HOW TO PROTECT INVENTIONS IN FOREIGN COUNTRIES WITHOUT EFFECT UPON THE TERM OF UNITED STATES PATENT.

ACCORDING to late articles in daily, and even certain electrical and other scientific papers, and according to current remarks of inventors, a prevalent idea seems to exist to the effect that it is detrimental to the inventor's interest to obtain foreign patents, because the duration of his domestic patent will be shortened. This inaccurate and misleading understanding of the law is employed as an argument in favor of the revision of the patent statute relating to the maximum and minimum terms of patents. The object of this article is not to argue concerning such a revision, but it may be stated that the writer is greatly in favor of revision, but would emphasize that misrepresentations of the present law will rather hinder than further revision. To say, in general, that a United States patent expires with the term of the patentee's foreign patent, is misleading, because it is true only in some instances. Such statements are made, and the conclusion arrived at by the ordinary inventor is such as to apparently convince him that foreign patents are very dangerous and had better be left alone.

It is probably impossible to compose one sentence which will convey the exact relations of the terms of patents, because of the multitude of variations or differences among the patent laws of the numerous countries in which inventions may be protected with profit. Classifications somewhat as follows will, it is thought, make the matter so plain that the ordinary inventor may easily use the same for reference, although he could not, probably, remember them very accurately from one reading. All important phases are set forth, because it is not enough to know simply the effect of foreign patents upon the term of the United States patent, but upon one another's terms. In order to be brief, the language is intended to be such as to convey concise and practical information to inventors, independently of historical developments, irrelevant conjectures as to future decisions, and other matters valuable only to the mere student and patent attorney.

In each list which follows, the countries are named alphabetically to facilitate reference.

The term 17 years of a United States patent is *not* shortened: —

By any simultaneous, or subsequent foreign patent;

Nor by a prior patent in Belgium, United States of Columbia, Liberia, or Spain, provided the foreign patent is not over three years old;

Nor by a prior caveat in Argentine Republic, British Guiana, British Honduras, Canada, Great Britain, Sandwich Islands, Leeward Islands, Queensland, Russia, South Australia, Switzerland, Tasmania, Trinidad, Victoria;

Nor by an application filed, within seven months of the United States application, in Belgium, France, Great Britain, Guatemala, Italy, Netherlands, Norway, Portugal, Servia, Spain, Sweden, Switzerland, and Tunis;

Nor by an application filed, within six months of the United States application, in Brazil or San Domingo.

The maximum amount of reduction of the term of a United States patent by a *prior* foreign patent is equal to the difference of the term of 17 years and that remaining term which the foreign patent has to run. The maximum terms of patents in foreign countries (leaving out those of longer term than 17 years) are: Argentine Republic, 15 years; Austria, 15 years; Barbadoes, 14 years; Brazil, 15 years; British Guiana, 14 years; British Honduras, 14 years; Canada, 15 years; Cape of Good Hope, 14 years; Ceylon, 14 years; Chili, 10 years; United States of Columbia, 10 years; Denmark, 5 years; Ecuador, 15 years; Fiji Islands, 14 years; Finland, 12 years; France. 15 years; Germany, 15 years; Great Britain, 14 years; Guatemala, 15 years; Sandwich Islands, 10 years; Hong Kong, 14 years; India, 14 years; Italy, 15 years; Jamaica, 14 years; Leeward Islands, 14 years; Luxumburg, 15 years; Mauritius, 14 years; Mexico, 10 years; Natal, 14 years; Newfoundland, 14 years; New South Wales, 14 years; New Zealand, 14 years; Norway, 15 years; Paraguay, 10 years; Peru, 10 years; Portugal, 15 years; Queensland, 14 years; Russia, 10 years; South Australia, 14 years; St. Helena, 14 years; Straits Settlements, 14 years; Sweden, 15 years; Switzerland, 15 years; Tasmania, 14 years; Trinidad, 14 years; Turkey, 14 years; Uruguay, 9 years; Venezuela, 15 years; Victoria, 14 years; West Australia, 14 years.

A valid patent is not obtainable in Ecuador, France, Germany, Leeward Islands, Luxumburg, Peru, Sandwich Islands, South Australia, Switzerland, Turkey, or Venezuela, after a prior patent has been issued in the United States, except in the case of France and Switzerland, under the condition that the application is filed within seven months after the United States application was filed.

