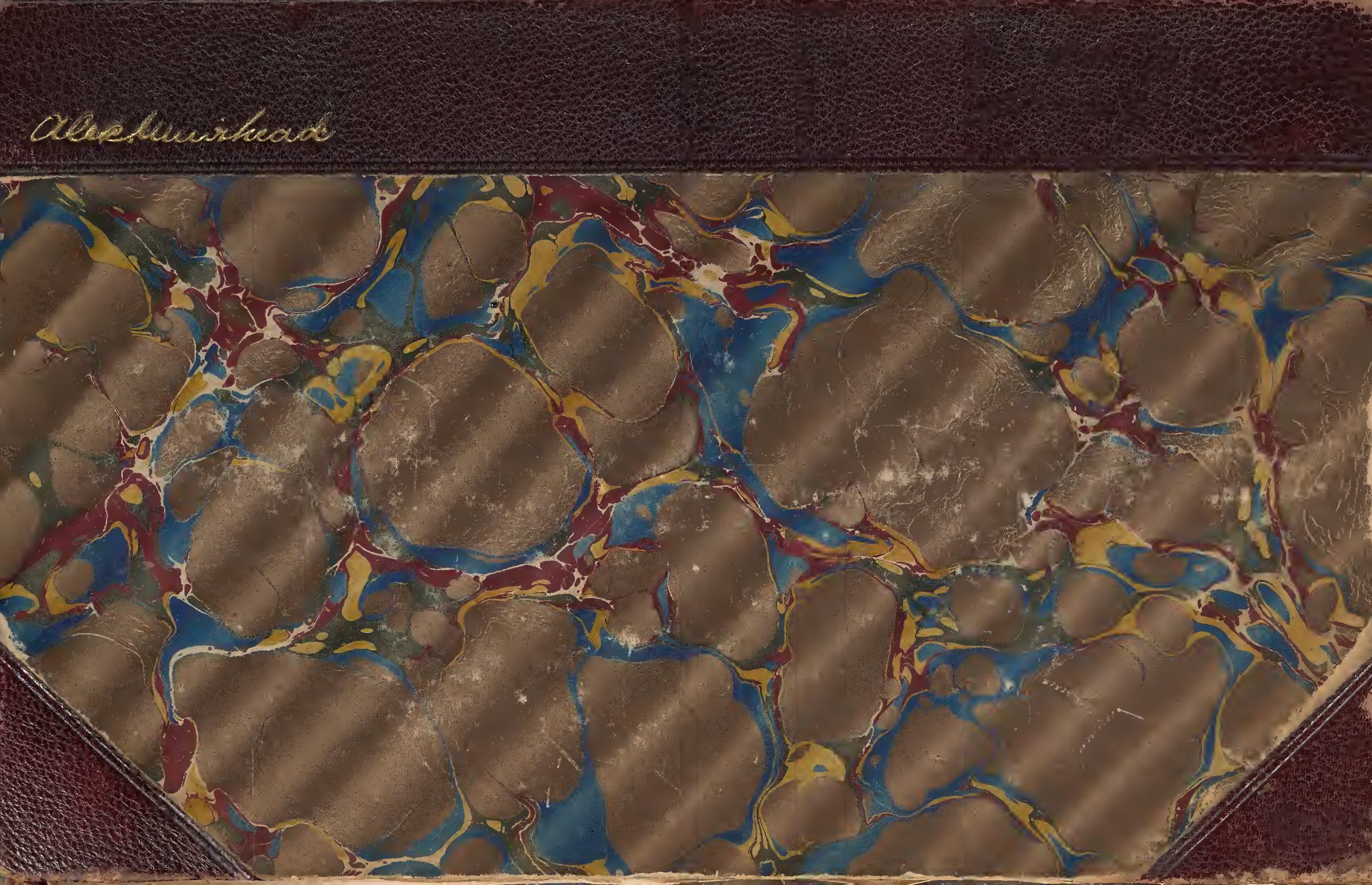
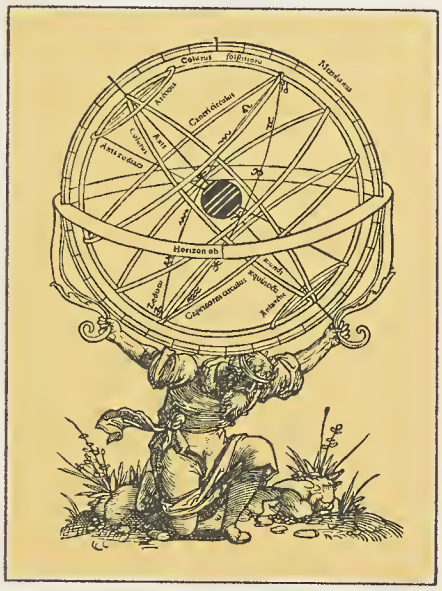

Abel Muirhead

Granville Hugh Baillie.

The Dibner Library
of the History of
Science and Technology

SMITHSONIAN INSTITUTION LIBRARIES



REMARKABLE

APPLICATIONS OF THE ELECTRIC FLUID

TO THE USEFUL ARTS,

BY ALEXANDER BAIN.

AN ACCOUNT

OF SOME

REMARKABLE APPLICATIONS

OF

THE ELECTRIC FLUID

TO THE USEFUL ARTS,

BY

MR. ALEXANDER BAIN;

WITH A

VINDICATION OF HIS CLAIM

TO BE

The First Inventor

OF THE

ELECTRO-MAGNETIC *PRINTING* TELEGRAPH,

AND ALSO OF THE

ELECTRO-MAGNETIC CLOCK.

BY

JOHN FINLAISON, ESQ.,

ACTUARY OF THE NATIONAL DEBT OFFICE, AND GOVERNMENT CALCULATOR.

LONDON:

CHAPMAN AND HALL, 186, STRAND.

1843.

PRINTED BY C. WHITING, BEAUFORT BUILDINGS, STRAND.

APPLICATIONS OF THE ELECTRIC FLUID,

&c. &c.

BY ALEXANDER BAIN.

PART I.

Most public men are aware that the writer of the present treatise has, for a period not much short of forty years, been employed as a subordinate servant of the crown, in situations of some trust and utility. He is, moreover, not altogether unknown to men of science, though in a very humble capacity, by his researches into the duration of human life. Why he should, under those circumstances, now concern himself with a subject so foreign to his ordinary pursuits as that which is treated of in the following pages, is a matter that seems to require some explanation.

It chanced that early in the last year, the writer, when inspecting the curiosities of the Polytechnic Institution, had occasion to see with surprise and gratification, the action of a machine for conveying messages to far distant places by electrical agency, in such a manner that one person sitting in London could, with the speed of light itself, converse with another at Portsmouth, each delivering to his correspondent the precise words that he might wish to say, in print, on a scroll of paper, so that no mistake in the meaning could by possibility occur. Having passed the first seventeen years of his service at the Admiralty, in no very inferior station, the author ventures to think himself as well qualified as most people, to judge of the

vast importance of such an invention to the interests of this great maritime nation.

The ordinary semaphores are useless by night, and in our cloudy atmosphere are ineffective for nearly one-third of the days in the year. They are, moreover, erected in the first instance, and subsequently maintained at very great expense.* But here is a small portable engine, costing something like £100, which can be set to work for less, perhaps, than £50 a mile in the outset, and worked afterwards for a triffing yearly salary, absolutely infallible in every state of the weather, by night or by day, in conveying words and sentences instantaneously and with perfect precision.

Supposing, for instance, a time of war with France: in less than ten minutes such a message as the following would certainly reach the Admiralty office, either from Portsmouth or Plymouth:

"The 'Prinee Albert' is in sight and working in. She signals that the Freneh fleet, yesterday at IV P.M. put to sea from Brest, steering S.E. by S."

The Lords of the Admiralty, after due deliberation, could cause such an order as the under-mentioned, to reach each of the senior officers at Sheerness, Deal, Portsmouth, and Plymouth, *simultaneously*, and infallibly within twenty minutes after it is written down at the Board:

"The Brest fleet is at sea, probably XV sail of the line. Send all your disposable ships to rendezvous at Cork. The senior officer, when suffieiently in foree, is to eruize in the chops of the channel, sending out steamers along shore to reconnoitre."

No one acquainted with naval affairs can be ignorant that a

---

* See a Return printed by order of the House of Commons, on 5th May, 1843, No. 236, from which it results that the semaphore eommunicating between the Admiralty and Portsmouth, is only available for 100 hours out of every 545, and that the expense of working it is on an average of three years at the rate of 3,403*l.* 9*s.* 3*d.* per annum, exclusive of the first eost of ereetion and repairs, and exclusive also of the ground which it was necessary to purchase in the first instance.

time may arrive when the facilities afforded by such an agency for immediate defence, might be of the very utmost importance to the public safety.

On enquiring who was the inventor of this extraordinary apparatus, the writer found, to his great surprise, that he was a young man, by name Alexander Bain; by trade a clock and watchmaker; a self-taught genius, from the author's own native spot in the extreme North of Scotland, totally unfriended, and hitherto unknown to fame.

There was further shown at the same institution, another of his inventions, consisting of a clock moved by electricity, which not only requires no winding up, but is capable of making any number (say 500) of other clocks simultaneously work together, by the one original movement. It may as well now be added, that, by a more recent discovery, Mr. Bain can make such a system of clocks keep time together for very many years, without their requiring any other trouble than such, perhaps, as an annual inspection.

Now it is one of the many curious characteristics of the present day, that the merit of those two remarkable inventions (and, indeed, the same consequence would have ensued if any other electrical application whatsoever had been in question) should be immediately claimed from the real author of them by persons who merely allege that they had, on some former occasion, imagined the same thing. It does seem, in fact, that men who, in the ordinary relations of life, are unexceptionable in point of honour and probity, have no scruples of conscience in regard to any thing that concerns an invention. Scientific discovery is now placed in the same category as horse-dealing, or shipwreck in certain districts; by some singular train of casuistry, it is entirely placed out of the pale of morality and held to be fair game, *fera naturæ*. There is scarcely a day in the year on which some invention or other is not diverted from the rightful owner without the smallest hesitation, and this not only without acknowledgement, but the very discovery is

appropriated as lawful prize in the shape of letters patent; and although these have, indeed, no legal effect when questioned, yet they serve the turn for a moment, in upholding the fame of the dexterous pilferer, for they impose on the unsuspecting and ill-informed portion of the public. It is feared that matters will never be mended in this respect until literary and scientific piracy is made an offence indictable at the Old Bailey, for there is no sense of shame nor fear of detection to operate as a terror to evil-doers.

Mr. Bain's recent discovery, which has just been alluded to, consists of a new method of producing electric currents from the water of the earth itself, without galvanic batteries, acids, or cells, and will probably have been laid before the learned world before these pages can see the light. That it will form an era in electrical science, and open a new field for experiment, is as certain as that its application to the useful arts, especially that of electrotyping, will immediately be pursued to such an extent as it is now impossible to foresee. Its nature and history is fully described with diagrams in the following treatise. Suffice it, in the mean time, to state, that the reasoning which led to it originated in a set of experiments conducted by Mr. Bain on the Serpentine River in Hyde Park for many weeks, but terminated on Thursday, the 2d of June, 1842. Some account of the very curious results developed by those preliminary investigations, appeared in the *Mechanics' Magazine*, and in others of the Journals published on the Saturday se'ennight, being the 11th of June. A letter from Mr. Bain also appeared in the *Literary Gazette* of that day, occasioned by a mysterious remark of a writer in the previous number, of the 28th of May, p. 366, in reference to a clock which had been just then exhibited in the Library of the Royal Institution *. It is called Professor

* The very next number, being that of the 4th of June, contained, oddly enough, the first publication of this part of Mr. Bain's discovery, in these words:

"Voltaic Electricity.—On Thursday we witnessed some curious expe-

Wheatstone's Electro-Magnetic Clock, "a description of which," says the writer, "is unnecessary, inasmuch as it has become familiar to the public," but how or in what way it is not for us now to discuss. The familiarity alluded to could only refer to Mr. Bain's Patent Clock, on view at the Polytechnic for more than fifteen months before this, and which it is here insinuated is really the invention of Mr. Charles Wheatstone, Professor of Experimental Philosophy in the new (or King's) College, in the Strand. Mr. Bain, feeling naturally hurt at this insinuation, wrote to the Editor that Professor Wheatstone was not the author of this invention; but that he himself had communicated that, and also his other invention of the Electro-Magnetic Printing Telegraph, to Mr. Wheatsone, in August, 1840, to the end that the latter might join him in bringing both inventions forward. Mr. Bain further stated, that this assertion was only a reiteration of what he had already (more than thirteen months previously) been obliged in his own vindication to insert in the *Inventors' Advocate*, a cotemporary journal of science.

Mr. Wheatstone immediately answered that letter by another,

---

riments in voltaic electricity, made in the Serpentine river, by Messrs. Thomas Wright and Alexander Bain, to whom the Duke of Sussex had granted permission for that purpose. A coil of wire was suspended from the bridge into the water, and the conduetor eontinued along the parapet and down the walk by the river side, to a small two-ineh battery about half-a-mile below. From this the voltaic fluid was discharged into a continuing wire, which also terminated in coils thrown into the river; and as the diseharges were made by signal, it was seen, by the deflexions of a magnet on the bridge, that the voltaic circuit was as complete through the half-mile of water as if the wire had been connected throughout the whole. By another experiment across the river, Messrs. W. and B. demonstrated that telegraphs might be constructed by this means without coating or defending the wires with any other matter, but merely laying them in the water. Other remarkable phenomena result from this series of experiments which will probably lead to a farther knowledge of the extraordinary nature and powers of the galvanie and eleetric fluids. Among other ineidents it was mentioned, that a eoil of wire thrown into a well in the park was equally affected as that upon the bridge, though there was no water-eommunication with the battery.

dated 13th June, which appeared in the next succeeding number of the *Literary Gazette*. Mr. Bain replied to this on the 18th of June, and vouched his statement by letters from Sir Peter Laurie and another gentleman. His letter was indeed allowed to appear, but not until the 6th of August, being seven weeks afterwards, with an intimation from the Editor, that he would insert no more on the subject than any rejoinder to this one, which Mr. Wheatstone might choose to make. The Professor's rejoinder was accordingly inserted in the number of the 20th of August; and it contained such testimony in favour of his mode of stating the case, under the hands of many distinguished persons, so well and honourably known in the scientific world, that any ordinary reader must needs be impressed with the conviction, that Mr. Bain could have no pretension at all to either of the two discoveries in question, notwithstanding that it is an absolute truth, that each of them are, in principle and detail, the certain emanation of his own unassisted genius. In the humble sphere of his acquaintance he had no such counter-testimony to adduce, nor any other person to come forward in his behalf of more consideration with the public than the unimportant individual who now attempts to place his merits in a very different point of view from that in which Mr. Wheatstone has left them, in the correspondence above referred to, which, for accuracy, is now reprinted *verbatim* in the Appendix.

