable of working from a power raised by itself.

"A Constant Reader" (vol. 1, 1823) states:—

* * * I have witnessed, however, a nearer approach to a method of obtaining perpetual motion than is set forth by your correspondent, which, if I comprehend it rightly, only shows one pump for raising the water over the wheel, but which is not sufficient to carry the wheel round. In the case I witnessed, there were two pumps, which moved successively after each other, by which means the wheel, if it were possible to overcome the friction, would be kept in constant motion; whereas, after the contents of a single pump are discharged on the wheel, it would immediately stop.

But, however an engine of this description may be made, it is utterly impossible to overcome the friction of the bearings, couplings, levers, &c.

No Perpetual Motion (vol. 1, 1823).—The writer says:—

I would advise those persons who yet may be misspending their valuable time on this vain pursuit, to consider the ques-

tion in its most simple form, divested of the more complex operations of raising water by means of pumps, as these operations always involve questions of difficulty as to the proportion of power expended to the effect produced; taking into account that the real mechanical effect in all hydraulic machines falls much below the power expended. Let the question be, therefore, considered by means of a simple pulley, mounted on friction wheels, so as to reduce the resistance to motion as much as possible: let us also suppose a line passing over this pulley, without weight, and without rigidity or stiffness; at each end of this line let there be attached an equal weight. As the subject is of importance, it will be right to consider well the result of this arrangement. It will be found that so long as the weights are equal there will be no motion produced, but that wherever the weights are placed they will remain; and to produce vertical motion, even in the smallest degree, it will be necessary to add a weight to one of the former, to create a preponderancy: this additional weight is therefore the mechanical loss, and the insurmountable bar to perpetual motion. All attempts to get rid of this difficulty, by the introduction of pumps, whether the common lifting pumps, the spiral cylinder, or any other rotatory machinery, will only serve to increase the loss of power, by the friction inseparable from every part of a machine.

[He says that—]

If one hundred gallons of water be made to operate upon any pump, with a fall of ten feet, it will be found that the quantity raised to the height of ten feet will be several gallons short of one hundred.

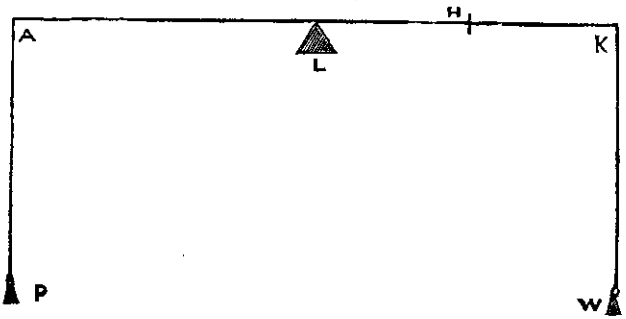
[He adds:—]

A very considerable portion of the fruitless attempts to procure a generating power, that have come to my knowledge in the course of the last twenty-five years, have been founded upon the presumption that a machine could be made to raise more water than was required for its own operation. A due consideration of the less complicated question of a pulley with two equal weights sufficiently proves that the presumption could never be realized.

No Perpetual Motion (vol. 1, 1823):—

Your correspondent has taken up a very wrong position when he insinuates that a perpetual motion cannot be made, because matter is inert. That matter is inert, no one will deny; but motion is as natural to matter as inertness. This was long ago asserted by Des Cartes: impress motion upon any mass, and it will keep that motion for ever, if not affected by any other agent; witness the harmonious motion of the celestial spheres.

The want of a perpetual motion arises from a very different cause than that of the inertia of matter. In the science of statics there are a few things most essentially necessary to be considered, and these are strikingly illustrated by the simple lever.



Let A K be an inflexible bar without weight; place it on the fulcrum L: place equal weights, P and W, at each end; these will evidently balance each other; put them in motion in a vertical plane, and the descent of the one will be equal to the ascent of the other; the times of ascent and descent will be the same; in short, a perfect statical equilibrium obtains—that is, the times, the velocities, the momenta, and the space passed over in each are respectively alike. Now, let the weight W, of six ounces, be placed at H; then, by the properties of the lever, $W \times H L = P \times A L$; hence $\frac{W \times H L}{A L} = P$, that is, $6 \times 2{\cdot}5 = 15$, and 15 divided by $4{\cdot}5 = 3{\cdot}3$, the weight P; in this position the balance is still