A valid patent is obtainable, in Canada, if applied for within 1 year after issue of United States patent; in Italy, within 15 years; in Spain, within 2 years; in Argentine Republic, within 10 years; in Victoria, within 1 year; and in Western Australia, within 17 years.

In countries not named in the two paragraphs preceeding, valid patents are obtainable, as a general rule, if the inventions are not well known, or in use, within the territory of those countries.

From the foregoing facts, it is evident that, by planning the times of application, valid and useful protection may be obtained throughout the world without in any way shortening the full term in any country.

The point of law to be considered for revision, is the provision of a right of the American citizen to obtain a seventeen years' patent whether he has previously patented it abroad or not.

EDWARD P. THOMPSON.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The General Circulation of the Atmosphere.

THE question concerning the origin of the winds, or the general circulation of the atmosphere, has been a perplexing one for many years, and is not yet completely and fully settled. There are so many factors entering into the question, that its solution is difficult to comprehend off-hand. Instead of a broad, flat plane, upon which idea some conclusions seem to be based, we have a globe, and the atmosphere is a complete envelope thereof, having almost the same spheroidal shape as the earth, upon which it rests. This envelope is made to adhere to the surface of the earth by means of gravitation, but not so rigidly that it may not be set in motion by the application of heat. The earth revolves on its axis daily, and the air revolves with it, although it does not always travel at the same rate.

A body of air at rest for some time, or moving only with a very slow motion, will soon acquire the direction of motion of those parts of the earth with which it comes in contact. When such a

body of air moves to the north or south near the surface, it soon acquires an eastern or western component of motion; and if the same body of air returns as the upper strata, the eastern or western component of motion is reversed.

If the temperature of the entire body of atmosphere from pole to pole and from top to bottom, were the same, it is believed there would be no motion whatever of the air. Heat, therefore, or difference in the temperature, is the prime factor in the generation of air currents. It is maintained by some writers, however, that the rotation of the earth upon its axis, from the west to the east, would propagate a current of air, in the opposite direction, at or near the equator. But this has not been demonstrated to the satisfaction of all. So also it is believed that as aqueous vapor gives buoyancy to the air, this might produce some gentle breezes. As the sun is the source of all heat, we must look to that luminary as the producer of all winds and air currents. If the earth's surface were all water, or all land with a homogeneous topography, the air currents of the earth would remain almost constant and uniform. This continuity and uniformity are broken up and interfered with by the various divisions of continents, oceans, mountains, sandy plains, etc., and also by the variations of the temperature at the same locality at different periods in the year.

As the earth revolves upon its axis, one-half of its surface is always in the sunlight and the other half at the same time in darkness. The temperature of the former therefore is always higher than that of the latter; and the atmosphere tends to flow from the one to the other at the surface, and in the upper strata to flow in the opposite direction. This is in obedience to the known laws of dynamics: 1. That heated air will rise, and the vacuum which this tends to produce will be filled up by cold air flowing in at the bottom. 2. As gravity tends to keep the air in equilibrium, when a current of air is observed to be moving in any direction, either horizontally or perpendicularly, a like current will somewhere be found flowing in the opposite direction, to restore the equilibrium.

Let us liken the two hemispheres of air (one in the light and the other in the dark) to two great thin metallic cups or bowls, each enveloping one-half of the earth, their edges touching each other and coinciding with a great circle or meridian of longitude. Let them be pivoted at the poles, so that they may slide around the earth, one following the other. The one in the sunlight we will paint white, and the other black; and they follow each other as the earth revolves, the white being always turned towards the sun. Again, as the sun always shines perpendicularly to the earth's surface between the tropics, we find here a broad belt abnormally heated; and we will represent this heat on the white bowl by a broad band of bright red, and on the black bowl by a similar band of dark brown. Further, in examining the air along the edges of the two bowls, we find but little difference in the temperature of the two, the air growing colder as we recede from the edge towards the centre of the black, and warmer in the direction of the centre of the white bowl. We will therefore shade these edges, at first both nearly alike, but gliding into a dark gray, and then black towards one, and a light gray and then white towards the centre of the other. Still further, as the sun is annually perpendicular at each of the tropics, so the two poles will alternately be in light and shade — heat and cold. We must therefore give some slight shading to these parts of the bowls, to represent the different amounts of sun energy employed to heat the earth at these points.