At his young friend's request, the writer undertakes the task of stating his case for several reasons. The first is, that he cultivated with assiduity the pleasure of Mr. Bain's intimate acquaintance. Not only did he find him to be far above most others of his station in every praiseworthy quality—kind-hearted, sober, temperate, candid, incapable of deceit, and utterly free of guile; but, considering his years and opportunities, very well versed also in electrical science. Add to this, that in practical mechanics he is not merely an artist of the very first order (an immense advantage this over the man of

books, because his hand can execute whatsoever his mind conceives), but he is endowed moreover with inventive faculties of such fertility that no one can see the exercise of his ingenuity without wondering what new invention may next occur to his prolific imagination. His late valuable discovery was the result of extensive and repeated experiments made in the author's own grounds, and in his presence.

The second reason is, that the letters of Mr. Wheatstone bear internal evidence of much ambiguity and want of candour. Many facts, obviously within his knowledge, are suppressed; others are greatly distorted and perverted from their true meaning. Some facts are solemnly denied, and yet at the same time fully admitted (a proof that the departure from veracity is involuntary, the effect, probably, of writing under some strange excitement), while, apparently from hallucination not far short of delusion, more than one important fact is asserted which has no foundation at all.

Thus, no allusion is made in those letters to the fact, that Mr. Bain, jointly with Mr. Barwise, is the legal proprietor of the invention of Electric Clocks, by letters patent of 8th January, 1841; and that, jointly with Lieutenant Thomas Wright, of the Royal Navy, he is also the legal proprietor of the Electric Printing Telegraph, on vastly improved principles, by a patent sealed on 7th of December following; both which patents were vehemently, but unsuccessfully, opposed by Mr. Wheatstone in person. This, it is humbly conceived, is the suppression of a very material fact.*

Neither does the Professor mention, that as early as March, 1841, he endeavoured to terrify Mr. Bain from daring to make any use of his own inventions, by threats of vengeance in the shape of legal proceedings; and that, subsequently, he caused

---

* It would be ungrateful on the part of Mr. Bain if he should not acknowledge his obligations to each of his co-patentees, for very many important hints in the furtherance of his own ideas in these his inventions.

his man of law, to follow up this intimidation by threatening "to make an example" of Mr. Bain, whenever he should first attempt to derive any benefit from those discoveries; all which menaces had the mischievous effect of deterring those to whom Mr. Bain applied to patronise his ingenuity, from having any concern with him, especially the Lords of the Admiralty, who, by this clever stratagem, were made to entertain a doubt as to which of the parties the property in the Printing Telegraph really belongs *. This is another instance, among many, of wilful suppression.

Again: the Professor never saw nor heard of Mr. Bain until the 1st day of August, 1840, when the latter waited on him to describe his two inventions of the Clock and Printing Telegraph. A second interview was fixed for the inspection of the rough models of those engines on the 18th of that month, on which day Mr. Wheatstone saw and examined each of them. For £5 in hand, with a written promise of £50 more eventually, he purchased on the spot, so much of Mr. Bain's Telegraph as related to the apparatus for printing. In a few weeks afterwards, he engaged Mr. Bain to execute a costly finished or working model of the same apparatus; as also another finished model of a more complex engine for printing, which Mr. Bain had likewise invented, and which he then considered a great improvement on the other. For all this, the Professor promised to pay Mr. Bain £150, whenever the engines should be

---

* That this doubt still continues, is manifest from the proceedings of the House of Commons, as given in the *Times* of March 7th, 1843, on the Navy Estimates.

On the question, that a sum should be voted for the service of the telegraphs,

"Mr. Hume asked, why advantage was not taken of the scientific improvements, and the Electro-magnetic Telegraph, adopted on some of our lines of railway, instead of this mode of communication, which at present was useless for almost half the year.

"Mr. Sidney Herbert said, that there had been some communication on the subject, and some propositions made, but a doubt arose as to the right to the patent."

brought into use, and in the meantime supplied him, on several occasions, for materials, &c. with various small sums, not exceeding £25 in the whole.

Now, when on the strength of thus purchasing an artist's model, and of thus engaging him to execute costly engines of that artist's own sole invention, in the total absence of any other transaction between the parties, Mr. Wheatstone thinks himself justified in describing Mr. Bain in general terms as "a working mechanic, who was employed by him between the months of August and December, 1840"—this is surely a perverse misrepresentation of the real fact! It is moreover a mischievous perversion for the interests and character of Mr. Bain, since it insinuates a most unfounded impression, that such a person had, during this pretended servitude, opportunities of pirating the ideas of his more enlightened patron. Not only this, but he broadly states, that Mr. Bain's performance was copied from his own previous inventions, and was moreover nothing else than what any workman of ordinary skill could have effected—a flat impossibility, because Mr. Bain's models, one of which the other immediately purchased, were of necessity complete before the parties ever saw each other. The worst of the matter is, that the impression of the artist being one of Mr. Wheatstone's ordinary workmen, had, from the first moment of that gentleman's acquaintance with Mr. Bain, been industriously circulated in many quarters, even at the Admiralty, to the serious injury of the latter both in fame and emolument; but neither do Mr. Bain nor his friends feel the smallest reproach in the epithet of his being "*a working mechanic.*" Quite the contrary: they conceive it infinitely more to his honour that he is enabled, and successfully, to contend in science with those who deem themselves so very far his superiors in knowledge.

There is, moreover, an intolerable aggravation of that injury inflicted by Mr. Wheatstone, with a view, probably, to gain evidence for the imputation itself, when he says, "Not many weeks after *Mr. Bain was employed by me, and while he was*

under a written engagement not to communicate what he was about to any other person without my permission," &c., for this, whether arising from hallucination or mental delusion, is a downright assertion of the thing that is not. Mr. Bain solemnly affirms, that no such engagement, whether verbal or written, was either asked or granted, and most certainly this much is clear to demonstration from all the circumstances of the case.

Again: the Professor, while admitting that he purchased Mr. Bain's model of the Telegraph in so far as relates to the engine for printing, and while the whole strain of his reasoning also confesses that he saw Mr. Bain's model of the Electric Clock on the 18th of August, 1840, nevertheless expresses himself as follows: "*It is quite untrue that Mr. Bain ever exhibited to me a model of an Electro-Magnetic Clock,* either before or after he was employed by me. He has not yet given the least proof of his having had in his possession, at the time he mentions, any such model; he has not yet adduced the testimony of any person who then saw it—*it is equally untrue that Mr. Bain showed me at the time he refers to, any model of an Electric Printing Telegraph.*" Now, this manifest self-contradiction is, and can be nothing else than sheer hallucination, as in the former instance. Mr. Wheatstone was fully aware, when he wrote those sentences, that each of the two inventions in question, had, for a period of twelve months previously, been not only publicly exhibited, but regularly lectured on at the Polytechnic Institution. To be thus in the working state, they must of necessity have been in existence for some considerable time before, that is on the 18th of August, 1840.

The Professor seems not to think it worth while to treat Mr. Bain with that language which every man of science, out of respect to himself and his readers, if for no better reason, is in duty bound to employ, when speaking of another through the medium of the public press. Besides the above expressions of this fact being "quite untrue," and that other "equally untrue," he begins his letter of the 10th of August last, by accusing

Mr. Bain of "unjust statements and actually *false averments.*" He ends it by saying, "of the real principles of telegraphic communication by *Electro-Magnets* which, assisted by the beautiful theory of Ohm, I was the first to determine, he (Mr. Bain) evidently knows nothing." As to the justice of this last aspersion, the reader will have full means of judging for himself. One thing is certain at any rate, that Mr. Wheatstone has voluntarily, by these and many other coarse expressions, which are so offensively disparaging to Mr. Bain, divested himself of all claim to courtesy at the hands of those who may take up that young man's cause.

"Quis tulerit Gracchos de seditione querentes ?"

There is, however, no offence meant in candidly telling the Professor, that whenever it may happen that his statements shall be at variance with those of Mr. Bain, the writer will, without hesitation, give full credence to the latter, to whom, he well knows, nature has denied even so much as the very rudiments of deception, and this not only because, like almost every other man of sterling genius, Mr. Bain is as simple in the ways of this world as a mere child, but also because the author knows him to be free from those infirmities with which some learned men are afflicted, namely, a strange fancy for the assertion and the negation of one and the same fact in the same breath (a curious defect of memory in all particulars which are disadvantageous to his own case)—an anxiety to bury in oblivion the merits of every cotemporary engaged in his own pursuits—and a morbid brilliancy of imagination, which conjures up vividly, as realities, events that never actually occurred, and written engagements which never existed.

Without being aware of the obligations under which the Professor has laid the human race, by those labours in which it is his pleasure to glorify himself in the eyes of the readers of the *Literary Gazette;* being on the contrary, with good reason, very sceptical as to the value of those services, if any value they have, the writer of these pages begs leave to affirm, from personal observation, that Mr. Bain knows "the real principles

of telegraphic communication by electro-magnetism" far better than Mr. Wheatstone, as will be evident also to the reader when he shall see by what ingenious means Mr. Bain has contrived to discard Electro-Magnets altogether from among his motive forces, substituting for these an agency of incomparably greater power and utility.

Be this as it may, the time selected by the Professor for degrading his rival into the rank of one of his own working mechanics, was singularly ill chosen, seeing that while he penned that epithet, he must have had in his hand the *Literary Gazette* of the 4th of June, and the *Mechanics' Magazine*, not then three days old, each of which journals recorded Mr. Bain's very interesting experiments on the Serpentine river, one of the most remarkable results of which was the discovery that the voltaic circuit may, from a very small battery containing only two plates, not three inches square, be completed, while an insulated wire performs only a part of the course, the water or even the moist earth itself performing the office of the remaining portion*. This derogation from the merits of Mr. Bain is also quite unpardonable as coming from Mr. Wheatstone, inasmuch as the discovery just alluded to, was immediately seized on by his own partner Mr. Cooke, and precisely in the space of three months after the experiments were announced, was appropriated to the advantage of their common firm, in a patent sealed on the 11th of September, as may be seen in its specification, which was enrolled on the 11th of March last. Mr. Cooke had written (only a few weeks before Mr. Bain's experiments) a book † on Electric Telegraphs for Railways, in which no mention is made of the idea that the earth could be made a conductor.

---

* Mr. Bain was not aware that Aldini had, about forty years ago, with one wire, supported on the masts of boats, sent the current from bank to bank of Calais harbour, through the sea. This, however, was effected by a powerful compound battery of eighty cells. Aldini also sent the current along the shore, the sea completing the circuit. But the discovery that the moist earth itself was as good a conductor as the water, is, it is believed, due entirely to Mr. Bain, as also that either element will complete the circuit with very feeble currents.

† Published by Simpkin and Marshall, 1842.

On the contrary, alluding to his "coadjutor, Professor Wheatstone," he says, (page 16) "our latest improvements have enabled us to carry on the most complete and extensive correspondence with only two or three wires." The improvements here alluded to, are those patented by Mr. Wheatstone on the 20th of January, 1840. But these have no reference to the efficacy of only *one* wire aided by the earth. This does not however prevent Mr. Cooke from claiming the discovery as his own, in contempt of the publication of it in the *Mechanics' Magazine* of the 11th June, 1842, and in the *Literary Gazette* of the 4th of that month, the editors of each of which journals were eye-witnesses of Mr. Bain's experiments. Such claims are, it is melancholy to see, made every day without the smallest compunction. Thus on the 17th of May, 1843, a paper was read at the Society of Arts (reported in the *Athenæum* of the 20th of May) descriptive of Mr. Cooke's new patent, which claims "the employment of the earth as half of the conducting circuit." "*For two years Mr. Cooke has tried this plan, successfully*, on the Blackwall Railway, and LATELY on the Manchester and Leeds line."

Need the reader be told, that if Mr. Bain's greater discovery (now happily secured by letters patent of 27th May, 1843, and by means of which, without any galvanic batteries whatsoever, he can send the current through earth or water for any distance) had been known to some of his industrious but unscrupulous competitors, the same claim of prior discovery would, with equal *nonchalance*, have glided into print sooner or later, without so much as a single mention of the inventor. The world is verily come to that pass that it has long been a received doctrine, that the only test of prior discovery is priority of publication—Mr. Cooke, perhaps, will be good enough to state in what journals of May, 1841, his discovery of this law of nature was announced.

There is one point more to which, from respect to science itself, the writer alludes with great pain. It cannot, however, be passed over in silence, as it constitutes a main reason for his

interference with the present question. Messrs. Cooke and Wheatstone have for several years very extensively advertised their patent Telegraph, for making signals by means of deflected needles, on which account their influence with the periodical press is not inconsiderable. Mr. Bain felt the effect of that influence two years ago, in the great difficulty which he found in procuring access to the press, when vindicating his claim to be the real inventor of the Electric Clock, some of the journals having even handed over his statements to his antagonist, who availed himself of the opportunity to intimidate Mr. Bain by threats of law—threats which were treated as they richly deserved by Mr. Bain in his reply; but to this correspondence the Professor prudently makes no allusion. Will he now publish it?

The *Inventors' Advocate* having, however, opened its columns freely to Mr. Bain, a person presented himself at the office of that journal, with Messrs. Cooke and Wheatstone's ordinary advertisement, and proffered, on behalf of the partnership, a series of those lucrative insertions, on the express condition that no more letters from Mr. Bain, *on the subject of the Electric Clock*, should be admitted into their pages. With this offer of corrupting the press, however, the high-spirited editor refused to comply, and so it turned out that no other than the first advertisement was sent, which may be seen in No. 95 of that paper.