preserved. The times of ascent and descent are equal; the velocities and spaces described are unequal, being as 4·5 is to 2·5; but this is again compensated by the momenta; for, since that is as the quantity of matter multiplied into its velocity, we shall have for the momentum of P $3{\cdot}3 \times 4{\cdot}5 = 15$, and for W it will be $6 \times 2{\cdot}5 = 15$; here, again, the momenta are brought into an equilibrated state, and of course motion will cease. The same truth will hold good in any other position, and in any other machine, however complicated may be its construction; for it has been asserted by an eminent astronomer and mechanical philosopher, that upon this principle depends the whole of mechanics; and it holds universally true that when the bodies are suspended on any machine, so as to act contrary to each other, if the machine be put into motion, and the perpendicular ascent of one body multiplied into its weight be equal to the perpendicular descent of the other body multiplied into its weight, those bodies, how unequal soever, will balance one another in all situations. In hydraulic machinery the same law holds true, and it is strikingly exemplified in the syphon. Suppose a vessel whose surface contains 16 superficial inches, and a syphon whose bore contains exactly one superficial inch—that is, any transverse section of the tube—it is well known that, if the longer leg of the syphon be on the same level with the surface of the water in the vessel, the water will not run, even though means be used to effect its egress. The reason is obvious: let the pressure of the atmosphere be 15 pounds on the square inch; since fluids press alike in all directions, the 15 pounds of upward pressure will exactly balance the pressure of 240 on the vessel; for, if 16 inches of water were to be forced through the syphon, the water in the vessel would only fall one inch, and this velocity 1×240 (the pressure on the vessel) $= 240$, and the velocity of the syphon 16×15 (its atmospheric pressure) $= 240$. Let the end of the longer leg be brought below the level of the surface of the water in the vessel, so as between that level and the point of discharge may contain one pound of water; and since this one pound of water acts against the 15 pounds of atmospheric pressure, hence 14 pounds only remain, which do not balance the pressure upon the vessel; in this case the water will flow; but no mechanical advantage can possibly be derived from this circumstance; for although the velo-

cities are as 16 to 1, yet the quantities are equal, the times are equal, and the momenta are equal; for the momentum or force thus generated by the affluent water can never raise a quantity in the slightest degree greater than itself to the point where it fell from; and, so long as nature acts in this form, in vain shall we look for a perpetual motion.

[He then quotes from Dr. Gregory, where he illustrates the impossibility of perpetual motion by the balance invented by Dr. Desaguliers.]

INVARIABLE RATHER THAN PERPETUAL MOTION TO BE SOUGHT AFTER (vol. 2, 1824):—

Notwithstanding the many ingenious papers which have appeared in your Magazine, tending to elucidate the subject of perpetual motion, with the laudable view of restraining deluded genius from the pursuit of an object which can never be attained, it seems pretty clear (from the observations of F. J.) that they have all proved insufficient to effect this purpose. It is not enough for one enamoured with his imagined discoveries, and more or less hallucinated by a long and almost incessant contemplation of them, to be shown the unsuccessful attempts of others; nor is it sufficient that a skilful mathematician can comprehend the demonstration of its impossibility; but I hope many may be restrained, by convincing them that it would be utterly useless if discovered, and that the pursuit of it is disreputable in the eyes of scientific men.

When, however, I assert that perpetual motion can never be obtained, I wish to be understood, that it cannot be produced by any means strictly mechanical, or hydrostatical: that it may be practicable by other means, must be sufficiently obvious to every theorist. For example: let a tube be made in the form of those used in common wheel barometers, sufficiently capacious to contain several hundred pounds of mercury; then suspend a weight on the surface of the mercury, with a proportional counterpoise, so placed, that every ascent, as well as descent, shall renovate the maintaining power of a train of wheels, terminated by a delicately small balance. By this means a very small alteration in the pres-

sure of the atmosphere will wind up the weight or spring sufficiently to maintain the vibrations of a balance for a period of two, or three, or more weeks, according to the weight of the column of mercury suspended in the tube. If it be objected, that there is a possibility of the atmosphere preserving an uniform pressure for so long a period, a thermometer constructed pyrometrically (*i.e.*, with bars of metal possessing an equal expansibility) may be substituted;* and as the power of this may, like the last, be accumulated to any given extent, it may be made to require only the constant changes of season to impart to the machine sufficient power to render it totally independent of the minor and inconstant variations of temperature, from which it would nevertheless frequently derive a renewal of power.

But to produce perpetual motion by mechanical means, is a proposition which in itself implies a contradiction: mechanical motion consists in an approximation to mechanical equilibrium, and it is therefore a contradiction to say that a body, or system of bodies, can constantly approach without ultimately arriving at that point of equilibrium where motion ceases.† If, again, it be said that motion may be produced without approaching the point of equilibrium, an equally obvious contradiction is involved; for the proposition comes to this, that we may produce, by the expenditure of a given quantity of power, a renovating power greater than that expended, which is impossible. It may not, perhaps, be so distinctly evident; but it is no less capable of demonstration, that projected bodies of any description, deriving their force from their momentum, are subject to the same or (in their result) similar laws, and equally inadequate to produce perpetual motion.

Let me exhort those of your readers, who will not be convinced of the impracticability of their schemes, and who, after all that has been said, still imagine that they can accomplish that which has baffled the learned of all ages; who esteem those facts which science has established, and which have been demonstrated to our understanding, and proved to our

* See Nicholson on the Solid Thermometer, p. 127.