We have now before us, therefore, most of the factors that enter into the production of air currents, or the circulation of the atmosphere. If the air could be seen with the naked eye, as we have here colored and shaded these two enveloping bowls, and if we could stand upon the moon or some inter-stellar planet and look upon the earth, what a grand and magnificent kaleidoscopic panorama would be presented to our view!

The theory of the general circulation of the atmosphere most generally accepted is shown in the following extract, taken from Buffon's "Natural History," which he quotes approvingly from Maclaren: "The unequal distribution of heat over the surface of the land and water necessarily disturbs the equilibrium of the atmosphere, and produces currents of air, or winds. These currents, however various, have been supposed to result from two general movements, pervading the whole mass of the atmosphere. The heavy and cold air of the temperate regions, having a tendency to displace the warm and rarified air of the torrid zone, generates a current in each atmosphere" (hemisphere?) "towards the equator. To replace the air abstracted from the higher latitudes, an upper and counter current flows back from the equator to the pole; and thus the atmosphere, while it performs a constant revolution, tempers the extremes of climate, by transporting the cold of the frigid zone to the equator, and carrying back the heat of the equator to the frigid zone." A writer on the article "Winds" in "Chambers's Encyclopædia" says: "When the part of the earth's surface which is heated is a whole zone, as in the case of the tropics, a surface wind will set in towards the heated tropical zone from both sides, and uniting will ascend, and, there separating, will flow as upper currents in opposite directions. Hence a surface current will flow from the higher latitudes towards the equator, and an upper current towards the poles." Professor William Ferrel, author of a "Popular Treatise on the Winds," published in 1889, practically adopts the above views. This is an elaborate work, containing about 500 pages, and is considered one of the best authorities on the subjects treated. In Chapter III., from page 89 to 162, he gives a detailed and graphic account of the "general circulation of the atmosphere." He frequently refers to the upper strata flowing "from the equator to the poles," and the surface currents flowing "from the poles to the equator," etc. On page 154 he gives a "graphic summary," as follows: "In the preceding part of this chapter it has been shown that if all parts of the atmosphere had the same temperature there would be a complete calm over all parts of the earth's surface. But that in consequence of the difference of temperature between the equatorial and polar regions of the globe, and the consequent temperature gradient, there arise pressure gradients and forces, which give rise to and maintain a vertical circulation of the atmosphere, with a motion of the air of the upper strata of the atmosphere from the equator towards the poles, and a counter current in the lower part from the poles toward the equator, as represented by the arrows in the following figure, and that this of course requires a gradual settling down of the air from the higher to the lower strata in the middle and higher latitudes, and the reverse in the lower latitudes. It has also been shown that, in case the earth had no rotation on its axis, this would be exclusively a vertical circulation in the planes of the meridians, without any east or west components of motion in any part; but that, in consequence of the deflecting forces arising from the earth's rotation, the atmosphere at the earth's surface has also an east component of motion in the middle and higher latitudes, and the reverse in the lower latitudes; and that the velocities of the east components increase with increase of elevation, so that, at great altitudes, they become very much greater than those at the earth's surface; while those of the west components decrease with increase of altitude up to a certain altitude, where they vanish and change signs and become east velocities, now increasing with increase of altitude to the top of the atmosphere."

Now the foregoing theory seems to me not to be sustained by the facts. It may seem presumptuous in a layman to question the conclusions of such great and confessed authorities; but if I am to follow what seems to me to be the truth, I must dissent. I have a profound admiration for the untiring labors and great researches of Professor Ferrel; he has placed the world under many obligations for his valuable suggestions; yet I fear he has fallen into the same error which has characterized the reasoning of all his predecessors. This is not strange or unexpected; for we all know that sometimes grave errors will for generations run through the writings of the most astute and learned men, undetected. Witness, for example, Lord Bacon's "Wisdom of the Ancients," where his "explanations" need explaining, and are more abstruse and muddled than the mythology of the Greeks and Romans. I do not know that what I may here offer as the true theory of the circulation of the atmosphere is new to the scientific world, as I have not kept full pace with all the new discoveries. I know, however, that it is not recognized by Professor

Ferrel, even by a reference; and if it had been proposed, before the publication of his book in 1889, I have full confidence that he would have known it, and either endorsed it or attempted to refute it. But no lover of truth should blindly follow any leader, however great; if his reasoning does not convince his understanding, he should mark out a course for himself, if that be to him the truth.