The fact is established by the letters of the editor and his clerk, which follow, and they show conclusively the species of persecution with which Mr. Bain has to contend.

"Mr. Bain.

"Sir, (*No date.*)

"I have no hesitation in stating, that about the 22d of May, 1841, an advertisement was given to me, for insertion in the *Inventors' Advocate*, by a person representing Messrs. Cooke and Wheatstone, with *the stipulation* that a series of advertisements would be given, if the correspondence of Mr. Bain, respecting the *Electric Clocks*, were discontinued; and if not, no more advertisements should be given—which was the case, as the Editor, who had the whole control of the Journal, would not accede to such a proposition.

"(Signed) W. Harris."

"Mr. Bain.

"Sir, 6, *Haverstock Terrace, Hampstead, Sept.* 14*th*, 1842.

"I have perused the statement of Mr. Harris, who was clerk to the *Inventors' Advocate*, of which paper I was the editor, and it accords with his representation of the circumstances to me at the time. So far as I am concerned, it is strictly correct.

"I am, Sir, your obedient Servant,

"(Signed) H. Bakewell."

It is obvious that no person was in a condition to authorize and give effect to the above iniquitous *stipulation*, other than one or both of the co-patentees. There appears to be no reason why Mr. Cooke should resort to such practices, inasmuch as, being concerned with Mr. Wheatstone only in the matter of the Telegraph, he could have no interest in the affair of the Clock. On whom, then, must rest that suspicion which never can be removed but by the production of the emissary and his credentials, with a plain story as to who sent him on such an unworthy errand?

The writer being unacquainted with mechanics, has availed himself of the aid of a scientific friend to describe the accompanying diagrams. Among them will be found the drawing of an Electro-Magnetic Telegraph, patented by Messrs. Cooke and Wheatstone, on 21st January, 1840, as also drawings of other engines by preceding inventors, from whose ingenuity those gentlemen seem to have derived nearly all, if not the whole of their ideas for the construction of the machine in question. This machine never contemplated the measurement of time, nor yet the means of recording signals or letters in print or otherwise. It was simply intended to show letters, which were to be copied down successively by some observer at the place to which a message should be directed, having withal this radical and fatal defect in its structure, that the transmitter of a message cannot know whether the engine is acting properly or not at the other end of the wire where the observer is stationed. Mr. Bain never saw nor heard of it before his second meeting with Mr. Wheatstone.

Now it is a part of this gentleman's case, that Mr. Bain's

two inventions—the one of a Telegraph to print the message at once—the other of a system of Electric Clocks moving simultaneously, are but *additions*, which, though they had not occurred to the Professor when he took out his patent, as is evident by *his not including them therein*, yet are only such additions as might have been grafted on his telegraph, which was constructed merely to show letters.

He, therefore, by virtue of his patented engine (itself a copy of other men's inventions, and of which to this hour he has neither made, nor is it capable of any use) claims most loudly the property of Mr. Bain's two discoveries. They are his, because they were *in posse*, though not *in esse*, capabilities of his signalizing Telegraph. The absurdity of such a pretension requires no comment.

Another part of his case is, that he, simultaneously with Mr. Bain, was also an inventor both of Printing Telegraphs and of Electric Clocks. It certainly does appear, that about the time when Mr. Bain had finished his two inventions, the Professor had conversed with various friends on the practicability of the same two objects, but it is also incontestibly evident, from his own showing, that he had made no progress in carrying his ideas into effect, until he fell in with Mr. Bain, only ten days after the specification of the Patent Engine for showing letters had been enrolled. If, therefore, during the six months which elapsed between the sealing and the specification of this patent, any inventions of the same kind as those of Mr. Bain had occurred to Mr. Wheatstone, they were obviously unknown to the former, because they could only then have their existence in the cogitations of the latter, not being at the time visible to any other person in an outward form.

The reader will now be relieved from the tedium of these general remarks, by presenting him with a copy of the paper just now submitted to the learned world, as descriptive of Mr. Bain's late remarkable discovery, from which he will judge whether this artist deserves to hold no higher rank in science

than that which Professor Wheatstone assigns to him—"a common working mechanic who was employed by me."

By those who may be altogether unacquainted with electrical science, it is feared that in these pages very little elementary information can be expected beyond a few hints. The father of that branch of it which is now called Electro-magnetism, and which unfolds the laws of the reciprocal action of the electric and magnetic influences on each other, was M. Oersted, Professor of Natural Philosophy and Secretary to the Royal Society of Copenhagen. His very surprising discoveries were first published in England by himself in Thomson's *Annals of Philosophy*, for October, 1820. Of the many curious results which were thus brought to light and explained, there are, perhaps, only three to which the mechanist is indebted for motive power.

1st.—THE DEFLECTION OF THE MAGNETIC NEEDLE.

When the poised needle is at rest in its ordinary terrestrial position, let the wire of a galvanic battery be brought parallel to it, and longitudinally coiled over it with many convolutions, and let the voltaic circuit be then completed. Instantly, as the electric current flows, the needle is deflected to the right, or to the left, of its former position, at the will of the operator, according as he shall direct the course of the current from the one end of the wire or from the other. When the circuit is broken and the current ceases to flow, the needle instantly regains its terrestrial position—it being understood that the conducting wire shall be perfectly insulated. The motions thus acquired by the needle are turned to use in many ways, one of which is, that, by causing it to point to certain letters of the alphabet, a telegraph is formed; an idea first suggested by M. Ampère about thirteen years ago. On this principle all the telegraphs hitherto worked by Messrs. Cooke and Wheatstone are constructed, as well as those of several other persons, to none of whom, however, is the first idea due. A fine needle placed in

this way in a voltaic curcuit is called a galvanometer, and is deflected by very feeble currents.

2d.—THE DEFLECTIONS OF THE COIL.

If round a frame of wood, which may be called a reel, in the shape of a parallelogram, there shall be wound many convolutions of coated wire close to each other, and if this reel be exactly poised on its centre, and a fixed magnet placed within its confines, then, if each end of the wire thus forming the coil is attached to the poles of a galvanic battery, and as soon as the electric current is let on, the coil will be deflected either one way or the other, according to the direction which the current has received. The electric and magnetic influences thus appear to be for ever at right angles to each other. But which of them is the agent, and which the patient, it may be difficult to say. The coil, when light, is moved by very feeble currents, as the needle is. But then the needle cannot conveniently be otherwise than small, like that of the mariners' compass; whereas the coil may be very powerfully influenced, if the magnets be indefinitely increased. Thus the coil becomes the means of a considerable motive power, which Mr. Bain, it is believed, was the first to employ to work machinery. Another advantage of the coil over the needle is, that the latter, in a particular state of the atmosphere, as well as under other disturbing causes, is uncertain, as every seaman knows, but the coil is never so.

3d.—THE ELECTRO-MAGNET.

If a piece of soft iron be bent into something like a horse-shoe, and enveloped as close as may be by very many convolutions of coated wire, each circle out of contact with that adjoining, by means of the coating, and if the ends of the convolving wire be respectively attached to the poles of a galvanic battery, and the electric current let on, the soft iron becomes, while so suffused with an atmosphere of electricity, a very powerful magnet. When the current is stopped, by detaching the wires or otherwise, the piece of iron ceases instantly to

have any magnetic attraction. When a plate of soft iron (technically denominated the feeder) is riveted to a weak spring and presented to this temporary magnet, the magnetic force overcomes the spring and attracts the feeder while the electric current is flowing. If this be cut off, the spring withdraws the feeder instantly. But by thus alternately making and breaking the current, which, by a pendulum and various other means, may be done at regular intervals of time, motion is generated of sufficient power to work machinery.

But the current of electricity, which is necessary to create an electro-magnet of the requisite strength for mechanical purposes, must be of far greater power than that which will deflect a coil of equal force. Hence the ingenuity of Mr. Bain has been lavished on the construction of such coils as have enabled him to dispense with electro-magnets altogether, thus economising to a wonderful extent his motive power; whereas, in so far as it has yet appeared, Professor Wheatstone knows of no other resource for his mechanical agency than electro-magnets, which are in themselves exceedingly limited in power, unless, indeed, at a great expenditure of materials.

There is another matter connected with the application of electrical agency to the useful arts, of no secondary import, but, on the contrary, of primary concern. This is, the means of practically insulating the conducting wire, when long distances are in question. Every tyro in electrical science, knows that the voltaic current is enfeebled, and finally exhausted, when sent through electro-magnets very far off. How much of this exhaustion is attributable to imperfect insulation, is a matter, however, which is very far from being known with certainty, in the present state of experiment.

It appears, by the evidence of Professor Wheatstone and other witnesses, before a Select Committee of the House of Commons on Railways, delivered on the 8th of February, 1840, that, in the previous summer, he and Mr. Cooke had laid down their telegraph, by the deflected needles, for a distance of thirteen

miles on the Great Western Railway, at the cost, to that enterprising Company, of very nearly £300 per mile, an agreement which the Directors very wisely terminated with all possible dispatch. In this case, the insulating wire was coated with thread and India rubber, and then inserted into metallic tubes. But, apart from the expense, Mr. Bain has ever resisted the system of tubing altogether, in whatever form it may be used; because, if in any part of the tube a crack should take place, the wire is enveloped immediately, far along the tube, with a column of water, when dispersion of the electricity must of necessity take place.

Messrs. Cooke and Wheatstone seem to be at length convinced of this incurable disadvantage, for in their late patent, specified only on the 11th March last, the new mode of insulation is to be by raising the wire on high iron stanchions, elevated into the air, and protected from contact by raw goose-quills—a very appropriate idea. What is there to hinder a roguish school-boy, or any mischievously-disposed clown, from cutting the wire thus extended over his head like clothes-lines? Independently of the exposure of the wire to certain damage, the expense also of the erection is advertised at £150 per mile, and all this for a telegraph to indicate signals by deflected needles!

Now, in reference to this very essential difficulty of insulation, the reader, when he considers the means by which it is so easily overcome by Mr. Bain, will form his own opinion whether he deserves what is said of him by Professor Wheatstone, that "of the real principles of telegraphic communication by electro-magnets, he evidently knows nothing." But the Professor was then well aware, from the specification of Mr. Bain's patent, which was enrolled on 7th June, 1842, that he ingeniously insulates his conducting wire by imbedding it in a bar of asphaltum, two or three feet under ground, at the expense of less than £50 per mile! The unctuous property of asphaltum renders it impermeable to water, and its readily yielding to any

casual pressure prevents the chance of such a fracture as would admit the smallest portion of moisture to run along the wire. This patented right of Mr. Bain to insulation, by means of asphaltum or any similar cement, explains the reason why Messrs. Cooke and Wheatstone are now driven to the preposterous expedient of long poles.

ON THE EARTH

AS A SOURCE OF PERMANENT VOLTAIC ELECTRICITY.

BY ALEXANDER BAIN.

In prosecuting some experiments with an Electro Magnetic Sounding Apparatus in the year 1841, it was found that if the conducting wires were not perfectly insulated from the water in which they were immersed, the attractive power of the Electro-Magnet did not entirely cease when the circuit was broken. For the purpose of investigating the nature of this phenomenon, a series of experiments took place with great lengths of wire, in the reservoir of water at the Polytechnic Institution, when similar results were obtained.

As this effect threatened to militate against the practical application of electric currents to the transmission of telegraphic communications or the working of Electric Clocks, it became a matter of considerable importance to discover, if possible, the true cause of the phenomenon, and to provide a remedy. With this view, therefore, Lieutenant Wright and Mr. Alexander Bain, having obtained the permission of His late Royal Highness the Duke of Sussex for that purpose, commenced a series of extensive and varied experiments on the Serpentine River, in Hyde Park, which it has been thought necessary to particularize, showing as they do the steps which have led to one of the most extraordinary and, it would seem, one of the most valuable discoveries yet made in Electrical science.

The first experiment consisted in passing an electric current through the water, by means of wires laid from one side of the river to the other, as shown in the *diagram*, *Experiment* 1.

A represents a compound battery of six cells, of about twelve

square inches surface; *B* and *C* are the wires; *D* is an electro-magnet of soft iron, and *E* its feeder. On an electric current being established in the wires, it was found that a small portion only reached the electro-magnet: enough, however, to enable it to sustain its own weight. On the circuit being broken, by disconnecting the wires *from the battery*, it was found that the attractive power of the magnet did not entirely cease. The electric current being again transmitted through the wires, the circuit was broken by detaching the wires *from the magnet*, when its attractive power ceased immediately. The experiment was then repeated as at first, and the same result obtained—viz., a very gradual decay of the magnetic power. It is well to observe here, that the feeder was removed from the magnet, and kept from it several minutes; on being again presented to the magnet, it was slightly attracted by it. It was premised that on an electric current being established in one direction, its effect on the magnet might be instantly annihilated, by changing the direction of the current; experiment proved this to be the case, and thus pointed out an effectual remedy for the inconvenience, although the cause was still unknown. As it was evident in the foregoing experiment that the greater portion of the electricity was conducted *from one wire to the other by the water*, particular attention was next given to this branch of the subject. A portion of one of the wires forming the circuit, was lifted out of the water at several points between the two banks of the river, and the Electro-Magnet placed in the circuit; when it was found that the current was transmitted by the water from one wire to the other, as shown by the small arrows: the greatest portion of the electric current passing from that part of the wires which was nearest to the battery.

These facts rendered it obvious that water was quite capable of conducting voltaic electricity, provided a sufficient surface of metal was present to convey the current into and out of the water. Before proceeding to apply this fact however, the first experiment was repeated, but with a smaller battery. See *Experiment* 2, *in diagram.*—*F* is a small Grove's battery of four inches surface; *G* and *H* the positive and negative wires; *I* the galvanometer. The results of this experiment were exactly similar to the former, except that a larger proportion of the diminished current reached the galvanometer, as

was anticipated from the metallic surface of the wires being an ample conductor for so small a current.

A copper wire was next laid down on the gravel walk along the north bank of the Serpentine River, from the bridge which separates Hyde Park from Kensington Gardens, to the east end of the river. About three square feet of metallic surface was attached to each end of the wire and put into the river; a galvanometer was put into the circuit at the bridge, and the small Grove's battery at the other extremity of the wire.