† Mathematically, perpetual approximation may easily be conceived. Not so here, because the motion of a specific body requires a specific power to maintain it; and when the power becomes less than that quantity, the motion ceases.

senses, to be merely as "customs," or fashions, which they can lay aside when they impede their operations: these I would advise to relinquish a pursuit which is profitable neither to society nor to themselves, and direct their exertions to the investigation of subjects in which their success would entitle them to remuneration for the trouble and anxiety inseparable from speculative experiments. Instead of studying perpetual motion, which has hitherto produced nothing but perpetual nonsense, let their object be an invariable motion. The necessity of winding up such machines at certain periods, is a circumstance altogether unimportant and frivolous, while it remains to obviate the evils arising from external motion; to neutralize the effects of heat and cold, without the introduction of other evils; to prevent the variable and injurious influence of oil, &c., &c.

In vol. 3, 1824, a correspondent, who signs "Esperance," gives the following as a memorandum made by him "while perusing some works relating to the controversy of finite particles:"—

Dec., 1813.—The theory of a finite quantity of matter being composed of an infinite number of particles, as to the truth of which mathematicians are divided in opinion, may perhaps be compared to that of perpetual motion. For mathematicians, on the other side, say, it is a contradiction to suppose anything of finite dimensions can be composed of infinities, which certainly appears correct in principle; yet, on the other hand, it is argued that no certain number of parts of which any matter consists can be supposed, without having an idea of a greater number, even *ad infinitum*. On the same ground, although no certain time can be pointed out which forms the maximum of the movements of machinery, nor can any length of time be conceived without an idea of greater extent, to which, by increasing either the moving power or the complication of the inferior parts, the motion may be carried: yet perpetual motion, as a mechanic principle, is visionary. *Query.*—Will this at all explain the subject which has been so long controverted, as it proves the maintainers of both sides of the question to be to a certain degree right?

This argument, of course, alludes to engines where a mechanical power is the moving force, and not a chemical power, as the electrical pendulum.

A correspondent (vol. 5, 1825) directs his remarks chiefly against the singular opinions of Mr. Pasley, who believes "that a perpetual-motion-making cause may yet be discovered, and that following such an *ignis fatuus* may lead to the path of wisdom," and observes:—

On the contrary, this vain pursuit has been known, even in the present age, to lead to poverty and ruin; and, indeed, what else can be expected, when speculators construct machines without understanding the first principles of mechanics? Such was the case with myself (perhaps thirty-five years since), when, believing that nature abhorred a vacuum, I constructed a syphon with a small bore as far as the water was to ascend, and a large bore in the shorter descending leg; fully expecting that the weight of the larger column of water would draw up the smaller column out of a basin, and permit the liquid to fall into the vessel from whence it came, and turn a wheel in its descent.* Another of my raw youthful speculations consisted in a water-wheel, contrived so as to pump up water near the centre of it, a part only of which I supposed would be amply sufficient to keep the wheel in motion, by the great power it would possess if conveyed into buckets at the wheel's circumference. I did not then know the universal law of mechanics, which must inevitably demolish all similar projects in machinery, viz., that whatever is gained in power is lost in time.

I believe the idea, that a perpetual-motion-making cause may yet be discovered, arises principally from ignorance of the laws of nature which relate to machinery, but partly from a notion which has been broached by certain pantheistical philosophers, that a propensity to motion is an innate and essential property of the particles of matter. Yet, in opposition to this doctrine, the natural immobility and inertness of matter are obvious wherever we turn our eyes; and the pro-

* For this favourite idea, see Appendix B; and Zonca's work on Machines, 1607, folio.

jectile motion in the planets, &c., can no more be an innate quality than it is in a cannon-ball. The whole universe is, indeed, an example of perpetual motion, as respects the larger masses of matter, yet the motion in all cases seems to proceed from an external or mental cause.

The circulation of the blood in animals seems to be caused by a series of galvanic shocks; but a constant external supply of food, air, and heat is indispensable, and shows that the motion of the heart, &c., is not an innate propensity. A watermill in a large river may be deemed a real perpetual motion; but the weight or gravity of the water, which constantly carries it towards the ocean, proves that some other agent must convey it up again towards its source.

[On Mr. Pasley's version of the projectile force, he remarks:—]

What! is the projectile force (as exemplified on the largest scale in the planetary system) a nullity? On the contrary, that is precisely the kind of force which all perpetual motion seekers should cherish above all others; for it is acknowledged that bodies projected into space move on *ad infinitum* with their original velocity, unless obstructed by the air or some other agent.

Without wishing any one to place a blind reliance on great authorities, I think no person ought to presume to promulgate any anti-Newtonian doctrines, till they have given sound reasons for rejecting the established system.

[This he says in allusion to such common-sense philosophers as Sir R. Phillips and others.]

* * * * * * *

I fear the delusive projects for perpetual motion have been encouraged in no small degree by the disingenuousness of the Marquis of Worcester, who, like some of your correspondents, scruples not to insinuate that he has actually succeeded in this hopeful attempt.