Any theory of the physical universe, or of any of its parts, which will account for the greatest number of known facts involved, will be most satisfactory and acceptable; and such theory will be held and entertained until another is discovered which will account for more, or all, of the facts.

Now any theory of the general circulation of the atmosphere may be accepted tentatively, as a true theory, which will fully explain and account for the following facts :—

1. The trade-winds of the tropics.
2. The belt of calms at the equator.
3. The ascent of the trades to the upper strata at the equator.
4. Their flow as upper strata toward the temperate latitudes.
5. The belt of calms near the 30th parallel of north latitude.
6. The high barometric pressure at this calm belt.
7. The prevailing south-west winds in the north temperate zone.
8. The source of supply of the trades.
9. The source of supply of the constant (or prevailing) south-west winds in the north temperate latitudes.
10. The limit of range of the return trades of the tropics and the same limit of the upper strata in the north temperate latitudes.
11. The calm belt about the 60th parallel of north latitude, if there be one, as alleged by some writers.
12. The location of a calm at the north pole, if there be one, as Professor Ferrel believes.

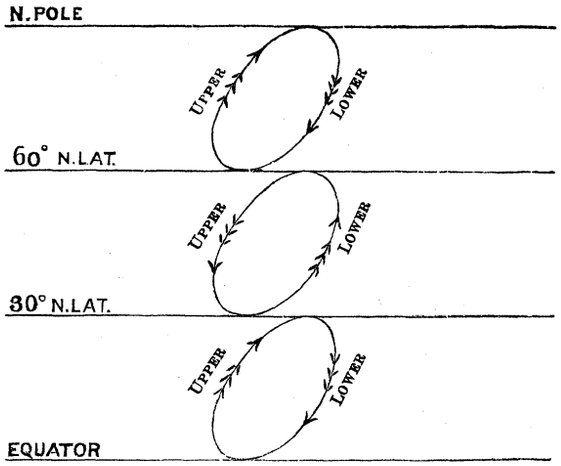
Now it will require but slight reasoning to prove that a body of air starting from the equator can never reach the pole. Take, for example, the amount of air included between any two meridians of longitude; at the equator, the distance between these lines is about or near 70 miles. This body of air, as a return trade or upper current, starts moving toward the north. Concede for a moment that the earth does not rotate upon its axis. This air in its northern flight cannot veer to the right or left beyond these lines, for there is always another body of air there on either side to prevent it. As the meridians continually approach each other, and at the pole unite, it will be readily seen that if the air should ever reach the pole under these circumstances, it must be squeezed into space where there is no space. The length of the equatorial line is about 25,000 miles. The air starts all along this line to move northward simultaneously; can it keep on converging, until the entire 25,000 miles of air shall be forced into a space represented by a dot? It is physically impossible. A million cubic miles of air cannot be compressed into a pint cup. Conversely, a cubic foot of air can cover the north pole; if this amount should endeavor to reach the equator, it must, when it arrives there, expand to the extent of 25,000 miles. The theory of Professor Ferrel — the interchange between the poles and the equator — requires that the air at the earth's surface in all northern latitudes should move southerly with a western component of motion, similar to the trades; but the fact is, as everyone knows, and as he himself admits, that in the north temperate zone the surface winds move northward with an eastern component of motion; that is, from the south-west. This motion is shown by the arrows in the figure on page 155 of his book, referred to in the above quotation. Furthermore, the arrows in the same figure indicate that he would have the motion of all surface winds except the trades at the tropics, and all the upper strata, without exception, towards the east, the surface winds moving north-east, and the upper strata moving nearly east, but a little north of east; and he endeavors to prove this to be true, by elaborate reasoning and mathematical formulæ, extending over many pages. But this easterly motion of nearly the entire atmosphere is directly opposed by another principle which he recognizes on page 117, where he says: "This principle was recognized by Hadley in his theory of the trade-winds, for he states that *all motions* in any direction must have their counter-motions, else the effect upon the earth's surface would be to change the earth's rotation upon its axis." If it be objected that this reasoning is intended only to apply to surface winds, it may be stated that Professor Ferrel, on pages 93 and 94, seems to recognize the broad principle that *all* motions must have their counter-motions, which he terms the "condition of continuity." It is difficult to conceive how it is possible that all the upper strata, from pole to pole, should move in one direction, and that direction east, and so rapidly as to get ahead of the motion of the earth in its rotation upon its axis. Where are the counter-currents to all these easterly winds? Nowhere, except the surface trade-winds within the tropics. What force, what energy is it that causes all the winds to flow in one direction, and at so rapid a rate? What is their source of supply? and what is their limit of range or destination? Since their motion, as alleged, is not directly east, but a little north and south, in the respective hemispheres, of an east and west parallel, will they not ultimately fly off from the earth at the poles? The western component of motion of the trades, he says, is balanced by the corresponding eastern component of the winds in the more northern latitudes, and there is kept up and maintained his "condition of continuity," so far. But as there are no counter-currents alleged to correspond to the easterly motion of all the upper strata, it seems that his "condition of continuity" is thus destroyed.

