increase, and, with the increase, diversity of industry and knowledge. To what length it will ultimately by carried, no one can, at present, predict. That its effect upon the profession of journalism is altogether salutary appears almost self-evident to us. It gives us men who concentrate their abilities upon the study and discussion of few subjects, instead of dispersing them over wide and unlimited regions of thought, and consequently gives strength and comprehensiveness to their productions.

AMERICAN AERONAUTICS---A FLYING SHIP TO BE BUILT.

Our transatlantic friends have done a good deal of talking and writing, and not a little inventing, upon and in the art of navigating the air. From giant projects down to engines of the minutest size and minimum weight, with maximum power in proportion to weight, they have filled the air with the fame of their devices, if not with the devices themselves.

Our trans-continental inventors on the contrary, have made little noise in the world; but if we are to credit statements coming from sources apparently entitled to credence, they are outstripping the rest of the world in this field.

Our readers will recollect the engraving of the aero-steamship *Avitor*, published in a recent number, with an account of a trial, the results of which as stated were not very encouraging. It now appears that the want of complete success in the experiments was, if we may credit our informant, attributable more to causes entirely disconnected from the machine, than the apparatus itself.

A meeting of the shareholders of the Aerial Steam Navigation Company was held on the 17th ultimo at San Francisco, and the Secretary's report read on that occasion details the following particulars.

An experiment made with the *Avitor* had resulted in a triumphant demonstration of the capability of the machine to move against the wind, to ascend or descend, and to be guided to any desired course. To use his own words, "enough has been demonstrated to convince the most skeptical, as well as to confirm the theory of the most scientific, that a machine has been constructed capable of moving through the air by its own power; capable of moving in any direction according to the will of the engineer; capable also of moving against the wind; nay, more, by its system of planes utilizing the adverse winds for the purpose of elevation and progress. This was not all. The committee judged it for the best to remove the model *Avitor* to the then unoccupied Mechanics' Pavilion, which was accordingly done, at considerable expense and risk. Thousands visited it there, and all expressed themselves satisfied that aerial navigation was an established fact. Nevertheless, there were great difficulties to contend with. The numberless gas fixtures in the hall were obstructions to continuous flight, and absolute impediments to the machine soaring to the roof. Still, the easy, graceful, calm power of motion through space was eminently exemplified in this, the first *Avitor*, that fulfilled all the requisitions for aerial flight, viz., sustaining power—propelling power—guiding power. The first was obtained by a spindle cylindroid filled with hydrogen gas, and by a system of planes, which, by their impingement on the air, materially aided the elevation of the machine when in motion; for whereas, when the model was at rest it barely maintained its equilibrium in the atmosphere, the moment it was in motion, and consequently atmospheric resistance obtained, the machine rose, more especially if the breeze were adverse, as was shown on that morning when it traversed the Shell-mound race track."

Naturally the public is skeptical of the truth of such statements as are here put forth, a skepticism which we not only think excusable, but in which we cannot help sharing. Not that we are wholly skeptical as to ultimate success in this field, but the thing has been so often to be done, and yet not done, that we are naturally shy of any sweeping announcements of success, fearing that they may prove premature. While, however, we may well be pardoned for entertaining some doubts, we must say that the action of the shareholders shows that their faith in the success of the invention is rather confirmed than weakened.

The construction committee having advertised for drawings and specifications, for a machine one hundred and fifty feet long with a carrying power of two thousand five hundred pounds—the steam engine and boiler being already constructed and in possession of the company—have accepted those prepared by Messrs. Miller & Haley, who offer to construct the machine for three thousand dollars in gold. This bid has been accepted, and a committee appointed to raise the necessary funds.

The general opinion prevailed at this meeting that the new *Avitor* would prove a triumphant success, and our readers will doubtless join us in cordial good wishes to the enterprise.

There is perhaps no mechanical problem of modern times more absorbingly interesting than that of self propelling air vessels, the solution of which has hitherto bid defiance to mechanical skill; and that the nineteenth century should add still another to its many glorious triumphs, is a consummation all must greatly desire. Success, say we, to "*The Avitor*."

PUMPING DOWN BUILDINGS.

A little recognized, but without doubt a serious cause of danger to heavy and massive structures, is the disturbance of deep water-bearing strata of earth underlying them. The moment a free outlet for the water in such strata is opened, the movement of the water commences to make inroads upon the material of the stratum through which it flows, the results of which will be speedy or slow in their manifestation, according to the peculiar character of the stratum itself.

If the water-bearing stratum be quicksand or of a character approximating thereto, the shifting of the material may be so rapid as to undermine and render unsafe any superimposed heavy structure in a short space of time.