See *Diagram, Experiment* 3.—*K* is the battery, *L L* the conducting wires, *M* the galvanometer. The electric current passed by the water and returned by the wire, as shown by the arrows, and with as much power as would have been the case with an ordinary metallic circuit.

In this arrangement the magnetic influence ceased the moment the circuit was broken, as it would have done in an entirely dry circuit.

Reflecting on the foregoing experiment, it occurred to Mr. Bain that the natural moisture of the earth might be a sufficient conductor for the electric current, and with a view to ascertain the correctness of this assumption, a wire was led along a wood-paling extending from the river to a well about a hundred and fifty yards distant; one of the metallic surfaces attached to the wire was put into the river, and the other into the well; the galvanometer was put into the circuit near the river, and the small battery near the well.

See *Diagram, Experiment* 4.—*N* is the battery, *O* the metallic surface in the well, *P* that in the river, and *Q* the galvanometer. On completing the circuit, the current passed freely, as in the former experiments, showing that *when sufficient moisture* is present, the earth is a good conductor of voltaic electricity; and that one-half of a voltaic circuit is all that is necessary to be insulated from surrounding conducting matter.

While reflecting upon these experiments, some few months after they had been performed, Mr. Bain was led to infer, that if a surface of positive metal was attached to one end of a conducting wire, and an equal surface of negative metal to the other end, and the two

metallic surfaces put into water, or into the moist earth (the wire being properly insulated from surrounding matter), an electric current of considerable energy would be established in the wire.

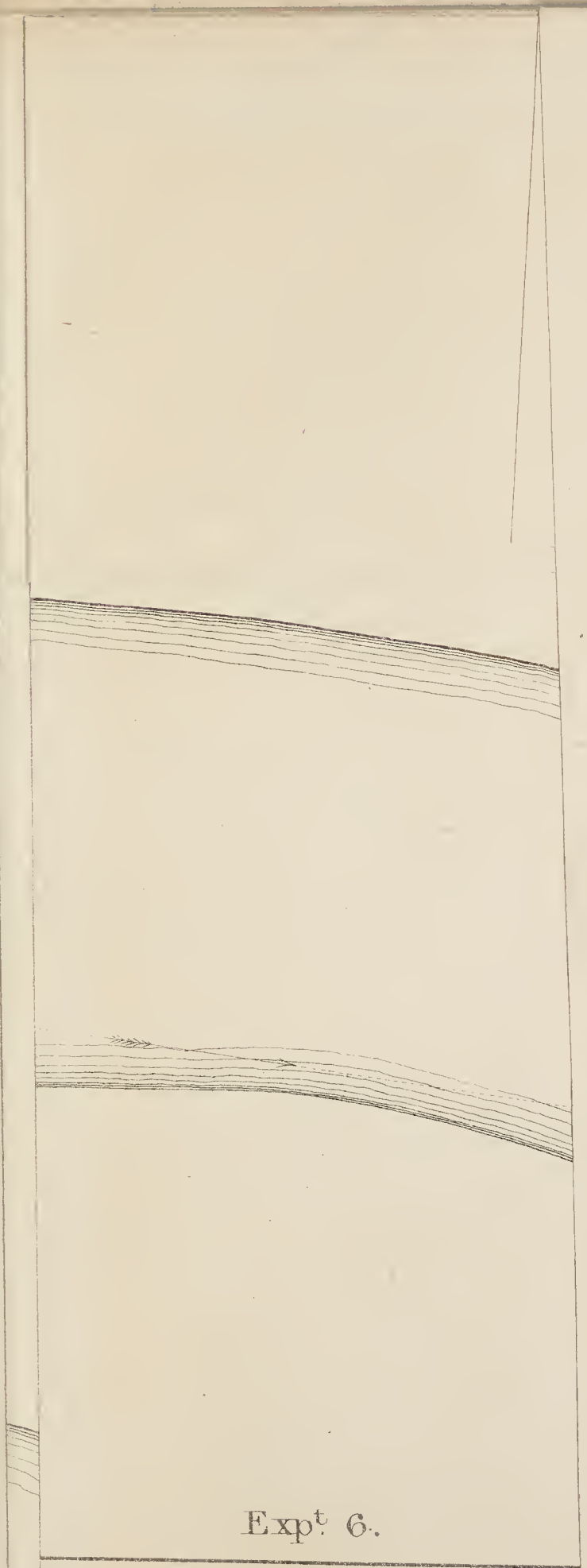
This proposition was soon tested by an experiment performed in the grounds of Mr. Finlaison (the government calculator), at Algher's House, Loughton, Epping Forest. See *Diagram, Experiment* 5.—*R* is a moat, distant one hundred and fifty yards from *S*, a pond of water; *T T* a conducting wire laid along a gravel walk, *V* a galvanometer, *W* represents about twelve inches surface of positive metal, and *X* a similar quantity of negative metal.

The moment this arrangement was completed, the galvanometer showed that an electric current was passing from the metal in the pond, through the earth, in the direction of the arrows, to the metal in the moat; returning back again by the wire *T*. The current was of considerable energy, and this experiment was repeated a number of times with unvarying success.

From observations that had been made during the prosecution of the foregoing experiments, it was next resolved to try the effect of a water battery upon a large scale. This was done in the Serpentine River, as shown in the *Diagram, Experiment* 6. A large surface of copper, *Y*, being placed in the water, a corresponding surface of zinc was inserted at *Z:* the two surfaces being connected by the wire *a a a*. On placing a galvanometer in the circuit at *G*, an electric current of considerable intensity was found to be passing through the water from the zinc to the copper and returning by the wire. This experiment was varied, by passing the current across the Serpentine with the wire immersed in the water, as shown in the *Diagram, Experiment* 7. *Z*, as before, is the zinc and *Y* the copper, *G* the galvanometer. With this arrangement, a portion of the electricity was transmitted from one side of the river to the other, but the greater part of the current from the plates passed through the water to the wire *en route*.

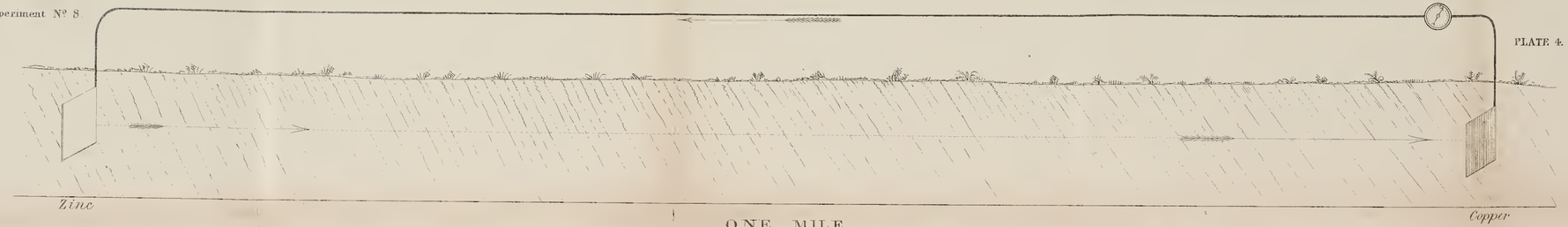
These points being satisfactorily established, Mr. Bain next proceeded to make the experiment as shown in the *Diagram*, No. 8.

A surface of zinc was buried in the moist earth in Hyde Park, and, at rather more than a mile distance, a copper surface was similarly deposited; the two metals were connected by a wire, suspended on

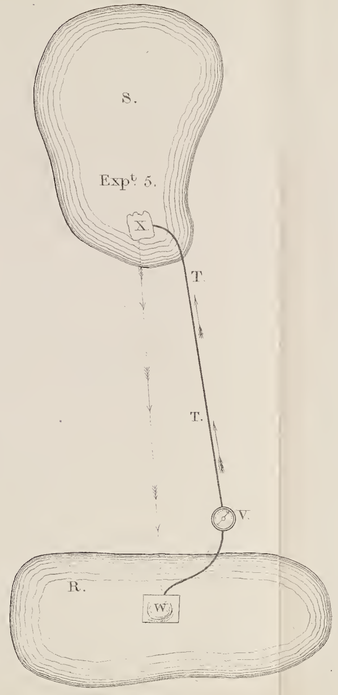


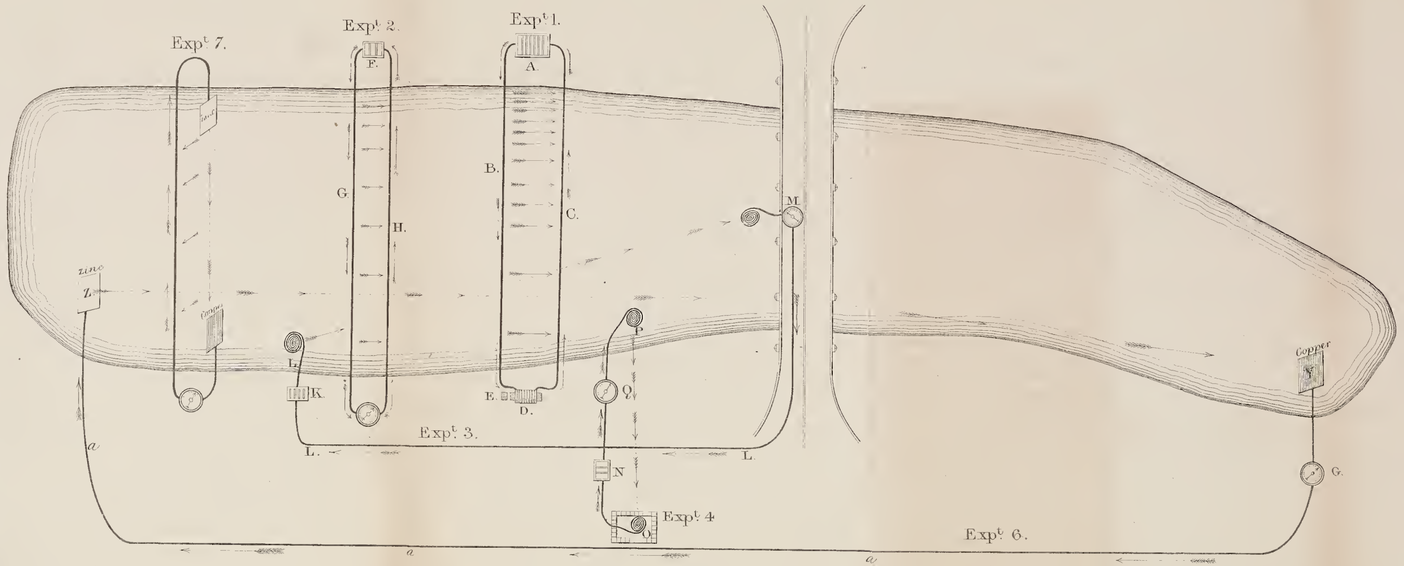
Exp$^{t.}$ 6.

Experiment N° 8



ONE MILE.





Madeley, lith. 3 Wellington St. Strand.

the railing, and on placing a galvanometer in the circuit, an electric current was produced, which passed through the intervening mass of earth from one plate to the other, returning by the wire. In the first experiment, the metallic surfaces being small, the electric current produced was feeble, but on using a larger surface of metal a corresponding increase in the energy of the current was obtained, with which an electrotype process was conducted, and various Electro-Magnetic experiments performed with uniform success.

Subsequent experiments have shown that if two metal plates (a negative and positive) of sufficient surface are sunk in the earth as a battery, and wires led therefrom, electrotype deposition may be effected, and every description of Electro-Magnetic apparatus worked for any length of time. The most successful results have, however, been obtained by depositing several surfaces of positive metal in the earth connected into a group by wires, from which a conducting wire was led to a series of negative surfaces similarly disposed at a more remote spot. When considerable power is required, this is the arrangement that should be adopted. It is essential to success, that the earth wherein the plates of metal are deposited should be of a moist nature. A current has, indeed, been obtained in dry soils, but of such small energy as to be of no practical utility. This, however, may have been occasioned by the very small proportion of metallic surface with which the experiment was made.

Such a source of electricity as the foregoing promises to be most extensively useful in the arts. Among other advantages, its simplicity and cheapness are no small recommendations; while the uniform character of its power is of the utmost importance. A battery of this description, under very disadvantageous circumstances, has produced a power which for upwards of six months has been found unvarying.

From disastrous experience it was very much feared, by Mr. Bain and his friends, that the honour and profit of this discovery also would be wrenched from the true owner, exactly as was that of each of his former inventions, and by the same

malign influence. To prevent this, however, as far as possible, a record of the experiments at Loughton was, in the first instance, made on the spot by one of the spectators, in the following words :

"*Monday*, 10*th October*, 1842.

"This day we witnessed Mr. Bain's experiment of eonveying eleetrieity from Mr. Finlaison's moat to his eattle-pond, a distanee of 175 paces, by a eonneeting wire; so that the eireuit was in part performed by the earth itself. A small copper kettle, with some eopper wire, was attached to one end of the eonducting wire, and sunk in the moat. Two pieces of zine, with many coils of iron wire, were attached to the other end of the conduetor, and sunk in the cattle-pond. A small galvanometer was placed where we sat. When the current was laid on to the magnet, we saw the needle drawn out of its place of repose, with great energy, to at least the quarter of the eircle: the current being let off, it regained its plaee of repose, and so on repeatedly."

The next step, after many more experiments had been made, was to ascertain, from the most eminent men of science, whether this mode of producing voltaic currents was a new discovery in electricity, or whether it had been known before; to the end that, if new, the advantage of it might be secured to Mr. Bain by letters patent. For this purpose the writer waited on a distinguished acquaintance, between whom and himself much kindness had passed in former days. He is justly in the first rank of science, as he is among the very first in place at the Royal Society. The gentleman alluded to, on seeing the drawings, readily admitted that he had never before heard of such a thing, and suggested that an account of the experiment should be laid before the Royal Society. On being earnestly requested by the writer to present such a paper, he generously pledged himself to do so, on the reasonable condition that, after due inquiry, he should be satisfied that no one, before Mr. Bain, had made the discovery. He rather discouraged the notion of a patent, but recommended the writer to call on a most eminent philosopher, to whom he kindly introduced him by note, as being one of the first electricians of the day. A few days after this, he wrote to the following purport :

"——— *Street*, 16*th January*, 1843.