Now to follow the air in all its motions, let us begin at the beginning of motion; that is, at the point where the greatest amount of energy is expended to produce motion,— at the equator,— and follow it in its flight, if we can. Here, as everyone can readily understand, the air is heated and rarified by the sun's rays, and rises up to the higher altitudes. This necessitates the inflowing of colder air from the north and south to prevent a vacuum. When the sun's energy has raised the column of air to the limit in height, it will then separate in two parts, one flowing north and one south, because of the descent of the temperature gradients in those directions. These motions and these causes are recognized by all authorities (except those who attribute everything to electricity), and we thus readily account for the trade-winds, the belt of calms at the equator, — the meeting of the two trades destroying motion, — the ascent of the trades to the upper strata, and their flow towards the temperate latitudes. As the subsequent motions of the atmosphere are similar in the two hemispheres, let us confine our further pursuit to those of the northern. When the upper stratum begins moving northward, it has acquired the eastern motion of the earth near the equator, and soon coming over portions of the earth with slower motion, it will get ahead of the earth and veer to the north-east,— making the return trades,— the cause being the reverse of that which produced the south-west motion of the trade-winds. As the parallels of latitude grow shorter and the meridians of longitude approach each other as we go north from the equator, it is evident that this body of air will soon become confined into narrower limits than it had at the equator; and it will sometime and somewhere happen that it will become so heaped up and crowded that its northern motion will be retarded, and finally cease entirely. When this happens, it will find the line of least resistance down towards the surface, where it will go to keep up the supply of the trades, and will then return to the equator again. So it may be inferred that this body of air will thus continue to make its eternal round in this grand cycle, unless changed from its course by local causes, topography, unequal distribution of temperature, etc. Its most northern limit is believed to be about the parallel of 30°, and its heaping up and downpour will cause both a calm and a high barometric pressure at this parallel.

Turning our attention next to the atmosphere in the north temperate latitudes, we discover that the air to the north of the above-named calm belt has a north-east motion at the surface of the earth. This eastern component of motion is doubtless produced by the same causes that operated to give a north-east motion to the upper strata of the tropics. When this body of air has proceeded for some distance to the northward, it will also be confined by the shortening of the parallels of latitude and the nearer approach of the meridians of longitude; and, thus meeting with resistance in front, it seeks the line of least resistance in the upper

air, whither we follow it in an ascending current. It being perceived that its departure from the 30th parallel tended to produce a vacuum on that line, this current of air flows back again as upper strata in a south-west direction, obeying the same law which gives a western component of motion to the trades; when it reaches the parallel of 30° and then meets the other body from the equator, its further progress in that direction ceases, and it pours down to the surface and begins its circuit again. The northern limit of this motion is believed to be about the 60th parallel. So here we have another body of air, similar to that within the tropics, moving in a continuous circuit, but in opposite directions. For similar reasons, the atmosphere between latitude 60° and the pole will also move in a circuit between those points, only the direction of motion will be the reverse of that in the temperate zone. The coldest air in this northern zone being presumably at the pole, and therefore heaviest, will sink down to the surface and move southward with a western component, obeying the same laws heretofore given. When it reaches latitude 60°, it will meet the current from the south, rise to the upper strata, and flow back to the pole.

These several motions and the entire circulation in the northern hemisphere may be better understood by reference to the following figure: —



The arrows at the right hand show the direction of the surface flow, and those at the left indicate the direction of the upper strata, in the several zones.