The wheel that he speaks of in No. 56 of his "Century of" ingenious speculations, rather than "inventions," certainly would not move of itself, though it is possible to make the weights descend at a greater distance from the centre than their ascending distance.

[He complains of Nos. 78 and 98 as fallacious; and—]

Nos. 99 and 100 are complete castles in the air, or else

they are worth a thousand of perpetual motions. The descent of 1 lb. is to raise 100 lbs. as high as the 1 lb. falls, in defiance of the mechanical principle—that what we gain in power we lose in time, &c.

The Editor (vol. 10, 1828) says:—

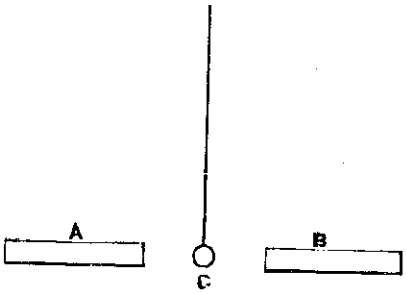
Philobrune, who expresses his determination never to believe in the impossibility of perpetual motion, until he has "spent twenty or thirty pounds in the trial," and who wishes for a candid examination of the arguments for and against it, will be pleased to learn that we propose inserting, shortly, a series of clever papers, which profess to have that object in view, by a correspondent nearly as incredulous as himself. We, however, recommend him to keep his money in his pocket till he has read these papers, and what may possibly be offered in reply to them. Strange to stay, notwithstanding all that has been experimented and written on the subject, the "Philobrunes" are still a very numerous class; and while they are so, no apology can be necessary for appropriating a portion of our pages to their conversion.

A lecturer (vol. 10, 1828) writes:—

Perpetual motion is, and ever must be, an impossibility. For, consider motion abstractedly from matter—a certain quantity of motion is communicated to a given body, and the seeker after perpetual motion endeavours, by the agency of machinery, to make it return to the same place again, and so continue for ever. Now, were there no such things as friction and resistance, all would be well; but as long as bodies continue to part with their motion to surrounding bodies, so long will perpetual motion be unattainable. It is of no use to invent machinery to economize the motion: at the return of each circulation, the motion must and will be less than it was at the end of the preceding one, and so it will continue till the machine stops.

Neither is it reasonable to suppose that, by the agency of any uniform moving power (if I may be allowed the expression), such as the magnet, the earth's attraction, the atmospheric pressure, &c., we can attain perpetual motion. For

instance, in the magnet, all cases may be reduced to the following:—There are two magnets, A and B, and another body, as C, to be attracted, first by one and then by the other, as in the figure.



First, then, A is to have sufficient power to attract C away from B; and then B is to have a greater power, to draw C away from A. Now, if the power of B be greater than the power of A, it could never have attracted C away from B in the first instance; and if B be less than A, B can never draw it back in the second. To suppose, then, that in any arrangements of magnets, first one should have the greater power and then the other, is absurd; and the same holds good of any uniform source of motion whatever.

In writing the above, I have gone at once to first principles, considering that I wrote for persons who understood the subject; for in investigating questions of this nature, we must not stop to consider the best passage for fluids, the superiority of a friction roller, or the advantages of a lever, but go at once to the first principles; the same as in algebra we clear an equation of all unnecessary quantities. * * If I have made the case clear, it may preserve talents from being wasted upon that which is not attainable.

SCRIPTURE TEXTS (vol. 11, 1829).—What the following has to do with the subject, it is difficult to surmise: but its author seems in good earnest:—

"Notice to Perpetual Motion Seekers."—The following is a literal copy of a communication which we have re-

ceived under this head. We publish it for the benefit of all concerned:—"Perpetual Motion Seekers! see Coloss., ch. ii., v. 8—'Beware lest any man spoil you, through philosophy and vain deceit, after the tradition of men, after the rudiments of the world.' Ye are making the words of God of none effect by your traditions, in publishing these things to the world. How can such toys and baubles as these be perpetual? See Malachi, ch. iv., v. 1—'For behold the day cometh that shall burn as an oven; and all the proud, yea, all that do wickedly, shall be as stubble.' Here is the end of them. I the undersigned have to inform the public, the model for making perpetual motion is to be found in that too much neglected book of models, the Bible. I called upon the Lord, and he showed it to me. I said, 'Lord, shall I show this unto them?' This was the answer to me:—See Isaiah, ch. xli., v. 29—'Behold, they are all vanity; their works are nothing.' I said, 'Lord, be pleased to show me some more about it.' 'Bring forth your strong reasons, saith the King of Jacob.'—Isaiah, ch. xli., v. 21. This was the answer:—See Isaiah, ch. xli., v. 14—'Fear not, thou worm Jacob. * * Behold, I will make thee a new sharp threshing instrument having teeth; thou shalt thresh the mountains, and beat them small, and shall make the hills as chaff.' See also Jeremiah, ch. viii., v. 9—'The wise men are ashamed; they are dismayed and taken,' &c. See also Jeremiah, ch. ix., v. 12—'Who is the wise man that may understand this?' If there is not a wise and learned man who can show this, there is a deaf and unlearned man that will, by the blessing of God, set it forth to you. I am that deaf and unlearned man, GEORGE LOVATT, Stafford.

