

should tend to take away the hope of almost fabulous wealth would remove this provocation to enthusiasm, and this form of human effort would become a thing of the past. This consideration should make an end of the various plans for limiting the rewards of invention; nothing but the millions that await the one triumphant inventor will lead the rest of the ten thousand to take the chances of failure that must await them. It would be infinitely better for society to let the fortune of the Rothschilds reward the success of some genius who should deserve it by an invention that laid every man under contribution than to take the inevitable reduction of the advance in the subjugation of the world to our needs which the destruction of the inventive spirit would entail. Any scheme that threatens to lower the value of the rewards of any form of intellectual life is directed against the dearest interests of society. In all the accustomed pursuits of intellect this would be readily acknowledged. No reasonable man would for a moment think of suggesting that the most eminent men at the bar, or the great physicians, or the successful clergymen, should be fined for their success to reward the mediocrities of other occupations, nor are there many who would think that the honors, wealth, and fame showered on a great general were bad investments for a State; it may not need a savior once in a thousand years, yet such monumental prizes as those won by Wellington or Marlborough are in a certain way schools of greatness, breeding in their time other Wellesleys and Churchills. We must come to recognize invention in all of its forms as a distinct class of human endeavor, one that cannot be spared from the standard labors of the world, entitled to its rewards, not only of honor, but of more substantial goods. We must see that whatever threatens to limit these in the case of inventors threatens the interests of society at least as much as if directed against the rewards of skill in medicine or statecraft.

With the proposition clearly before us that the advance of a community in the ways that lead to wealth is determined by the extent to which the inventive faculty is exercised among its people, the question arises, What can be done to extend its development through the institutions of an educational, a social, or a legislative nature? It is easier to suggest the need than it is to provide for its supply. The education of the elements of the imagination and judgment that is required in all inventive labor can only be secured by the practice of work requiring the activity of these qualities. Our schools are wanting in any extended system to supply these needs. Something can be done by giving young men the especial training in laboratory work which experience proves to be an admirable means of developing those powers; but, as our educational institutions now exist, it is idle to suppose that a large enough part of our population can make the advance in experimental science that would be required in order to have them profit by the training it can give. It seems that we must trust to the training that the shops themselves may give, aided by the stimulus of great prizes procurable by those who attain to excellence in their special pursuits; with a fortune awaiting his success in solving some small problem of improvement in the machines of his daily craft, with access to certain teaching as to the principles of machines in books or in schools of mechanic arts, we may trust the naturally gifted operative to find his way to his training—a training by no means perfect, but in a way suited to his needs. As far as we can give the foundation for an understanding of the elements of physics, dynamics, etc., in our intermediate and higher schools, it will be well; but we must trust to the training at the work itself, plus the stimulus of the prize, for most of the results we seek to obtain.

Fortunately there exists for us a practical experiment as to the relative value of training, and of the prize of large monetary gain in stimulating inventiveness. The republic of Switzerland, with the seemingly sagacious consideration that they might profit by using the inventions of their neighbors without paying an equivalent therefor, long ago resolved that they would grant no patents within its territory. It appeared at first a profitable piece of sharp dealing to reserve the power of using all inventions for which others were taxed quite without payment therefor. Yet despite the remarkably advantageous position of Switzerland, the natural vigor and capacity of her people, and their admirable system of public education, there have been disadvantages connected with this plundering system that give us another proof that, in the long run, honesty is the best policy. All the while that Switzerland has been trusting to outside training for every invention she has applied in her manufactories, she has failed to train her own people in inventiveness; the result is, that Switzerland, of all civilized countries, is the most backward in the adaptation of every skilful appliance in every part of her economic life. One of the results gives a most surprising evidence of the preponderance

of training over all the other advantages of the world. Despite Switzerland's cheap labor, low taxes, low interest, and central position, Americans, carrying their burden of debt, costly labor, high taxes, dear money, and remote position, are surpassing them in arts which have been their own for centuries. American watches, as good as their best, are sold at their doors for less money than they can make them. Our well-developed mechanical imagination has so organized the labor and the machines used in this branch of manufacture, that the advantages derived therefrom outbalance the vast advantages of the Swiss labor. Our labor is double or more, our taxes double or more, our interest about double that of Switzerland, we have no traditional skill, nevertheless inventiveness conquers them all. Yet the inventiveness used in this work is but a very small part of our vast store of the priceless product of imaginative labor that has been created for us by our patent system. It is a work of generations to create such a training. It is questionable whether a State originating it at so late a date as Switzerland will have to do can ever overtake a country like this, where there is nearly a century of the stimulus in the blood of the people.