"Dear Sir,

"I should not like to present your friend's paper without showing it to Mr. ——— (the same gentleman to whom the writer had been introduced), and being guided by his opinion. Some caution seems necessary; for it is very possible that the current might be conveyed a few hundred yards, in the way your friend described, but it would be rash to conclude from thence that it might be carried many miles in the same way.

"I am, dear Sir, your most faithful Servant,

"* * *"

The writer and Mr. Bain had very soon afterwards two interviews with the experienced philosopher to whom they were so referred, and whose name, if mentioned, would excite universal respect. The name of neither can, however, be mentioned in print in the absence of their express permission, as such an indelicacy would be a bad return for their past kindness. The allusion to them, on the present occasion, has no other object than to record that such discussions took place many months ago.

The eminent electrician referred to, however, perused the the drawings, and listened to the statements made to him by Mr. Bain and the writer, with profound attention, and declared his perfect conviction of the novelty of such a remarkable discovery; adding, emphatically, that if any thing of this nature had previously been made public, he, from his position, *must have heard of it*.

Encouraged by these opinions, a patent was solicited for the application of this mode of producing electric currents to telegraphs and clocks, which, on being referred to the Solicitor-general, was, as usual, opposed by Mr. Wheatstone, and with his usual want of success; for in due time the warrant was prepared, and passed the privy seal, but the opposition delayed the patent until April.

In the mean time it was proved by experiment that the process of electrotyping by Mr. Bain's mode of producing currents, was, though slower, likely to be better accomplished than by the use of galvanic batteries; because Mr. Bain's method possesses the inestimable advantage of a never-varying flow, in

reference to quantity and energy, while that of the galvanic battery is subject to rapid diminution from the continual oxidation of the metals and many other causes. The eminent practical electrician who is the patentee of the beautiful process of precipitating metals, was, therefore, made acquainted with this discovery, and he, and one of his friends, readily consented to pass a day at the writer's house, at Loughton, to make the necessary experiments with his own hands. These were made on the 6th of April last, by depositing metallic plates in the earth, and also in water, at a distance of 150 yards from each other, as before; and a strong solution of silver was placed in the circuit of the connecting insulated wire. By either mode of producing the current, electrotype action immediately took place. Two little articles were coated with silver. But in the course of exactly one hour, a portion of a large iron key (slightly gilt, being the key of a strong safe), which had been immersed in the writer's presence, came out so effectually encrusted, that three shavings with a knife were necessary to scrape off the silver. Similar experiments were repeated at the residence of the Patentee, near Birmingham, where Mr. Bain attended; and in the mean time a conditional agreement was made with him, on very liberal terms, for an exclusive licence to use this discovery for electrotyping. To give effect to this, however, it was necessary to make an alteration in the title of Mr. Bain's patent, in each stage of its official progress; and this occasioned the issue of fresh notices, just the same as if a new patent had to be solicited. The indefatigable Mr. Wheatstone again opposed the proposed alteration, and this, notwithstanding that his own patent agent, who happened to be the same person whom the proprietor of the electrotype process also employed to make the alteration, offered his written guarantee that the Professor's interests were in no way concerned in the matter. The delay occasioned by all those movements, however, retarded the affixing the great seal until the 27th of May last. On the 31st of May, the writer left for the distinguished member of the

Royal Society, who had promised to present it, the paper and the diagram which has just now been laid before the reader. It was returned next day with the following laconic epistle:

"1st *June*, 1843.

"Dear Sir,

"I am sorry that I must decline presenting the paper of your friend.

"I am, dear Sir, yours, faithfully,

"* * *"

How bitterly is the loss of Sir Joseph Banks, that generous and noble-minded friend to real merit, to be deplored in these days!

Does the reader require to be told by whose influence it was that the gates of the very temple of Science itself are thus barred and bolted against Mr. Bain? *Mr. Charles Wheatstone is himself one of the Council of the Royal Society.* From various members of the *Athenæum*, it was learned that he had very lately, perhaps from the title of Mr. Bain's patent, which purports to be "for improvements in producing and regulating electric currents," gained some imperfect ideas of this artist's discovery, which, it appears, he imagined reached no further than the experiments on the Serpentine River, on the 2d June, 1842. The merit of these, with his usual candour, he determined to claim for himself and others, without the slightest mention of Mr. Bain at all. On the 23d May, at the Society of Civil Engineers, Mr. Wheatstone delivered an allocution, which is reported (doubtless in his *own words*) in the *Literary Gazette* of the 3d June instant, on the merits of his and Mr. Cooke's newly-patented telegraph, which was specified only on the 11th March last. From that discourse the following is an extract:

"Professor Wheatstone's former permutating magnetic-needle telegraph, though possessing a power of combination far exceeding that of any preceding telegraph in which magnetic needles were proposed to be employed, required a number of wires proportionate to the number of signals; by employing the earth, or an extent of water, to return the current or complete the circuit, which might be done by connecting the two extremities of one of the communicating wires with plates of metal, and plunging them in the earth or the water, one of the communicating wires might be entirely dispensed with. This plan would be adopted at Aix-la-Chapelle. That a large extent of earth, or the portion of

a river, could be made to complete an electric circuit, was long since established, with respect to electricity of high tension, by the extensive experiments of Dr. Watson, in 1748, and others ; and the same thing was proved with regard to voltaic electricity, by the independent experiments of Erman, Basse, and Aldini, made in 1803. Erman's experiments were performed in the river Havel, near Potsdam ; those of Basse in the river Wern and the environs of Hamel ; and Aldini's researches were prosecuted on the shore near Calais. Professor Steinheil also employed the earth as a means of completing the circuit in the electro-magnetic telegraph, which he established at Munich, in 1838. A pair of Professor Wheatstone's telegraphs were established at Berlin, in the beginning of 1842 : the line of communication was a single wire, carried through the air upon wooden posts ; and plates of metal, attached to the ends of the wire, were buried in the ground. In the same year, he formed a communication between King's College and the shot-tower upon the opposite side of the river; the communicating wire was laid along the parapets of Somerset House, and Waterloo Bridge, and thence to the top of the tower, where one of the telegraphs was placed ; the wire then descended, and a plate of zinc, attached to its extremity, was plunged into the mud of the river ; a similar plate was attached to the extremity at the north side, and was immersed in the water. The circuit was thus completed by the entire breadth of the Thames, and the telegraphs acted as well as if the circuit were entirely metallic. *The peculiar construction of the present signal-telegraph enabled a magneto-electric machine to be substituted for a voltaic battery. This source of electric action not being subject to cessation or diminution, the attention necessary for keeping a voltaic battery in order was dispensed with, and the instruments were always ready for action without any previous preparation.*"

There is more, far more, of artifice in this paragraph than is at first sight apparent. It appears, however, by the two last sentences, that Professor Wheatstone, up to the present hour, knows of no method of dispensing with the use of galvanic batteries, except by the agency of magneto-electric machines. So much at least it is important to bear in mind, lest it should happen at a future day that some one shall boldly lay claim to Mr. Bain's recent discovery of producing very sufficient currents from the earth or water itself. Such, indeed, has been the fate of most of his former inventions.

For the information of the unlearned reader, it must be explained, that a magneto-electric machine consists of a very powerful permanent magnet, to the poles of which and nearly in contact, there is presented a large piece of soft iron, in the form of a small magnet, but enveloped with many convolutions

of coated wire. If the magnet receive a rotatory motion currents of electricity are excited in the wire by the mere act of rotation. When the poles of the magnet are at rest, adjacent to the iron and its coil of wire, no flow takes place. When the poles are whirled round, currents are excited in the wire, not continuous but somewhat in the nature of pulsations, and the direction of which depends on that of the revolving magnet. If this be from right to left, the currents flow in one way; if from left to right, they run in the contrary direction. By such currents mechanical action may be produced. But the insurmountable impediment to the use of magneto-electricity, consists in the very considerable force necessary to make the great magnet revolve, the attraction between which and the soft iron opposing a strong resistance when the current is of such power as to be of any avail. The same effects would be produced by fixing the magnet and compelling the piece of soft iron to revolve, and this, indeed, is the mode most frequently in use, as requiring somewhat less force to effect the revolution, seeing that the soft iron is of less weight than the magnet; but the resistance to be overcome, which is caused by their mutual attraction, remains the same.

The wire laid down by Professor Wheatstone along Waterloo Bridge is there now. If any one should enquire of the Tollmen when it was laid down, the answer will be that it was just three months after Mr. Bain's experiments on the Serpentine, of which this was nothing else but a repetition.

On the 20th of August, 1842, the Professor reviled Mr. Bain in the *Literary Gazette* of that day, accusing him "of false averments," and as "evidently knowing nothing of telegraphic communications by electro-magnets." On the very next day, he wrote to the Directors of Waterloo Bridge for leave to repeat Mr. Bain's experiments. On the 3d of September, he gave that Board a guarantee to make good any possible damage to the bridge; and these letters have been read by a friend of the writer. They are in Mr. Wheatstone's own hand-

writing. The learned member of the council of the Royal Society makes no mention of this, but the fact is not the less matter of record, neither does he let out that the electricity in his own experiment had its source in a galvanic battery, the circuit of which was completed in part by the River Thames. Having thus by repetition verified Mr. Bain's results of the previous 2d of June, the Professor proceeded in his partner's (Mr. Cooke) name, to take out a patent for it on the succeeding 11th of September, all within a very few days, refraining from any publication of it until now. Is such a want of candour a fit attribute in the teacher of the ingenuous youth at one of our universities? The writer himself is the father of several young men; but he would not choose to have them taught experimental philosophy by a person who, with commercial views, is interested in concealing from them the progress made by others in that very branch of science which he is commissioned to illustrate.

On the 11th of March last, the specification of this patent was enrolled, in which it is recorded, that the mechanical power to be employed consists exclusively of electro-magnets and magnetic needles, deriving their currents from the source of galvanic batteries. He now states, that, *in the beginning of* 1842, a pair of his telegraphs were established at Berlin, in which the line of communication was a single wire, to the ends of which were attached plates of metal buried in the earth. Nothing is said, however, about the galvanic battery used on the occasion. Nor is there so much as a hint that the earth was employed to complete the circuit, for this aid could not have been *then* known to Professor Wheatstone, else why should he try the unnecessary experiment on Waterloo Bridge, in August following, or why defer his patent for that discovery until the 11th of September? There is, however, a further invincible proof of the Professor's ignorance of the earth's capacity to complete a circuit, up to the 7th January, 1842; inasmuch as on that day, he specified his Printing Telegraph, and made no mention of

the matter, nor yet of his recent exquisite contrivance of elevating his wire in the air on long poles. The telegraph set up at Berlin, therefore, "in the beginning of 1842," was, most probably, the one just then patented, and which, it will be found, originated in the model which the Professor purchased from Mr. Bain.

It is said, in the report of Mr. Wheatstone's discourse, that he stated, "Professor Steinheil also employed the earth as a means of completing the circuit in the Electro-magnetic Telegraph which he established at Munich, in 1838." Very singular it is that no record of such a thing, *if it took place*, is to be found in Poggendorff's *Annals of Physics and Chemistry* for 1838 and for 1839. Still more extraordinary is the fact, that Mr. Wheatstone should never have heard of it till now, seeing that it was in July, 1839, that he put the Directors of the Great Western Railway to the expense of nearly £4000 in laying down, for thirteen miles, the *many* wires required for what he now calls his "former permutating-magnetic-needle telegraph." One wire, it appears by Mr. Bain's experiments, is sufficient, with a battery of very feeble power. As to that of Professor Steinheil, *if it really happened*, nothing more can be said than that no mention is made either of the distance at which the current was passed through the earth, nor yet of the power of the galvanic battery which was employed to send it. The experiment of Aldini, and most probably those of the other philosophers mentioned, in 1803, was certainly made with a compound battery of eighty cells, which produced a current of such high tensity as nearly to equal that of the frictional electricity employed by Dr. Watson, in 1748. This very important circumstance is, however, passed over in silence by Mr. Wheatstone, as well as all mention of Mr. Bain, who has, at least, the merit of re-inventing the discovery in May, 1842.

He has, moreover, the merit of being led to it by a well-reasoned train of observations. That the water or moisture of the earth would, to some extent, conduct voltaic electricity, is a fact which might have been known in the scientific world, without any useful application of it. To this end a further stretch

of thought became necessary. Mr. Bain found that if the mere ends of the wire were dipped into the water, the current that passed was so feeble that, if he had stopped here, it would be applicable to no practical use. He then saw that it was necessary to attach a few feet of metallic surface to be immersed at each end of the insulated conducting wire. The result was, that the whole current of the small battery employed immediately passed as freely through the water as it could have done through an entire metallic circuit.