"P.S.—Mr. Editor: I have told you what I was commanded to do. See Ezekiel, ch. iii., v. 4 to the end. Now, see thou forget it not; let those models which come from the Word of God have the first place.—Joshua, ch. xxiv., v. 15."

A correspondent, and the Editor's note (vol. 13, 1830), appear as follows:—

"I believe there are principles, could they be brought into action, which would effect the desired purpose, and the difficulty is mostly in the practical application."

Sir,—The above is the conclusion of "Hezron's" letter

in your 366th number, who, "at some sacrifice of valuable space," has described a perpetual motion, the most unlikely to keep moving that ever was thought of.

Now, Sir, if "Hezron" will point out the "principles" he speaks of, I will engage to remove every "difficulty" that stands in the way of their "practical application."

The pursuit of the perpetual motion has been supposed by some to render the same service to mechanics which the efforts to discover the philosopher's stone are said to have rendered to chemistry. Whether or not the latter science has been improved by the dreams of the alchymists, I am not prepared to say; but I think I may assert, without fear of contradiction, that the science of mechanics neither has been, nor ever will be, benefited by the attempts to discover a perpetual motion. What probability is there of persons improving a science, who are completely ignorant of it? And this is almost universally the case with perpetual motion seekers. What benefit has science ever derived from their exertions? I believe none at all.

To believe in the possibility of the perpetual motion involves the absurdity of believing that the same thing may be greater or less than itself. I cannot help lamenting that ingenuity should be thrown away in endeavouring to discover what, from the nature of things, never can exist in this world; when, at the same time, that ingenuity might be productive of public good and the private advantage of its possessor, if properly directed.

[We do not think that a belief in the possibility of perpetual motion argues such complete ignorance as "S. Y." supposes: of this, at least, we are well satisfied, that "Hezron" possesses both information and ingenuity enough to prove himself a troublesome antagonist to any one, be his scientific attainments what they may. "S. Y." should in candour have noticed that the scheme given in No. 366 was not one of "Hezron's" own, but an attempt to exemplify one of the Marquis of Worcester's Century of Inventions. Neither do we agree with "S. Y." that the subject is one from the prosecution of which nothing is to be gained to the science of mechanics. We conceive that were the result of the experiments for which "Hezron" solicits subscriptions to do even no more than this—convince the many hundreds (thousands, we may say) who still cherish the notion that a

perpetual motion is possible, of the fallacy of the thing, it would do a great deal of good, inasmuch as it would direct into channels of practical utility, all that labour and ingenuity which are now fruitlessly spent in pursuit of the (alleged) chimera.—ED. M. M.]

DISCOVERING IMPOSSIBILITIES (vol. 17, 1832):—

M. Mathulon, a manufacturer of stuffs at Lyons, once announced that he had discovered the quadrature of the circle and the perpetual motion, and he deposited 1000 crowns, to be awarded to any person who should prove that he was in error. M. Nicole effectually did this, and the thousand crowns were awarded to him, and were presented by him to the General Hospital at Lyons.

A FEW WORDS TO THE PERPETUAL MOTIONISTS (vol. 17, 1832):—

Gentlemen,—

"When leave you off your vagaries?"

Five-and-twenty years ago, I entertained the notion of making a machine, not only to work itself, but to put in motion as many traps as Bishop Blaize in the miniature wool machinery of a show, that used to go about the fairs in the north of England, when I was a lad. As soon as I had got the necessary tools, I made a wheel of brass, with weights, friction-wheels, &c., to be thrown out from the centre on the one side, and brought near to the centre on the opposite side, by means of guide-rings. The whole was made of well-lackered brass, and contained in a frame-work of the best mahogany. So confident was I of its working, that I hardly thought it possible my hobby could fail, and actually prepared myself with a table-cloth to stop it in case it should go so fast as to break in pieces! I thus gained some experience, and beginning to inquire of men, books, and machines, I soon found that the great enemy to all perpetual or self-acting machines is friction and gravity.

Emerson says, prop. 116, cor. 1, "Hence it follows, that if any weight is moved by help of a machine, what is gained in

power is lost in time." Again, cor. 2, "Hence the motion of the weight is not at all increased by any engine or mechanical instrument (think of that, gentlemen), only the velocity of the weight is so much diminished thereby, that the quantity of motion of the weight may not exceed the quantity of motion of the power; and, therefore, it is a vain fancy of any one to think that he can move a great weight with a little power, and with the same velocity as with a greater power!" So that, gentlemen, if your machines or wheels were to run in diamonds, your pumps to be of glass, still you would find a few drops of water necessary to overcome friction; which drops must, of course, be lost, for they cannot be got up to the overshot wheel again without some extra power. It is reported in America that a clock has been invented, going without help! I have heard of clocks going seven years in England; but, as Peter Keir said of Wolf and Edward's new steam-engine in Lambeth (about, I think, 1810) which ground 19 bushels of corn with one bushel of coals, "that's a thing only to be believed on seeing it." But even suppose you could make a machine to go or work of itself, it could have no overplus power to spare for any other purpose, and would therefore be of no practical utility whatever.