The experience of Switzerland shows plainly that it is not the untaxed use of the inventions that give the means of doing the difficult things in manufacture that is the great point gained by a system of patent law, for that country has had access to all such inventions at an even cheaper rate than other countries; it is rather the training that comes from the continued work of devising, the habit of meeting difficulties as they arise, the habit of never being content with the existing condition of any work while betterment is possible.

Again, it is argued that inventors are naturally impelled to do their work, and would do it all the same, whether they were paid or not; but paying for their labor is like paying for gravitation or air or a running stream. There is no doubt that the impulse to invention is in many cases innate; so is the impulse to the law, or to the practice of medicine or trade. But we don't make lawyers' or doctors' fees uncollectable, because we find that people rather like to give gratuitous counsel or physics to their neighbors, as we should if we really believed that the work we want them to do would be done as well without pay. It will be well, moreover, for these speculative minds to consider what an invention means; it means the turning of the ways of men from old channels to new, always a difficult task. Few inventions of value can be put into the complicated framework of society without years of devoted toil and vast sums of money. Take a new invention that will revolutionize trade; grant that, when introduced, it will save, say, five million days' labor each year to this country. It will then have to overcome the inertia of a vast machinery, and the opposition of a great population, who are monetarily troubled by it. Experience shows that it will require from ten thousand to half a million dollars to give this seed a chance to take root and show its nature. Where are the philanthropists who will give their time and money to this work, if their pay is to be made in fine words? Or what system of governmental aid is to determine the machines or processes that are to be tried at the public cost? The very energy of the advance of our modern civilization adds to the difficulty of introducing new features into its mechanism of thought or action. Now and then there are men of Archimedean genius, who bring such power to their work that they may succeed in making considerable revolutions by mere force of genius. Count Rumford and Benjamin Franklin, among our own countrymen, and near our own time, have shown a power to push novelties into general use, but both had the fame and place of political success to back their projects. Moreover, modern inventions are generally of a complicated nature, and demand far more continued labor in their projection and introduction than those of Franklin or Rumford. We have passed by the simple stage of our discoveries, when important changes can be made by the sporadic energy of great intellects finding their customary avocations in other fields. Men must now give their lives to the work of inventing, in case they are to attain any eminent success whatever, and their lives must be able and devoted, and as a condition thereto, must be well paid. When some other practicable means of payment is suggested, it will be full time for us to abandon the present system, which, with all its defects, certainly gives the necessary stimulus to insure the activity of the inventive faculties of our people.

It has been furthermore suggested that the ordinary stimulus of competition in trade would, of itself, lead to the employment of inventive mechanics on the part of great manufacturers, in order to get an advantage over their competitors. The experience of Switzerland should be a sufficient answer to this unlikely objection. Manufacturers there have not been found to do any

such thing, although pressed thereto by great needs, and supplied with every element of liberal-mindedness and ambition. Men are never willing to make roads for others to travel; it has not been found that men built railways for the pure enterprise of the thing, and it is ridiculous to talk of manufacturers building costly ways to new methods, when others could traverse them without cost.

In case the present patent system were abolished, there would doubtless be a vigorous method made to utilize the profits which are to be made from certain sorts of inventions around which a net of secrecy can be drawn. We would have again the mediæval system of men surrounding their processes with mystery, which was often made eternal by their death. But many inventions—such as the Westinghouse air-brake, for instance—must be operated in the open day, if used at all, and for these there would be no means of protection.