This fact has been illustrated quite recently in a striking manner. The Metropolitan Railway Company in London, having tapped a layer of water-bearing earth extending under the dining hall of King's College have pumped down that building, and have, it is said, brought out of perpendicular to the extent of three inches, the river front of the large structure known as Somerset House. It is feared that unless proper precautions are taken, the safety of several other important structures, including St. Paul's church may be endangered by the operations of this company.

So far as we are aware nothing is determined in regard to the effect of tappings remote from large buildings upon the stability of such buildings; but it seems probable that in course of time a stratum of loose material might shift sufficiently to cause settling in an edifice situated so far from the outlet as to be supposed beyond the influence of any such movements. The subject is one of such interest and importance that more light upon it is desirable.

SILVERING MIRRORS.

The process of coating glass with an amalgam of quicksilver and tin is interesting. Notwithstanding many attempts have been made to secure an easier and less expensive process for converting plates of glass into mirrors, it still remains the principal method by which this important object is attained.

To understand this process it is necessary to understand somewhat of the nature of an amalgam.

When metals are reduced to a liquid state, they will, by their solvent power, often reduce other metals to that condition, although the fusing temperatures of the latter may be many degrees higher than that of the metal which dissolves them. In such cases the dissolved metals mingle intimately with the solvent metals, and in many instances form definite chemical combinations. Such mixtures or combinations are called alloys, but the special term amalgam has been applied to the alloy of mercury with another metal.

Mercury being liquid at common temperatures forms amalgams with a number of metals without the aid of heat, but its most important amalgams are those of tin, gold, and silver. The amalgams of gold and silver are important, as by their formation these metals are readily separated from certain kinds of ores.

The amalgam of mercury and tin is readily formed by dissolving tin in mercury, and this amalgam adheres with considerable force to glass when properly applied.

The process is as follows: The size of the glass being known, a sheet of tinfoil somewhat larger than the glass is spread upon the silvering table. This table is a slab of stone with as perfect a plane surface as can be made by mechanical means. When the tin foil has been sufficiently smoothed, it is brushed over with quicksilver until its surface is uniformly covered. Quicksilver is then added in larger quantity until the fluid metal lies upon the foil to a depth of from two to three twelfths of an inch.

The plate of glass is now gently and slowly slid, its longest side foremost, on to the foil, care being taken that its edge dips beneath the surface of the quicksilver so that no air may be retained between the latter and the plate.

The glass being thus slid upon the quicksilver floats upon it, and the excess of the latter is now squeezed out by the application of pressure to the glass. This is done by placing heavy weights upon the plate; and the table being now inclined, so that the quicksilver flows to one side, the latter is received in a trough provided for that purpose.

Notwithstanding the process is simple enough in its general principles, it requires much skill to successfully silver very large plates, and there are many things connected with it which it would be very desirable to avoid.

Hence many processes for silvering have been devised. Of these, we believe Drayton's has been the most successful, but it has not superseded the use of quicksilver. Mr. Drayton's method consists in depositing a film of pure silver upon the glass, the silver being reduced from a mixture of nitrate of silver, ammonia, and oil of cassia.

CORRELATION OF VITAL AND PHYSICAL FORCES.

ABSTRACT OF A LECTURE DELIVERED BY PROF. G. F. BARKER, BEFORE THE AMERICAN INSTITUTE, DEC. 31, 1869.

The third of the series of lectures now in progress at the above institution, was delivered by Professor Barker, of Yale College, and was one of deep interest. The lecture was illustrated by experiments, and was listened to with marked attention throughout. It is impossible to do justice to this able lecture in an abstract, but we find ourselves unable to spare space for anything more than this.

After an eloquent introduction reviewing ancient and modern opinions on the subject of life, Prof. Barker proceeded to discuss the evidences of vital and physical correlation. The word force had been employed to signify three things: In the first place, it is used to express the cause of motion, as when we speak of the force of gunpowder; it is also used to indicate motion itself, as when we refer to the force of a moving cannon ball; and lastly, it is employed to express the effect of motion, as when we speak of the blow which the moving body gives. Because of this confusion, it has been found convenient to adopt Rankine's suggestion, and to substitute the word energy therefor. And precisely as all force upon the earth's surface—using the term force in its widest sense—may be divided into attraction and motion, so all energy is divided into potential and actual energy, synonymous with those terms. It is the chemical attraction of the atoms, or their potential energy, which makes gunpowder so powerful; it is the attraction or potential energy of gravitation which gives the power to a raised weight. If now, the impediments be removed, the power just now latent becomes active, attraction is converted into motion, potential into actual energy, and the desired effect is accomplished. The energy of gunpowder or of a raised weight is potential, is capable of acting; that of exploding gunpowder or of a falling weight is actual energy or motion. By applying a match to the gun powder, by cutting the string which sustains the weight, we convert potential into actual energy. By potential energy, therefore, is meant attraction; and by actual energy, motion. It is in the latter sense that we shall use the word force in this lecture; and we shall speak of the forces of heat, light, electricity, and mechanical motion, and of the attractions of gravitation, cohesion, chemism.