I will allow that perpetual motion-hunting is a very pleasant and exciting pursuit. It may be compared to being in a sort of waking dream, and in the one case so in the other it is very vexatious to be jilted.—I am, gentlemen, your well-wisher,

WILLIAM REED.

Peterhoff Paper-mill, near St. Petersburgh,
January 19, 1832.

Editorial Notice (vol. 19, 1833):—

[A correspondent, writing November, 1832, having spoken against the publication of fallacious schemes, the Editor gives as a reason for admitting all into his journal, a hope to do good to the "seekers" themselves.]

They are still, notwithstanding the wide diffusion of scientific knowledge in modern times, a very numerous race: almost every village can boast of some lone enthusiast of this de-

scription. Now, as there is a common fallacy which pervades all schemes for effecting a perpetual motion, the chances are, that by subjecting any one of the number to the test of a public examination, and thereby ensuring its refutation, you will demolish hundreds of others, and, while thus exposing the folly of one visionary, may be the means of curing many. We know, indeed, that, in point of fact, our journal has in this way done much good.

The following article is quoted in vol. 27, 1837:—

Two classes of persons are inveigled into this hopeless quest: the first is the projector,—generally a man who can handle tools, and who is gifted with some small power of invention—a faculty, as Mr. Babbage justly observes, by no means rare, and of little use unless coupled with some knowledge of what others have done before him. Of the inventions already made—of the experiments which have been tried and have failed—our projector is usually profoundly ignorant. What are called the laws of mechanics—namely, general truths which were established by the observations of scientific men in times past, and which are now admitted by all who take the trouble to investigate them—he has either never heard of, or chooses to set at nought without inquiry. The other class is that which finds capital. The projector, having perhaps exhausted his own funds, takes his scheme to some person who has a *little* money to spare, and dazzles him with the prospects of sudden and splendid wealth; *little* by little, he is drawn into expenses which neither of them, perhaps, had anticipated. Failure after failure ensues, but still all is to be right at last. The fear of ridicule—the necessity for retrieving, the one his capital, the other his credit,—these motives carry them on till the ruin of both puts a termination to their folly.

Unhappily, however, the stage is quickly occupied by other adventurers, profiting nothing by the fate of their precursors; and yet one would think that a very slight consideration of the subject would be sufficient to shew the absurdity of the undertaking. What is the object aimed at? Is it to make a machine which, being once set in motion, shall go on without stopping until it is worn out? Every person en-

gaged in the pursuit of the perpetual motion would perhaps accept this as a true statement of the object in view. Yet nothing is more easy than to make such a machine. There are from ten to twenty of them at work at this moment on the Rhine, opposite Mayence. These are water-mills in boats, which are moored in a certain part of the river; and, as the Rhine is never dry, these mills, which are simple in their construction, would go on for years—go on, indeed, until they were worn out. But if this instance were mentioned, the projector would perceive that the statement of his object was imperfect. It must run thus:—a machine which, being set in motion, shall go on till worn out, without any power being employed to keep it in motion.

Probably few persons who embark in such a project sit down beforehand to consider thoroughly what it is they are about to undertake, otherwise it could hardly require much knowledge of mechanics to see the impossibility of constructing such a machine. Take as many shafts, wheels, pulleys, and springs as you please; if you throw them in a heap in the corner of your room, you do not expect them to move; it is only when put together that the wildest enthusiast expects them to be endowed with the power of self-movement; nor then, unless the machine is set going. I never heard of a projector who expected his engine to set off the moment the last nail was driven, or instantly on the last stroke of the file. And why not? A machine that would continue to go of itself would begin of itself. No machine can be made which has not some friction, which, however slight, would in a short time exhaust any power that could have been employed merely for the purpose of setting it in motion. But a machine must not only keep moving itself, but furnish power; or, in other words, it must not only keep in motion, but it must have power to expend in some labour, as grinding corn, rolling metals, urging forward a vessel or a carriage; so that by an arrangement of parts which of themselves have no moving power, the projector expects to make a machine, self-moving, and with the power of performing some useful task!

"Father, I have invented a perpetual motion!" said a little fellow of eight years old. "It is thus: I would make a great wheel, and fix it up like a water-wheel; at the top I would hang a great weight, and at the bottom I would hang

a number of little weights: then the great weight would turn the wheel half round and sink to the bottom, because it is so heavy; and when the little weights reached the top they would sink down, because they are so many; and thus the wheel would turn round for ever." The child's fallacy is a type of all the blunders which are made on this subject. Follow a projector in his description, and if it be not perfectly unintelligible, which it often is, it always proves that he expects to find certain of his movements alternately strong and weak—not according to the laws of nature, but according to the wants of his mechanism.