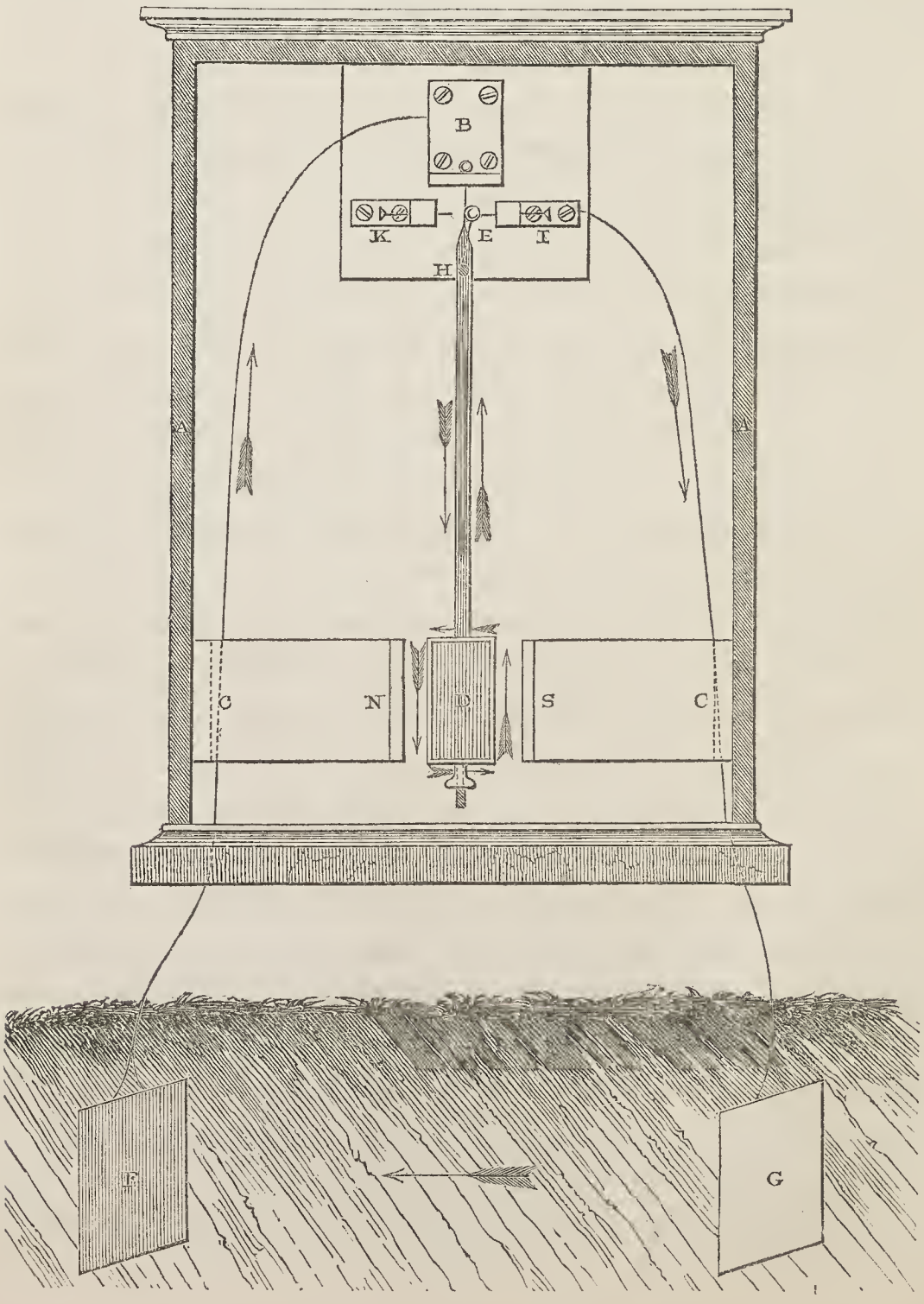
The success of that experiment obviously led Mr. Bain to his great discovery of plunging, in a similar manner, plates of positive and negative metallic surfaces in the earth, or in the water, at great distances; then connecting these by a well insulated wire, he is enabled to discard galvanic batteries altogether, and to produce an everlasting and unvarying flow of electricity, proportionate in power to the amount of metallic surface. The importance of such a discovery cannot be overrated, and it is hoped that Mr. Wheatstone will now at long last be pleased to leave Mr. Bain quietly in possession also of the honour. If a copper wire, one-sixth of an inch in thickness, be imbedded in a bar of boiling asphaltum, and sent along the railway (for its better protection) from London to Liverpool—if two tons weight of zinc plates be immersed in the Mersey at Liverpool, and attached to that end of the wire—and if one ton weight of copper be sunk in the river Thames, and attached to this end of the wire, no rational man can doubt that an electric current would be established of ten times the power necessary to work a telegraph. What is 200 miles, or any terrestrial distance, to an agency that travels with the speed of light! By two independent astronomical phenomena, namely, the aberration of light, and the retardation of the eclipses of Jupiter's satellites, it is alike established that this influence travels, in round numbers, at the rate of 192,000 miles per second. Mr. Wheatstone says, that he has discovered the velocity of electricity to be still greater, and gives, as his conclusion, that it goes at the rate of 197,000 miles per second.

Now, in the voltaic circuit in question, it may be a hard

matter to say whether the current flies round the coast by the sea, or whether it penetrates the earth superficially. One thing is, however, certain—the experiment is not likely to be tried at the sole cost of the inventor, and it is humbly conceived that the country, which is to be benefited by the discovery, should incur the trifling charge of bringing it into use. Supposing, however, the very improbable event, that the current, from some unforeseen cause, could not be passed to the distance of 200 miles, it may still be sent as far as it will go, in relays, connecting these very easily by means which are well known to every practical electrician.

It has hitherto been a received idea, that the voltaic current is only to be produced by the oxidation of the metals in the galvanic battery; but is this idea a truth so very certain? May not the mere contact of the respective plates with moisture excite an electrical activity of the metallic particles, without any oxidation taking place?—and may not oxidation itself be the effect, not the cause, of such electrical action, so originating in the mere contact of the metals with moisture, the action being greatly increased in energy when the liquid is acidulated? The writer has seen the current produced through the earth so instantaneously, that there was not a moment's time for oxidation. Be this, however, as it may, the continuous and unvarying flow produced by Mr. Bain's method, is capable of generating a motion with such feeble currents as are scarcely conceivable, and hence pendulums are to be moved with a vast diminution of friction, continuing their vibration as long as the particles of metal concerned in the process shall hold together. It was premised that the coil can be deflected with a current so feeble as to excite no perceptible attractive force in an electromagnet. The following diagram exhibits Mr. Bain's latest improved pendulum, which is moved by a metallic surface, in the moist earth, of no more than four or five feet. It is, indeed, very necessary in these times to publish it without delay, lest the merit of this invention also should be snatched from him by some one or other of the *faiseurs* of the day. Can any man now foresee

the important ends to which this little instrument may hereafter be applied? In the ordinary use of it for the measurement of time, diminished friction, and hence far greater accuracy, is obviously secured. Its permanence of action is probably the nearest approach yet made to the impossible chimera called the perpetual motion. Mr. Bain intends to apply it also to telegraphic purposes, in which its agency secures him improvements of the last importance, for he can certainly, by its means, discard wheels of any and every description, as well as electro-magnets.



A A is a mahogany case with a glass front; *B* is a metal bracket fixed to the back of the case, and to which the pendulum *D* is suspended. *C C* are permanent steel magnets fixed to the sides of the case in such a manner as that the pendulum-ball *D* can vibrate freely between the poles of each magnet. The magnets are so placed as that poles of dissimilar names face each other. *E* is a small platinum ball affixed to a brass stem, free to move to one side or the other, being fastened to a light spindle carried by the pendulum-rod at *H*. The plate of copper *F* is deposited in the moist earth, from which a wire leads to the bracket *B*. The plate of zinc *G* is likewise deposited in the earth, and its wire leads to the piece of metal *I*. To the lower end of the suspension-spring of the pendulum is attached a wire coated with silk. It is led down the back of the rod (which is wood), and then coiled longitudinally, in many convolutions, around the edge of the pendulum-ball, in a groove previously made for the purpose. It is then taken up the back of the rod and terminates in the bearings of the spindle at *H*. The action of the engine is as follows:—A constant and uniform current of electricity would be established and would pass through the earth, the plates and wires in the direction of the arrows, as long as the platinum ball *E* rests on the platinum pin projecting from the metal *I*. But if the pendulum is put in motion, suppose that, at first, it were drawn aside until the ball *D* should be between the poles of the right-hand magnet, the point *H* being now farther to the right than the ball *E*, the latter would fall to the left and rest on the pin *K* until the pendulum took its vibration to the left, when the ball *E* would fall to the right, and so on continually, the action being produced by the change of the centre of gravitation at each vibration of the pendulum. This action of the ball *E* lets on and cuts off the flow of electricity at or near the extreme ends of the pendulum's vibrations, so that the convolving wire of the pendulum-ball is attracted and repelled by the magnets at the proper points of its vibrations, and thus a continual motion is kept up for an indefinite period of time.

The reader is requested to bear in mind, that the discovery which paved the way for such a chronometer was contemptuously refused to be presented to the Royal Society by one of its brightest ornaments. The inventor is the same artist of whom Mr. Charles Wheatstone, at the moment when repeating that artist's experiments—from which, however, the learned gentleman failed to extract their most valuable result—says, "*He was a working mechanic, who was employed by me between the months of August and December*, 1840." "*Of the true principles of telegraphic communication by electro-magnets, which, aided by the beautiful theory of Ohm, I was the first to determine, he* (*Bain*) *evidently knows nothing.*"

PART II.

Among the many signs of the times there are, perhaps, none more remarkable than the difficulties which now oppose themselves to the student, who really labours for honest fame through the medium of successful ingenuity, when making his way to the notice of the public, among a host of competitors. These are generally men who, with far inferior talent, yet succeed, by following the maxim of the French poet,

"Travaillez votre succès plus encore que vos vers,"

in gaining an ephemeral reputation and in extinguishing effectually their more meritorious rivals. The thousand channels of the periodical press echo, far and wide, any discoveries to which they may choose to lay claim—sometimes, in the shape of an article of scientific information; sometimes, in the review of a preface to another man's work, which preface the candidate for fame had previously written in his own praise*; and very often in the shape of reports of the proceedings of learned societies, also written by the candidate, who most carefully dwells on his own excellence, and as carefully suppresses any mention of the works of his fellow-labourers. What chance of notice has the retired artist with those who thus everlastingly keep themselves in the public eye, and assume every shape of Proteus to attract men's attention? This was not so in former days. In the time of Shakspeare, the noble and ancient art of puffing, though then also in vogue as at present, could scarcely have a wider scope than the personal circle of him who desiderated the species of fame thus to be acquired. The conversation between Beatrice and the shrewd and caustic Benedict, evinces the value of self-praise, such as it was two hundred and fifty years ago.

* See such a Preface to the work of Professor Daniell, of King's College, on Chemistry, in laudation of his fellow Professor, Mr. Wheatstone, copied into the *Companion of the Year Book*, for 1843.

"*Beat.* There's not one wise man among twenty that will praise himself.

"*Ben.* An old, an old instance, Beatrice, that lived in the time of good neighbours. If a man do not erect in this age, his own tomb ere he dies, he shall live no longer in monument, than the bell rings and the widow weeps.

"*Beat.* And how long is that, think you ?

"*Ben.* Why an hour in clamour, and a quarter in rheum. Therefore, it is most expedient for the wise, if don Worm, his conscience, find no impediment to the contrary, to be the trumpet of his own virtues, as I am to myself. So much for praising myself, who, I myself will bear witness, is praiseworthy."

Had Benedict lived in our times, he would have found that Don Worm is either asleep or dead, so much are matters altered for the worse, as respects the unassuming man of merit. Mr. Bain, for one, has therefore no resource but to throw himself on the impartial judgment of the scientific world, who alone are really capable of giving a just verdict in his cause, bringing before that enlightened tribunal, not mendacious statements, but absolute demonstrations, to the eye and ear, of his veracity, both in respect of his own labours, as well as in regard to the efforts of those who contend with him in the race of discovery.

He cannot compete with his opponents in the warfare of the periodical press. He has no well-paid advertisements to insert, nor any news to send of the progress of science in this and other countries, in order to ingratiate himself with the Editors of particular journals. But he would be guilty of gross injustice to that generous class of men if he did not declare his persuasion, founded on experience, that they are often the unconscious agents of the commercial views of interested individuals, in giving publicity to articles which, under the guise of literary and scientific notices, are in reality nothing else than so many trumpetings in praise of those who have no other avenue to fame.

In the whole range of the science of puffing, however, there never, perhaps, has been laid for human credulity a more ingenious trap than the subjoined most singular document—a trap, indeed, which escaped even its place in the nomenclature of the highly-gifted author of the *Critic*. Two men embarked in a commercial partnership, with a view to advertise their commodity, pretend to

quarrel. To reconcile these imaginary differences, they each prevail on an unsuspecting friend to arbitrate between them. One of thoseis Sir Isambard Brunel, whose works have justly won him the admiration of the whole world, while his amiable qualities in private life entitle him to be revered by all who have the happiness of his acquaintance. The other ought to hold, also, a distinguished rank in science, being a professor of one of our universities. Neither of them, however, was well versed in the history of the application of electricity to telegraphs (as the sequel of this tract will clearly show), while of the respective claims of the pseudo-disputants they obviously could know nothing beyond that which it suited the immediate purpose of the latter to declare. The arbitrators are thus innocently induced to sign a manifesto which, under the sanction of their distinguished names, is to be converted into a glowing prologue to every future lecture in praise of the commodity which the partners have thus in the market. The time when this strange stimulus to public curiosity was judged to be necessary, is precisely three months after Mr. Bain had published, in the journal of his native county (the *John o'Groat's*, of 25th January, 1841), a complete description of his electro-magnetic printing telegraph; it was at the moment when Mr. Bain was asserting, in the *Inventors' Advocate*, his claim to the invention of the electric clock, and when he was, on 7th April, 1841, answered by Mr. Wheatstone, under the name of John Lamb (a controversy which ended in the attempt to corrupt that journal); and it was at the very moment when the partners, who happen to be in the private acquaintance of the directors of the Polytechnic, had good reason to know that Mr. Bain's Telegraph was in preparation for exhibition at that institution. This invention did, in fact, become the subject of lectures there in July, only eight or nine weeks after the date of the following commercial announcement:—

"STATEMENT.

"As the electric telegraph has recently attracted a considerable share of public attention, our friends, Messrs. Cooke and Wheatstone, have been put to some inconvenience by a misunderstanding which has prevailed respecting

their relative positions in connexion with the invention. The following short statement of the facts has, therefore, at their request, been drawn up by us, the undersigned, Sir Isambard Brunel, Engineer of the Thames Tunnel, and Professor Daniell, of King's College, as a document which either party may at pleasure make publicly known.