Driven from his last position, our advocate of the new method of getting something for nothing out of men's brains will perhaps say, How is it that scientific men are doing such wonderful things? They do not patent them, but make their works solely for the love of us their greedy fellow-men. Here, too, the reckoning is made without the host. Scientific men are paid, and in their way pretty well paid for their work, although the pay is not in money; besides their subsistence, there is the prize of reputation and of station in their class, which will spur men to any labors. But, unhappily, the bettering of some economic engine does not draw any of these prizes. If our friends will engage to secure the organization of a society where the invention of the little devices that grow into great machines will secure the prizes won by Faraday and his peers, there will be a chance of dispensing with the money profit of inventions as a means of securing their production. But though we may imagine conditions of society where the invention of the thousand and one things that make up the whole of great machines should be rewarded by laurels, our present world pays them with money rather than praise, and is certain to pay in no rarer thing for a great while to come.

Brontidi, Mistpoeffers, or Barisal Guns

By Charles Fitzhugh Talman

THERE are two phenomena of nature, both mysterious and unexplained, the reality of which, though sometimes doubted, seems to be attested by the fact that in each case we find the same facts reported from widely scattered communities under a great variety of independently-formed names. One of these is the will-o'-the-wisp, which bears at least twoscore names in the English language alone, and probably as many in German. The diversity of nomenclature is evidence of independent observation of the phenomenon in question; for if any given community had merely borrowed its ideas on the subject from its neighbors, it would have borrowed the name as well.

The name *brontidi*¹ (i. e., "like thunder") was coined in 1904 by Prof. Tito Alippi in order to facilitate the discussion of a phenomenon known under a bewildering variety of local names in various parts of Italy—*marina*, *bomba*, *rombo*, *boato*, *bonnito*, *muggio*, *baturlio*, *tromba*, *rufa*, etc. Forty of these names are enumerated in one of Alippi's memoirs, and he has furnished several additions to the list in subsequent publications. Brontidi are usually described as detonations resembling distant and muffled discharges of cannon or peals of thunder, sometimes heard singly and sometimes in groups. They occur chiefly in warm and settled weather, when the air is calm and the sky clear. Their distribution over the Italian peninsula has been carefully studied and mapped; it appears that while they are common in some localities, they are quite unknown in others not far distant. The peasantry have various explanations for them—natural and supernatural—but the unanimous opinion, which has been fully confirmed by scientific investigation, excludes the possibility that they are due to any human agency or to thunder. The most curious feature of the phenomenon is that the detonation always appears to come from a distant source.

The same phenomenon is well known on the coast of Belgium under the name of *mistpoeffers* (i. e., "fog-belchings," "fog-hiccups"); also as *zeepoeffers*, *mistbommen*, *paper-bags*, *rots de mer*, *bombes de mer*, *canon de mer*, etc. Here they were made the subject of painstaking investigations by E. van den Broeck, beginning about 1890, and it was found that they occurred not only on the coast but in the interior of Belgium and adjacent countries.

¹ This seems likely to become the international name of the phenomenon, either with or without modifications in termination to adapt it to the various languages. It was Anglicized to "brontides" by a writer in *Nature*, November 30th 1911, p. 154. It would also become "brontides" in French, "Brontiden" in German, etc.

Phenomena of this class were, however, first systematically studied in India. At a meeting of the Asiatic Society of Bengal in May, 1867, Babu Gaurdas Bysack called attention to the mysterious sounds, resembling distant cannonading, frequently heard throughout the Ganges delta. His remarks called forth numerous communications, published in the newspapers and scientific journals of India, showing that these detonations were familiar in many localities. From the circumstance that the phenomenon is observed with great frequency and intensity in the neighborhood of Barisal—a town on a delta-island of the Ganges, about 120 miles from Calcutta—we have the name "Barisal guns," under which these mysterious sounds were made known to European science at a meeting of the British Association in 1890. Numerous observations of the phenomenon had been collected the preceding year by a special committee of the Asiatic Society of Bengal. The report of the committee discussed various suggested explanations, without coming to any conclusion.

Thus, systematic investigations of brontidi (to adopt Alippi's non-committal name of the phenomenon) have been made in three widely scattered countries—Italy, Belgium, and India. Recently a similar undertaking has been carried out by Dr. J. D. Cleland in Australia, where the phenomenon has been known for years under the name of "the desert sound." The publication of these studies has had two results; first, it has led to a search of earlier literature for references to similar phenomena, and it is found that these are rather numerous; and second, it has called forth reports of the contemporary occurrence of brontidi in many other parts of the world.