If man could produce a machine which would generate the power by which it is worked, he would become a creator. All he has hitherto done—all, I may safely predict, he ever will do—is to mould existing power so as to make it perform his bidding. He can make the waterfall in the brook spin his cotton, or print his book by means of machinery; but a mill to pump water enough to keep itself at work he cannot make. Absurd as it may seem, the experiment has been tried; but, in truth, no scheme is too absurd for adoption by the seekers after perpetual motion. A machine, then, is a mere conductor of power into a useful channel. The wind grinds the corn—the sails, the shafts, and the stones are only the means by which the power of the wind can be turned to that particular purpose; so it is the heat thrown out by the burning coal which performs all the multifarious operations of the steam-engine, the machinery being only the connecting links between the cause and the effect.—"Penny Magazine."

DISCOURAGEMENTS FOR PERPETUAL MOTIONISTS (vol. 41, 1844).—A correspondent gives the following extracts from Mudie's "Popular Mathematics:"—

"Of the vast number of inventions and projects which are every day brought before the public—not as mere bubbles or impostures, but with perfect honesty and zeal on the part of the projectors—we speak with most charitable liberality when we say that not one in the hundred proves to be of any use, and nine out of every ten are altogether impracticable. The reason clearly is, that neither the projectors nor those by

whom they are encouraged are able to see the impossible elements which their schemes involve; that they look at the possible and promising ones only: and thus a large quantity of well-meant labour and ingenuity is constantly wasted."

In reference to this "lurking impossible quantity," Mr. Mudie says:—"Perhaps we cannot select a better one than that of the 'perpetual motion'—that is, a self-moving machine, which shall not involve any stoppage, save the wearing out of the materials of which it is composed. We believe that the fonder votaries of this visionary project do not take even the wearing out of the materials into the account; but it is necessary to do this: and even this necessity, when analysed, involves the necessity of the machine stopping before the parts are worn out."

"The power which tends to stop the motion of all machines upon the earth's surface is a power which acts constantly and uniformly, never pausing an instant, nor abating a jot; and therefore, in order to get the better of this gravitation, we must have a counteracting power as continually new as itself; and we are not acquainted with any such power, or kind of matter in which such a power could reside. It is not difficult to calculate (upon mathematical principles) that if we could give any piece of matter a motion round the earth at the rate of about 5 miles in a second, or 1,800 miles in an hour, and keep up the motion at this rate, we should overcome the gravitation of that piece of matter. This is what may be regarded as the possible case of perpetual motion.

"In the case of a fixed machine—and the more complicated the machine is, it is the less likely to succeed—the impossible element, in the most simple view we can take of it, is this: to find a piece of matter which, of itself, shall be alternately greater and less than itself, and which shall also remain equal to itself all the time; and if this is not an impossibility, it is not easy to see where impossibility is to be found.

"The knowledge of impossible or absurd quantities, and the method of readily discovering them, are often of great use to us—not only in preventing us from wasting our time in attempting to do that which cannot in the nature of things be done, but in enabling us to prove or demonstrate truth in cases where that cannot be done directly." [Edition 1836, pages 23 to 27.]

PERPETUAL MOTION (vol. 64, 1856) :—

A paper containing certain important inferences from the negation of perpetual motion was recently read at the Royal Institution, by W. R. Grove, Esq., Q.C., F.R.S., &c. In the following remarks we give an abstract of the author's communication :—

Scattered among the writings of philosophers will be found allusions to the subject of perpetual motion, and here and there are arguments like the following :—Such a phenomenon cannot take place, or such a theory must be fallacious, because it involves the idea of perpetual motion. Thus Dr. Roget advanced as an argument against the contact theory of electricity, as originally propounded, that if mere contact of dissimilar metals, without any chemical or molecular change, could produce electricity, then as electricity could, in its turn, be made to produce motion, we should thus get perpetual motion.

It may be well to define, as far as such a definition is possible, what is commonly meant by the term perpetual motion. In one sense, all motion, or rather all force, is perpetual. For example, if a clock weight be wound up, it represents the force derived from the muscles of the arm which turns the key; the muscles again derive force indirectly from the chemical action of the food, and so on. As the weight descends, it conveys motion to the wheels and pendulum; the former giving force off in the form of heat from friction, the latter communicating motion to the air in contact with it, thence to the air of the room—proved in a very simple manner by the ticking heard, which is, in fact, a blow to the organ of hearing. Although ultimately lost to our senses, there is no reason to suppose that the force is ever in fact lost. The weight thus acting reaches the ground quietly, and produces no effect at the termination of its course.

If, instead of being allowed to communicate its force to the works of the clock, the weight be allowed to descend suddenly, as by cutting the string by which it is suspended, it strikes the floor with a force which shakes the house; and thus conveys, almost instantaneously, the amount of force which would be gradually dissipated, though not ultimately consumed, by the clock in a week or nine days.