"In March, 1836, Mr. Cooke, while engaged at Heidelberg in scientific pursuits, witnessed, for the first time, one of those *well-known* experiments on electricity, considered as a possible means of communicating intelligence which have been tried and exhibited from time to time, during many years, by various philosophers. Struck with the vast importance of an instantaneous mode of communication to the railways then extending themselves over Great Britain, as well as to government and general purposes, and impressed with a strong conviction that so great an object might be practically attained by means of electricity, Mr. Cooke immediately directed his attention to the adaptation of electricity to a practical system of telegraphing; and giving up the profession in which he was engaged, he, from that hour, devoted himself exclusively to the realization of that object. He came to England in April, 1836, to perfect his plans and instruments. In February, 1837, while engaged in completing a set of instruments for an intended experimental application of his telegraph to a tunnel on the Liverpool and Manchester Railway, he became acquainted, through the introduction of Dr. Roget, with Professor Wheatstone, who had, for several years, given much attention to the subject of transmitting intelligence by electricity, and had made several discoveries of the highest importance connected with this subject. Among these were his *well-known* determination of the velocity of electricity, when passing through a metal wire; his experiments, in which the deflection of magnetic needles, the decomposition of water, and other voltaic and magneto-electric effects, were produced through greater lengths of wire than had ever before been experimented upon; and his original method of converting a few wires into a considerable number of circuits, so that they might transmit the greatest number of signals which can be transmitted by a given number of wires, by the deflection of the magnetic needles.

"In May, 1837, Messrs. Cooke and Wheatstone took out a joint English patent, on a footing of equality, for their existing inventions. The terms of their partnership, which were more exactly defined and confirmed in November, 1837, by a partnership deed, vested in Mr. Cooke, as the originator of the undertaking, the exclusive management of the invention in Great Britain, Ireland, and the Colonies, with the exclusive engineering department, as between themselves, and all the benefits arising from the laying down of the lines and the manufacture of the instruments. As partners standing on a perfect equality, Messrs. Cooke and Wheatstone were to divide equally all proceeds arising from the granting of licences, or from sale of the patent rights—a percentage being first payable to Mr. Cooke, as manager. Professor Wheatstone retained an equal voice with Mr. Cooke in selecting and modifying the forms of the telegraphic instruments, and both parties pledged themselves to impart

to each other, for their equal and mutual benefit, all improvements, of whatever kind, which they might become possessed of, connected with the giving of signals or the sounding of alarums by means of electricity. Since the formation of the partnership the undertaking has rapidly progressed, under the constant and equally successful exertions of the parties in their distinct departments, until it has attained the character of a simple and practical system worked out scientifically on the sure basis of actual experience.

"Whilst Mr. Cooke is entitled to stand alone as the gentleman to whom this country is indebted for having practically introduced and carried out the electric telegraph as a useful undertaking, promising to be a work of national importance; and Professor Wheatstone is acknowledged as the scientific man, whose profound and successful researches had already prepared the public to receive it as a project capable of practical application; it is to the united labours of two gentlemen so well qualified for mutual assistance, that we must attribute the rapid progress which this important invention has made during the five years since they have been associated.

(Signed) "Mc. Id. Brunel.

"*London*, 27*th April*, 1841. "J. F. Daniell."

"Gentlemen, "*London*, 27*th April*, 1841.

"We cordially acknowledge the correctness of the facts stated in the above document, and beg to express our grateful sense of the very friendly and gratifying manner in which you have recorded your opinion of our joint labours, *and of the value of our invention.* We are, Gentlemen, with feelings of the highest esteem, your obedient Servants,

(Signed) "William F. Cooke,

"Sir M. Isambard Brunel, *and* "C. Wheatstone."

"J. F. Daniell, Esq., *Professor, &c. &c.*

No remark is necessary as to the import of the foregoing document, which the partners lost no time in circulating in every possible way, both in the periodicals and by hand-bills. It is, indeed, to be regretted, that Professor Wheatstone had not favoured the umpires with the loan of his copy of *Mr. Ronalds' book*, published in 1823, containing that gentleman's experiments on eight miles of wire, and showing that many other parties, long antecedent to Professor Wheatstone's "successful researches," *had prepared the public to receive the project* of electric telegraphs.

It is now proposed to advert to the private history of Mr. Wheatstone's treatment of Mr. Bain.

The editor of the *Literary Gazette** has amused his readers by a specimen of Mr. Bain's *griffonage* in his first letter to that journal, of the 10th of June last, the faults in which are, however, for the most part chargeable on his own printer. Let this joke pass. True it is, that the letter in question proves that Mr. Bain owes nothing to books, the fact being that he never read any in science or the arts, until very lately, when a sense of ill usage compelled him to cast an eye on the labours of others in the same field as that in which he is occupied. But this fact proves equally a *per contra*. Whatever Mr. Bain may have invented is the unalloyed product of his own natural and untutored genius. His antagonist is, however, as he himself says, an experimenter of many years standing; as Professor of Experimental Philosophy he is bound to be well versed in electrical science, and in every practical application thereof to the useful arts, which is on record. If he shall therefore be accused of various inroads on the inventions of others, as he will presently be, the evidence is rendered credible from the ample means within his reach: but in the case of Mr. Bain such a charge is utterly incredible, from the absence of any similar opportunities.

Less versed in the ways of the world even than in letters, but endowed with an ardent thirst for mechanical contrivances, Mr. Bain, in the exercise of his vocation, as a clock and watch-maker, arrived in London at the age of twenty-six, in March, 1837.

Here he attended with all the ardour of youth, and soon became fascinated with such brief lectures as he could hear at the Adelaide Gallery and Polytechnic Institution, on the wonders of electro-magnetism. He arranged in his own mind almost intuitively, the idea of applying that mysterious essence to his own art, the measurement of time, than which there could be nothing more natural and likely, seeing that the art of clock and watch-making was the only branch of mechanism which he

* See the annexed Letters in the Appendix.

had ever attended to. It is proved by the subjoined letter from Mr. Charles M'Dowall, watchmaker, then of St. James's Street, now of Beaufort Street, Chelsea, that as early as March, 1838, Mr. Bain had told him of his intention to apply the electric fluid to the movement of clocks "*so as to make any number go together.*" (*See infra, page* 85.)

No man will venture to assert that the idea of *measuring time,* so as to make any number of clocks go together by electricity, had occurred to any other person than Mr. Bain at this early date, although in the previous year (and in one instance as long as twenty years ago) many others had thought of applying the electric fluid to telegraphic communications, on account of its property of passing with the speed of light to unknown distances.

In the course of the two following years Mr. Bain had not only matured his invention of the system of Electro-Magnetic Clocks, as above, but he had extended his application of the same agency to various other purposes, especially to the transmission of telegraphic messages in such a form as that the message should be delivered in print to those for whom it was intended.

It is certified by Mr. M'Dowall (*See infra, page* 85), that in the course of the month of June, 1840, he, a very competent judge, personally inspected Mr. Bain's model of the Electro-Magnetic Clock, and also "the apparatus for printing at a distance by means of electricity;" and that he further saw "several pieces of paper which had been printed on by the apparatus."

It is again certified in the annexed letter* from Mr. Robert

---

* "Mr. Alexander Bain.

"Dear Sir,

"In reference to your application, I recollect visiting you at your apartments in Wigmore Street, early in July, 1840, when you *showed me the model* of your Electro-Magnetic Printing Telegraph, with which you printed my name at the time. You also showed me a model of your Electro-Magnetic Clock, and explained to me the principles and utility of them.

"I remain, dear Sir, yours, respectfully,

(Signed) "Robert C. Pinkerton."

"*Perceval Street, Clerkenwell,* Aug. 23, 1842.'

C. Pinkerton, of 20, Perceval Street, Clerkenwell, watchmaker, and therefore another competent judge, that early in the month of July, 1840, he also inspected Mr. Bain's model of his Electro-Magnetic Printing Telegraph, with which Mr. Bain printed his (Mr. Pinkerton's) name. He certifies, moreover, that, at the same visit, Mr. Bain showed him "a model of the Electro-Magnetic Clock, and explained to him the principles and utility of them;" *viz.*, of both models.

No man will hazard the assertion, that up to these dates the electro-magnetic power had ever actually performed the work of telegraphic printing, in any mode or fashion, by the hands of any other person than those of Mr. Bain.

But why was he more than two years occupied in thus maturing those two inventions?

Those who have themselves consumed the midnight oil in questioning nature concerning her mysterious ways, insensible to hunger and cold, as if they were not of this earth, but spirits of another sphere, are best able to appreciate the merit of this young artist, who, regardless of the allurements of London, to which others of his age are so prone, doomed himself for more than one-half of every day to the drudgery of life, and this indeed for its needful support, and snatched from the importunate claims of frail flesh to sleep and repose such time as was necessary for his experiments in science. Nay, more, he subtracted even from the scanty pittance which was earned by irksome, because uninteresting, toil, the very considerable sums which he was obliged to expend for the mere materials of his models and other operations. Let those, his fellow-labourers in the field of scientific inquiry, look at his works and say, considering his means, whether he was dilatory or slow of apprehension, or whether he is not rather another example, that

> "Haud facile emergunt quorum virtutibus obstant,
> Res angusta domi!"

Hard and unfeeling, indeed, is this miserable world; but it would be harder than adamant and colder than ice, if it could

see, without respect and admiration, a young man, unfriended and untaught, enthusiastically striving to raise himself to fame and honour by the noble impulse of becoming a benefactor to the human race. Such are the materials out of which were created Arkwright and James Watt—and men formed of such materials are not those who can or ought to be trodden down under the iron hoof of insolent pretension.

It thus appears in evidence that, by the month of June, 1840, Mr. Bain was prepared with models of each of the two inventions in question, to be laid before men of science and capital, in the hope that these would promote the introduction of them into practical use. To this end he waited on Alderman Sir Peter Laurie, early in the morning of the 1st of August following, who attests the fact as under:—

"TO THE RIGHT HONOURABLE THE LORDS COMMISSIONERS OF THE ADMIRALTY.

"MY LORDS,

"Mr. Alexander Bain called on me on the 1st August, 1840, for the purpose of learning whether I could introduce him to some one possessing capital, to join him in bringing his inventions of the *Electro-magnetic Clock* AND the *Electro-magnetic Printing Telegraph* into full operation, and I wrote to my late friend, Dr. Birkbeck, as more able than myself to promote Mr. Bain's wishes; and I write this note for the purpose of showing, that at the above date, Mr. Bain's inventions were in a complete state, and only delayed from want of the necessary capital.

"I have the honour to be,

"Your Lordships' faithful Servant,

"*Park Square, June 20th*, 1842." "(Signed) P. LAURIE."

What says Professor Wheatstone in reply to this plain story as to what occurred before he had ever heard of Mr. Bain? Why the insinuation of a denial that any such inventions were *in esse*.

"Sir Peter Laurie's letter seems to have been written with a kind wish of introducing a countryman to the Lords of the Admiralty, and apparently without any intention of its being applied to its present use. It cannot be any disparagement to this gentleman's judgment to observe, that the highest mechanical attainments could not enable a person, after the lapse of nearly two years, *to pronounce of his own knowledge*, from a single conversation, about a machine, which he had never seen, that such machine was in 'a complete state.'"

Here, although Sir Peter Laurie mentions two machines for very different purposes, the Professor would have it understood that there was only one machine in question, *viz.*, the Printing Telegraph, the rough model of which he cannot deny that he himself had subsequently purchased, and that even this was not in a complete state; that is, it was not then in the costly form of a complete finished working model, but only in design.

The object of the letter was not to "*introduce*" Mr. Bain to the Lords of the Admiralty—for the Professor well knew that he was before then, *viz.* on the 11th of May, a competitor with himself, at that department, for the adoption of their respective Telegraphs—but to remove from their lordships' minds a most unfounded impression (he knows best by whom implanted), that Mr. Bain was only "a working mechanic whom he had employed," and who, during this employ, stole his master's ideas. The letter showed that Mr. Bain's invention of the Telegraph, as well as that of the Clock, was complete before he ever saw Mr. Wheatstone.

Sir Peter Laurie's introductory note to Dr. Birkbeck is as follows:—

"My dear Sir, 7, *Park Square*, 1*st August*, 1840.

"The bearer seems to be a very clever young man, and has something worth *your* notice. As you understand all these things thoroughly, I have sent him to you. It is not an effort to obtain money, but to introduce something really useful. Could you recommend him to the Society of Arts?

"I am, my dear Sir,

"Yours, very truly,

"Dr. Birkbeck, *Finsbury Square*. "(Signed) P. Laurie."

With this letter Mr. Bain immediately waited on Dr. Birkbeck, who was then, however, unfortunately, too ill to be seen. Not knowing in that case what to do, he repaired to the office of the *Mechanics' Magazine*, in Fleet Street, which he reached about noon, *all on the same day* [*quod nota bene*]. Here he met with Mr. Baddeley, the able mechanist, who was then the assistant editor of that journal, to whom he minutely explained his two inventions, and who recommended him to wait on Professor Wheatstone, with the same explanations, at King's College, in the Strand, close by, with which Mr. Bain

immediately complied, and saw the Professor for the first time on that very morning.

Mr. Wheatstone gravely gives it to be understood that a young man, then only twenty-nine years of age, and naturally of great simplicity and diffidence, would venture to present himself successively to three adepts in mechanical philosophy, in order to talk about pretended inventions, which, Mr. W. would insinuate, were in reality only so many castles in the air. Mr. Bain, it is true, carried no models about with him on that day's circuit (rather a cumbersome affair); but he is a ready draughtsman, and could, by sketches far better than in words, explain his meaning to the full satisfaction of the initiated.

At this, the first interview, the Professor listened to Mr. Bain's disclosures with profound attention and apparent surprise. But giving no hint that he was himself then occupied with similar projects, he said, that he would see him again on the subject at another time. It is a circumstance full of suspicion that he fixed their second interview at his own house, in Conduit Street, for so distant a day as the 18th of August.

They met accordingly at the Professor's house, when Mr. Bain produced his models, viz. the one that of the Electric Clock, the other that of the Printing Telegraph. The Professor advising Mr. Bain *to postpone, for the time being,* all proceedings, with reference to the Electric Clock, without the smallest hint that he had ever thought of such a thing himself [mark, Reader, in the sequel, the reason of this disinterested advice], agreed to purchase the model of the Printing Telegraph, disclosing, for the first time, that he also was then contriving a Printing Telegraph on another construction, but which contrivance he only explained in part, omitting his intended process of inking the paper. But nothing in the shape of a model of it was ever shown, for this especial reason, that none such, as will soon be evident, was then in existence. Some scrap of a diagram, on a little bit of paper, and that only of a small portion of it, was indeed lying on the table.