It is to be understood, of course, that the foregoing theory is based upon the assumption of an earth with a homogeneous surface in both hemispheres; and that any variations from these results are due to differences of temperature, topography, etc. The existence of these three zones of air currents, with motions as here proposed, seems to furnish a full explanation of most of the facts known and observed up to date. That there is a belt of calms at the 30th parallel, and also a high barometer, seems to be so well established that no one can be found with the temerity to deny it. If there be an interchange of air between the poles and the equator, by a surface flow southward and upper strata flowing north, as proposed by Professor Ferrel and others, it seems impossible to explain the existence of this calm belt and high barometric pressure at parallel 30, or at any other place between the equator and the pole. The air flowing horizontally across any particular locality cannot produce a calm or a high pressure at that locality, whatever the velocity may be. A calm is produced by the meeting or parting of winds; a high pressure is produced by a down-pour, and a low pressure by an up-pour of the air.

So, also, the prevailing winds in the north temperate latitudes, from the south-west to the north-east, are so well established, that it is deemed no evidence is required here to prove their existence. Their direction and motion cannot be explained on Professor Ferrel's theory of a southward tendency of the air in that zone at the surface. A calm at the pole might be reasonably deducible from his theory; but one at the 60th parallel is impossible.

T. A. BEREMAN.

Mount Pleasant, Ia, May, 1892.

Four-Fold Space.

IN the May 13 number of *Science*, I find a very interesting discussion of "The Possibility of a Realization of Four Fold Space," being a digest of a paper by Dr. T. Proctor Hall. As I have not had the pleasure of reading Dr. Hall's paper, and as I have not read any fourth-dimensional literature for quite a while, what I am about to say may be old. If not, and you find it worthy of publication, you may use it.

All modern thinkers about the Kantian philosophy of the fourth dimension of space, have, I suppose, dipped more or less into Professor Zöllner's Transcendental Physics. It looks as if Dr. Hall had done so, as his discussion of the knotted-string question and the "plane being" as distinguished from an ordinary three-dimensional mortal, is quite similar to certain illustrations used by Professor Zöllner.

I think Dr. Hall's idea of trying to get a clear concept of fourth-dimensional space, by initial projections from three-dimensional space, and then modifying those projections as best we can, is very ingenious, and may become a very useful factor in the study of the possibilities of four-dimensional space and four-dimensional beings; and I think he is entitled to great credit for his clear and effective start made in that direction.

I have only one criticism to make about it, which is that such a process would be exceedingly slow, as slow as the building up of the science of mathematics, or chemistry, or any other science which had to start with wholly unknown premises. I do not think that the study of four-fold space absolutely requires treatment of this elementary character. This opinion is based upon the following thoughts and inferences, which I have from time to time drawn with regard to this fourth dimension, and made use of in private conversation with regard thereto.

The so-called universe of matter, as has been repeatedly said, is known to us only because there is an unknown x (whether force or substance we cannot tell), which successfully resists our attempts to penetrate it, whether the attempt be made by the sight, the touch, or such power of projectile force as we think we have succeeded in bringing under our control. Outside of this resistance there is absolutely nothing but inference, an inference which some philosophers regard as amounting to conviction, and others, not.

When we say a block of granite is impervious or impenetrable, we simply announce an inference mentally drawn from impressions received by our various organs; and the point which I am now raising is simply this: that the same impressions might be received, and hence the same inference drawn, under a totally different state of affairs, provided we assume — and we have no reason for not assuming — that our standards, such as a foot of twelve inches, an inch of three barley-corns, etc., are simply relative, and compared with the infinite universe mean absolutely nothing, in other words, are not standards at all. Not to make this too long, but to illustrate hurriedly where I have thought, for some years, a starting point for the practical demonstration of four-dimensional space may be found, let me use an illustration.

Let us call our granite block a ten-foot cube. Standing in front of it we can only see one side; at a certain angle we can see two sides. From an elevated point we can see two sides and the top; but we can never see, except by the aid of reflectors, more than three of the six sides at once. We can easily walk around and under it, and see the other sides. In other words, and this is the key of the whole situation, we can see the whole of the cube successively but never simultaneously; and this applies to the inside as well as the outside. If this granite block were magnified so that each dimension was a thousand times what we have assumed it to be, it might be a very porous and loosely-jointed structure; yet if our eye were placed with increased faculties at a proper distance, the phenomenon presented to that eye would be exactly that which now shines forth in the ten-foot block of granite, and our inference as to its size and structure would be identical with our first assumption.

As we have no difficulty in believing that, owing to the revolution of the earth combined with its motion around the sun, we have been carried many miles through space in the fraction of a second which elapses, as we think, between dropping a coin and