From what has now been said, it is obvious that when we speak of the forces of heat, light, electricity, or motion, we mean simply the different modes of motion called by these names. And when we say that they are correlated to each other, we mean simply that the mode of motion called heat, light, or electricity, is convertible into any of the others, at pleasure. Correlation therefore implies convertibility, and mutual interdependence and relationship.

Having now defined the use of the term force, and shown that forces are correlated, which are convertible and mutually dependent, we go on to study the evidences of such correlation among the motions of inorganic nature usually called physical forces; and to ask what proof science can furnish us that mechanical motion, heat, light, and electricity, are thus mutually convertible. As we have already hinted, the time was when these forces were believed to be various kinds of imponderable matter, and chemists and physicists talked of the union of iron with caloric as they talked of its union with sulphur, regarding the caloric as much a distinct and inconvertible entity as the iron and sulphur themselves. Gradually, however, the idea of the indestructibility of matter extended itself to force. As it was believed that no material particle could ever be lost, so, it was argued, no portion of the force existing in nature can disappear. Hence arose the idea of the indestructibility of force. But, of course, it was quite impossible to stop here. If force cannot be lost, the question at once arises, what becomes of it when it passes beyond our recognition? This question led to experiment, and out of experiment came the great fact of force-correlation; a fact which distinguished authority has pronounced the most important discovery of the present century. These experiments distinctly proved that when any one of these forces disappeared another took its place; that when motion was arrested, for example, heat, light, or electricity was developed In short, that these forces were so intimately related or correlated—to use the word then proposed by Mr. Grove—that when one of them vanished, it did so only to reappear in terms of another. But one step more was necessary to complete this magnificent theory. What can produce motion but motion itself? Into what can motion be converted but motion? May not these forces, thus mutually convertible, be simply different modes of motion of the molecules of matter, precisely as mechanical motion is a motion of its mass? Thus was born the dynamic theory of force, first brought out in any completeness by Mr. Grove, in 1842, in a lecture on the Correlation of Force, delivered at the London Institution. In that lecture he said: "Light, heat, electricity, magnetism, motion, are all convertible material affections. Assuming either as the cause, one of the others will be the effect. Thus heat may be said to produce electricity, electricity to produce heat; magnetism to produce electricity, electricity magnetism; and so of the rest."

A few simple experiments will help us to fix in our minds the great fact of the convertibility of force. Starting with actual visible motion, correlation requires that when it disappears as motion, it should reappear as heat, light, or electricity. If the moving body be elastic like this rubber ball, then its motion is not destroyed when it strikes, but is only changed in direction. But if it be non-elastic, like this ball of lead, then it does not rebound; its motion is converted into heat. The motion of this sledge hammer, for example, which if received upon this anvil would be simply changed in direction, if allowed to fall upon this bar of lead, is converted into heat; the evidence of which is that a piece of phosphorus placed upon the lead is at once inflamed. So too, if motion be arrested by the cushion of air in this cylinder, the heat evolved fires the tinder carried in the plunger. But it is not necessary that the arrest of motion should be sudden; it may be gradual as in the case of friction. If this cylinder containing water or alcohol be caused to revolve rapidly between the two sides of this wooden rubber, the heat due to the arrested motion will raise the temperature of the liquid to the boiling point, and the cork will be expelled. But motion may also be converted into electricity. Indeed electricity is always the result of friction between heterogeneous particles. When this piece of hard rubber, for example, is rubbed with the fur of a cat, it is at once electrified; and now if it be caused to communicate a portion of its charge to this glass plate, to which at the same time we add the mechanical motion of rotation, the strong sparks produced give evidence of the conversion.

So, too, taking heat as the initial force, motion, light, electricity may be produced. In every steam engine the steam which leaves the cylinder is cooler than that which entered it, and cooler by exactly the amount of work done. The motion of the piston's mass is precisely that lost by the steam molecules which batter against it. The conversion of heat into electricity, too, is also easily effected. When the junction