Thus, Van den Broeck quotes a reference in the works of Lord Bacon to "an extraordinary noise in the sky when there is no thunder." Similar phenomena are mentioned by Humboldt and Boussingault. In some of the early reports the detonations are described as occurring in connection with earthquakes, but also when there were no sensible shocks of this character. Unmistakably subterranean noises, with or without earthquakes, should perhaps not be included in the same category with brontidi, the source of which—whether in earth or air—is not obvious to the senses. Such noises are mentioned by Aristotle and Pliny, and a remarkable case is reported in Humboldt's "Cosmos," as having occurred in Mexico in 1784; for a whole month the town of Guanajuato was kept in terror by a succession of subterranean *bramidos* ("roarings"), unaccompanied by any trace of an earthquake. A typical occurrence of brontidi is recorded in Capt. Sturt's "Two Expeditions into the Interior of Southern Australia" (2d. ed., 1834, vol. I, p. 98) as follows:

"About 3 P. M. on the 7th (i. e., February 7th, 1829) Mr. Hume and I were occupied tracing the chart upon the ground. The day had been remarkably fine, not a cloud was there in the heavens, nor a breath of air to be felt. On a sudden we heard what seemed to be the report of a gun fired at the distance of between five and six miles. It was not the hollow sound of an earthly explosion, or the sharp cracking noise of falling timber, but in every way resembled a discharge of a heavy piece of ordnance. On this all were agreed, but no one was certain whence the sound proceeded. Both Mr. Hume and myself had been too attentive to our occupation to form satisfactory opinion, but we thought it came from the northwest. I sent one of the men immediately up a tree, but he could observe nothing unusual. The country around him appeared to be equally flat on all sides, and to be thickly wooded. Whatever occasioned the report, it made a strong impression on all of us; and to this day the singularity of such a sound in such a situation is a matter of mystery to me."

Nowadays every year brings fresh reports of the occurrence of brontidi in widely scattered parts of the world. On the shores of Lough Neagh, in Ireland, mysterious sounds as of gunshots, generally heard in fine weather, have long been known as "water-guns." According to Prof. Scherer, of the College St. Martial, Port au Prince, brontidi have been frequently heard in Haiti, where the phenomenon is known as "gouffre." From time to time similar phenomena have been reported in the United States. It is said that they occur at Moodus, Conn., where they are known as "Moodus noises."

In its issue of October 19th, 1907, the SCIENTIFIC AMERICAN published a brief notice of one of Prof. Alippi's memoirs on brontidi. A result of this notice was that the Italian savant received an interesting letter from a correspondent in California reporting the frequent occurrence of brontidi in his neighborhood, viz., in Marin, Sonoma and Mendocino counties, apparently along a fault-line extending inward from the coast. This writer, Mr. George Madeira, also published an article on the subject in the Santa Rosa Republican, in which he states that brontidi are often heard during the warm summer months in the middle and west coast mountains of the State; also sometimes on winter nights. He goes on to say that "a tremendous explosion, presumably in the air, occurred in September, 1896, near Cazadero, heard by

the dwellers of the mountain region over an area of 900 square miles."

Although so great a number of observations of brontidi have been reported, it is reasonably certain that the unreported cases are far more numerous. Probably as a rule a person who hears one of these detonations pays little attention to it, assuming that it is actually what it appears to be, viz., the report of a distant cannon, an explosion of dynamite in blasting operations, a peal of thunder, or whatnot. It is only when the phenomenon occurs in a place remote from human habitation, and when the observer takes note of the fact that the meteorological conditions make the proximity of a thunderstorm extremely improbable, that the noise compels attention as something out of the ordinary—assuming that the observer has no knowledge of brontidi, as such. On the other hand, persons who make regular observations of brontidi for the benefit of science probably often record other sounds under this designation. Thus it has been noticed that the keepers of lighthouses and lightships on the North Sea coast, who keep records of brontidi for the meteorological service of Belgium, report these phenomena much less frequently on Saturdays and Sundays than on other days of the week; a fact that seems to indicate that many of the supposed brontidi of that region are due to human agencies.