This idea, however, of the perpetuity of force, is not what

is commonly understood by the term perpetual motion: that expression is used to convey the notion of a motive machine, the initial force of which is restored by the motion produced by itself—a clock, so to speak, which winds itself up by its own wheels and pendulum, a pump which keeps itself going by the weight of the water which it has raised. Another notion, arising from a confusion between static and dynamic forces, was, that motion might be obtained without transferring force, as by a permanent magnet. All sound philosophers are of opinion that such effects are impossible; the work done by a given force, even assuming there were no such thing as friction, aërial resistance, &c., could never be more than equal to the initial force; the theoretical limit is equilibrium. The weight raised at one end of a lever can never, without the fresh application of extraneous force, raise the opposite weight which has produced its own elevation. A force can only produce motion when the resistance to it is less powerful than itself; if equal, it is equilibrium: thus, if motion be produced, resistance, being less than the initial or producing force, cannot reproduce this; for then the weaker would conquer the stronger force.

The object of this evening's communication was not, however, to adduce proofs that perpetual motion, in the sense above defined, is impossible; but assuming that as a recognised truth, to show certain consequences which had resulted, and others which were likely to result, from the negation of perpetual motion; and how this negation may be made a substantive and valuable aid to scientific investigation.

After Oersted made his discovery of electro-magnetism, philosophers of the highest attainments argued that, as a current of electricity, circulating in a wire round a bar of iron, produced magnetism, and as action and re-action are equal, and in contrary directions, a magnet placed within a spiral of wire should produce in the wire an electrical current. Had it occurred to their minds that if a permanent magnet could so produce electricity, and thence necessarily motion, they would thus get, in effect, perpetual motion, they would probably have anticipated the discovery of Faraday, and found that all that was required was to move the magnet with reference to the wire, and thus electricity might have been expected to be produced by a magnet without involving the supposed absurdity.

[The remainder of the paper relates to results arising from heat and freezing.]

ON PERPETUAL MOTION (vol. 68, 1858). By General T. Perronet Thompson, M.P.:—

Searches after what is known by the name of a perpetual motion have been at all times so common that it cannot be without use to endeavour to ascertain and set down the circumstances under which such a phenomenon is possible, or the contrary, with the reasons why.

The innumerable attempts at perpetual motion from time to time made known, fail generally by running against two canons which nature has set up, and which it is not in man to bear down: that action and re-action are equal, and that the velocities of the power and weight are inversely as those forces. And it is not unamusing to see how curiously these truths may be disguised, and yet with what certainty they will spring out on the hapless projector, at the moment he thinks, good easy man, his success is in the act of ripening.

The old books of "rare inventions" deal in speculations of this disappointing kind. They conceive of balls, rolling down an inclined plane or series of planes, and, by some crafty modification of art, acquiring velocity enough to carry them to the place from which they came. Or, they pour water on an overshot wheel, with intent that this shall turn machinery to pump the water up again. When the great mechanic of antiquity declared he would move the world if anybody would show him where to fix his machine, why should these apparently minor performances be beyond the reach of man? Simply because the one offers no contradiction to the canons above named, and the others do.

To one who has never reflected on such subjects, it would look like a comparatively easy thing to make a watch which should wind itself up.

A friend of early days went to considerable expense with a machine consisting of a cylinder which turned on friction-wheels, and to its circumference were attached certain arcs or arms of brass, with a weight or ball at the end, and these

were expected to turn or fall into a position approaching the horizontal on one side of the cylinder, and lie snug upon the other. But when tried, it moved for a short time when set in motion, and then stopped; the projector expressing his surprise at the very small help required to make it continue in motion. It was suggested to him to put quicksilver into the arcs or arms, which should run outwards in one of their positions and back again in another; with which he was much elated, but nothing came of it. It was evident, in all these cases, that when the machine stopped there was an exact balance in all its parts, and no surplus of force anywhere by which any motion could be continued.

But though there is no making a perpetual motion by the simple application of mechanical force, there is no difficulty in making what may be called so by the help of certain natural powers, if we can get them; and this by the token that nature is full of perpetual motions. And it is not at all unlikely that by some application of these, something very novel and important may be forthcoming. A mill on a perpetual stream is a perpetual motion, because the stream is. And if we ask why the stream is perpetual, it is because the sun to-day, yesterday, and as long as the world shall last, is drawing up water from the sea by evaporation, which in the absence of the sun condenses itself into the shape of rain, some of which falls into the sea again, and what falls on the land forms rivers. So that the result may be traced to two facts—that the sun is perpetual, and that the world turns round without stopping.

If the force of magnetism had been capable of being intercepted like light, it would have been possible to make a perpetual motion by the attraction of a magnet on steel points in the circumference of a wheel. And here there would have been one of nature's perpetual forces, which man cannot copy. There are ideas abroad that something of this kind is to come of electricity; though how we are to have electricity without working an electrical machine does not appear.

On the whole, however, there is nothing hopeless in the expectation of great results from some of nature's perpetual forces. And one of the first means towards such an end is to cultivate an acquaintance with the impossible which is to be kept clear of.