Occasional cases of malobservation, however, do not affect the problem as a whole. Evidence of the existence of brontidi as a phenomenon of nature is overwhelming, and the explanation of these curious noises is an inviting task for the scientific man.

Many suggested explanations that seemed more or less plausible when the problem was viewed as a local one—as in the early discussions of Barisal guns—are invalidated by the wide range of physical conditions under which the phenomenon is now known to occur, and need not be enumerated here. The trend of recent opinion is toward looking upon the source of brontidi as subterranean in most cases, though perhaps not in all. Movements within the crust of the earth must frequently set up vibrations of such an amplitude as to affect the ear, when communicated to the overlying atmosphere; and as rocks are generally excellent conductors of sound (i. e., of vibrations within the range of audibility) the effects may be transmitted to great distances from their source. Assuming the focus to be far below the surface, the air would be set in vibration over a wide area, giving the indefiniteness as to the direction of the sound that is commonly noted. Prof. W. H. Hobbs, who has made a painstaking study of the seismic geology of Italy, concludes that the brontidi of that country are due to the slow settlement of orographic blocks, and the consequent production of vibration within their marginal zone. Utilizing the reports collected by Alippi, he shows that the places where brontidi occur are also places that are subject to frequent earthquakes; they are arranged in lines which he identifies with seismotectonic lines, and they follow geological contacts and other earth lineaments. In other words, they are fault lines of structure lines of the earth, whose presence is revealed by earthquakes and also by brontidi. He has called attention to the great importance of studying these phenomena with the aid of microphones, in order to locate the lines more accurately, as a contribution to the seismological survey of the country. According to this writer there is no sharp distinction between brontidi and the sounds that actually accompany earthquakes. Prof. Alippi, who has probably made a more thorough study of the phenomenon *in situ* than any other living person, while accepting without hesitation the subterranean origin of many or most brontidi, is not convinced that they may not also sometimes be of atmospheric origin. He can, however, offer no explanation of atmospheric brontidi, if they exist.

The initial cause of brontidi—whether in or out of the earth—is only half the problem. They must also be studied as an interesting acoustic phenomenon of the atmosphere. As we have stated, they occur when the air is tranquil—hence homogeneous horizontally—though, as they seem to be most common on warm afternoons, they may be in some way conditioned by strong inversions of temperature, and hence of density, in the vertical. Lastly, it seems probable that, as Alippi believes, the initial vibrations, whatever their cause, are far more common than audible brontidi. In order that the sounds may be heard they must be re-enforced by a peculiar configuration of the ground, above or below the surface; where such conditions exist brontidi are observed, while where they are lacking the vibrations pass unnoticed. Alippi attaches special importance to the effect of caverns, which he suggests act as resonance boxes in the production of audible brontidi.

Aluminium Alloys

In the Engineering Section of the British Association meeting at Dundee, Ernest Wilson presented a report on "Exposure Tests of Light Aluminium Alloys." Investigations made during the last ten years have shown that alloys of commercial aluminium with copper only were not satisfactory. Wilson investigated

alloys in the form of wire, 0.126 inch in diameter, to ascertain the effect of exposure on electrical conductivity. The addition of iron, nickel and manganese to the low-copper alloys was found to increase both the tensile strength and the resistance to deterioration. With specimens containing, respectively, 1.16 per cent of iron, 2.25 per cent of nickel, and 1.78 per cent of manganese, the electrical resistance had only increased about 9 per cent in eleven years. "Duralumin" was a copper-manganese-aluminium alloy, plus about 0.5 per cent of magnesium, and after an exposure of one year a specimen 80 feet long had increased 5.15 per cent in electrical resistance. Wilson asked, was this due to the comparatively high percentage of copper or was the manganese too low? This alloy could, by suitable treatment, be obtained with a very high breaking load, but its specific resistance was about twice that of commercial aluminium.

In the discussion, Lupton pointed out the well known destructive action of salt on aluminium and its alloys. Petavel called attention to the fact that "duralumin" at its best might have the lightness of aluminium with the strength of steel, but, unfortunately, it was extremely sensitive to heat treatment.

In this connection, see W. Roberts-Austen, Third Report of the Alloys Research Committee, wherein the melting points of the iron-aluminium alloys are given; and E. F. Law, Faraday Society, June, 1910.

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