Two papers were *drawn up by the Professor* on the spot, and signed by them respectively. Mr. Bain understood that they were both to the same effect. That in his possession is as follows:

"In addition to the sum of five pounds, which I have given you for the *model* [*Reader, this man avers that he never saw such a model*] of your proposed modification of the printing apparatus, to be added to the Electric Telegraph,* I will give you fifty pounds, in the event of my making any profitable application thereof; that is, should I have any instrument made for sale in which the inking roller is employed, and in which the wheel, on the circumference of which the types are placed, is bodily moved forward, in order to impress the types on the cylinder carrying the paper, instead of the types being pressed individually, as in my instrument.

"(Signed) C. WHEATSTONE."

"*London*, 20, *Conduit Street*, 18*th August*, 1840."

In the paper retained by the Professor, there was originally inserted a proviso, to the effect that Mr. Bain should not dispose of any model of a Printing Telegraph to any other person. But Mr. Bain decidedly objected to this clause, having in contemplation a very important extension of the powers of that engine beyond what it was capable of in the simpler model thus disposed of. The Professor readily acquiesced in the objection and struck out the passage. By this obliteration then, the real counterpart will be known, if Mr. Wheatstone shall produce it. Does not this open reservation to himself of full power to act, with regard to any other invention, according to circumstances, prove, on the part of Mr. Bain, the very reverse of a written engagement "not to communicate to any other person what he was about without my (the Professor's) permission?" What! enter into such an engagement for only Five Pounds! The Professor dares not assert that any other written agreement ever passed between them. Nay, in his first letter of the 13th June, 1842, he quotes this agreement, but makes no mention of the offensive stipulation in question. At this point

* This is the Patent Telegraph of which the specification had only been enrolled ten days before the first interview.

of time, indeed, Mr. Bain considered their connexion at an end: he had sold, and Mr. Wheatstone had purchased on certain conditions, the model of one of his inventions in the state in which it then stood, declining to purchase the other, viz., that of the Electro-Magnetic Clock, and exhorting Mr. Bain very earnestly not to proceed any further in working out this invention. This advice, however, Mr. Bain disregarded, as he not only proceeded forthwith to construct another Printing Telegraph on far more elaborate principles, and of greater power as above mentioned; but also to look out for a friend to join him in patenting the invention of the clock, which Patent was actually applied for on the 10th October, just fifty-three days after this interview. It would have been sealed in a few weeks more, but for the interesting situation of Her Majesty, whose first confinement took place on the 24th November, and who could not therefore be troubled to affix the Royal Sign Manual to the warrant for sealing.

His applications at this time to several friends "to assist him in bringing his inventions before the public," is indeed admitted *totidem verbis* by the Professor himself, who says it was "not many weeks after Mr. Bain was employed by me, and while he was under a written engagement not to communicate what he was about to any other person, without my permission." Such is Mr. Wheatstone's designation of the transaction of the 18th of August above set forth *verbatim*. How far it is a fair colouring of the case is left to the impartial judgment of the reader.

Mr. Baddeley, who in an evil hour first recommended Mr. Bain to the Professor, gives the following account of that matter, which is another instance of the manly generosity that characterizes by far the greater number of those who wield the all-powerful periodical press of England.

"*To* Mr. A. Bain.

"Sir,

"In reply to your application, I beg to say, that I most distinctly recollect your calling upon me in Fleet Street, in August, 1840, and consulting with me as to the best mode of proceeding with your inventions of an Electric Clock and

an Electric Printing Telegraph, *both of which you explained to me.* I also beg to state, that I then recommended you to call upon Professor Wheatstone, the inventor and patentee of the Electric Telegraph, as the most likely person to appreciate the merits of your inventions, as well as to further your views respecting them. *Professor Wheatstone was at that time unknown to you*, but at my recommendation you waited upon him, and submitted your plans to his inspection; and I only regret that I should have been the means of introducing you to a gentleman who should so far have forgotten what is due to real merit, *as to attempt to dispute with you the two important inventions of which you are unquestionably the author.* To these facts I am quite ready to speak at any time and place that your occasions may require, and remain,

"Yours, very faithfully,

"(Signed) W. BADDELEY."

"29, *Alfred Street, Islington, June 8th*, 1842."

The Professor's answer to this very plain and trenchant charge is a most exquisite specimen of what lawyers call *fencing* with a question:

"It is quite untrue, that Mr. Bain ever exhibited to me a model of an Electro-Magnetic Clock, either before or after he was employed by me. He has not yet given the least proof of his having had in his possession, at the time he mentions, any such model; he has not yet adduced the testimony of any person who then saw it.

"It is equally untrue, that Mr. Bain showed me, at the time he refers to, any model of an *Electric Printing Telegraph!* [Gentle Reader, forget not that he bought this very thing].

"In conclusion, I will merely refer to the letters of Sir P. Laurie and Mr. Baddeley. And what are these letters after all brought forward to prove? that Mr. Bain, *long subsequently* to the dates I have referred to [kind Reader, you shall find that all this *long subsequently* means in reality a space of time rather less than three months!], called upon these parties, and told them he had made certain inventions, which it does not appear they ever saw."

"With respect to the note written by Mr. Baddeley, with whom I have not the honour of being acquainted, I will merely observe, that several of the assertions and negations which it contains could not have been within the *personal knowledge* of the writer. Several of those which Mr. Baddeley has stated as facts, could only have been derived directly or by inference from the statements of Mr Bain. Perhaps, Mr. Baddeley may find some reasons for doubting the perfect accuracy of his friend Mr. Bain's information, viz.: 'that Professor Wheatstone was at that time unknown to him,' Mr. Bain, if he will refer to the eighty-seventh number of the *Inventors' Advocate*, where he will find *that person* stating, that he had made communications to me on the 1st day of August, 1840. If his visit to Mr. Baddeley, therefore, was on any other day in that month [ay, IF; but it was on that day, and no other], he must, from his own

admission, have previously known me. I have strong grounds for thinking this was the case."

This is singular special pleading. The Professor denies not that his first interview with Mr. Bain was on the 1st of August, 1840, nor that Mr. Baddeley was the person who first sent Mr. Bain to him. Mr. Bain must of necessity, therefore, have seen the person who sent him before he could see the person to whom he was thus sent. The reverse of this logical proposition, however, Mr. Wheatstone says,

"I have strong grounds for thinking this was the case; for not many weeks after Mr. Bain was employed by me [This is the phrase by which he designates his purchase of Mr. Bain's model], *and while he was under a written engagement not to communicate what he was about to any other person without my permission* [It is distressing to find that any professor of an English University should allow his imagination to lead him into such an assertion of the thing that is not], he called upon other parties, in the same manner as Mr. Baddeley says he called upon him, and stated also, on those occasions, that he had made the inventions in question, and was looking for some person to assist him in bringing them before the public. I have been informed of this by Mr. Irving, one of the gentlemen to whom he so applied. I have now done with these unjustifiable charges," &c.

Does the whole or any part of the above long extracts, concerning the memorable 1st of August, contain an answer to the heavy charge so plainly set forth by Mr. Baddeley in his letter to Mr. Bain?

"I only regret that I should have been the means of introducing you to a gentleman, who should so far have forgotten what is due to real merit *as to attempt to dispute with you the two important inventions, of which you are unquestionably the author.*"

During the month of September, succeeding the sale of his model to Mr. Wheatstone, and while his patent for the Electric Clock was in process of negociation, Mr. Bain turned his attention to that improvement on his first invention of the Printing Telegraph, which he had in contemplation at the time he sold the model of it, as already mentioned, the object of which improvement was chiefly to produce greater rapidity in printing the message, though by more complex mechanism than the former and simpler machine was capable of effecting. Not doubting that this improved principle would be highly accept-

able to the Professor, he waited upon him, for the third time, at his own house, with a rough model of this new invention. But Mr. Wheatstone objected to the much greater expense which would attend the new principle, as well as the increased wear and tear consequent on the added mechanism, and the danger of the apparatus falling more frequently into disorder. He ended by declining to have any concern with it.

Differing greatly in opinion from the Professor, Mr. Bain, as the former is pleased to say, "*not many weeks* after he was employed by me, called upon other parties, and stated also *on these occasions*, that he had made the inventions in question [viz. those of the Electro-Magnetic Clock and of the *improved* Telegraph], and was looking for some person to assist him in bringing them before the public. I have been informed of this by Mr. Irving, one of the gentlemen to whom he so applied."

In fact, a scientific friend recommended Mr. Bain to Sir George Cayley, an excellent mechanician, who was so good as to introduce him to another scientific friend, by whom he was in turn recommended to Mr. Irving, a gentleman who was said to be engaged in establishing an Electric Telegraph in Belgium.

Mr. Irving received him very kindly, and on understanding the merits of the more complex mode of Printing, which Mr. Wheatstone had rejected, proposed to bring about an interview at an early day between himself, the Professor, and Mr. Bain. It was not until many months afterwards that Mr. Bain learned from Mr. Irving that, on his proposing to the Professor the interview in question, the latter informed him that Mr. Bain was *then a workman* in his employ! on which account Mr. Irving thought it improper to attend the interview, as also to inspect Mr. Bain's models on any subsequent occasion.

At this point of time, a bright thought seems to have flashed on the mind of Mr. Wheatstone He had learned from Mr. Irving the active efforts of Mr. Bain to obtain patronage for his inventions, and the probability of his success. Could he but get Mr. Bain in real earnest into his pay, he might ruin all his pre-

tensions to originality of invention, even although Mr. Bain should only work out his own, and nothing of the Professor's, ideas. By spreading a rumour of that which, by studied anticipation, he had thus prematurely told Mr. Irving,* that Mr. Bain "was a working mechanic whom he had employed," no one would believe such a person capable of any invention, except such as he might pirate from his master. Another reason for taking Mr. Bain into pay for a few months was also cogent. It will be distinctly and abundantly proved, and by his own witnesses too, that up to the date of his first interview with Mr. Bain, the Professor had not matured or advanced towards maturing any clock or other contrivance for the measurement of time by the electric fluid, although he had for some few weeks previously mentioned to his friends that such a thing could be effected. It will, moreover, be proved that, on the 20th of June, 1840, he was "chewing the cud of sweet and bitter fancy" over several devices for this object. Nay, the very idea of being able to measure time at all had not occurred to him up to the 21st of January, 1840, when the patent of his signalizing telegraph was sealed, else who can doubt that he would have secured the property of this important invention in that same patent? But on the inspection of Mr. Bain's model clock, on the 18th of August following, all difficulty vanished. It will appear that he employed some one silently and secretly to get ready just such another clock against the meeting of the Royal Society, on the 26th November. It is necessary to repeat, that on Mr. Bain's exhibition of his two models at their second interview, Mr. Wheatstone gave not the smallest hint that his own attention was at this time turned to the object of one of them, the measurement of time—not only this silence; he earnestly exhorted Mr. Bain to pursue the improvement which he was then meditating of the Printing Telegraph; but

* The fact is, that up to the moment when the Professor was thus pleased to mystify Mr. Irving, nothing whatsoever had passed between himself and Mr. Bain at their three interviews, except some conversation and the purchase of the artist's model.

to lay aside, for the time being, all thoughts of advancing the Electric Clock. Finding, however, from Mr. Irving that this advice failed, he resorted to the other stratagem of occupying Mr. Bain's thoughts for a short time with other pursuits, even at some expense to himself, so as to make sure of diverting his attention from the clock. He says, on 13th of June last, "Though I purchased from him (Bain) the rude model which he made to explain his notions, and *subsequently* [*Nota bene*, Reader] employed him to see how far it was capable of practical application to my Telegraph, *I have never made, nor do I ever intend to make, use of any of his suggestions*, nor have I ever laid the slightest claim to them." This is pretty well, when, in the same breath, he calls every one of Mr. Bain's inventions infringements of his own. Always ambiguous, it is his pleasure to call an invention developed and made visible by means of a model, *a suggestion*, the ordinary sense of which word is a verbal hint; as if people were kept in pay to make suggestions! It is here admitted, however, that the Professor retained Mr. Bain for no other purpose than to show forth, in iron and brass, the ideas of the latter's *own* brain exclusively, not those of his Patron. Under these circumstances, is it candid to denominate such a man, over and over again, "a working mechanic who was employed by me?" It is, indeed, to be gathered from the quotation that the employment itself was but a farce, to serve a latent and sinister purpose.

With these cogitations Mr. Wheatstone repaired to the residence of Mr. Bain, to hold this their fourth, and which was a concerted interview. He stated without hesitation, that he came alone, because Mr. Irving had left the whole affair in his hands, which Mr. Bain implicitly believed. Mr. Bain, moreover, entered into a new agreement into which the former one was to merge, without the precaution of committing it to writing; so unlimited at that time was his reliance on the honour of Mr. Wheatstone, whom truth to say, he deemed a generous Mecænas, and of whom, though he could not well say, "*atavis edite*

regibus," the humble artist was willing enough, just then, to exclaim,

"O et præsidium et dulce decus meum!"

By the new treaty it was provided, that the Professor should from time to time supply the necessary funds for the materials and workmanship of two perfect working models, one of the simpler, the other of the more complex Printing Telegraph, which Mr. Bain had thus invented; and that on the application of either of those principles to the intended improved Telegraph of Mr. Wheatstone, Mr. Bain should receive a further sum of £150 as the price of both inventions. It cost Mecænas nothing to make a promise which he could at any time annul, as in fact he did. He had before then, but on what precise date cannot at present be discovered, slily set one of his artificers to work on the construction of a clock, which should be a perfect *fac-simile* of that of Mr. Bain, as he himself, under the name of one of his own workmen, afterwards, with great simplicity lets out. Pursuant to the new treaty Mr. Bain's labours proceeded for several months; the working model of the Telegraph on the simpler principle was finished—that on the more complex plan was far advanced. But the time had arrived for throwing him overboard, the Professor's clock being now secretly finished. Mr. Bain had received, in various small sums, altogether about £25, and the first symptoms of estrangement which he discovered were, that the supplies began to be more and more reluctantly yielded. On being importuned, the Professor desired the finished model to be taken to him on a given day at King's College, with which Mr. Bain complied, in the hope of obtaining some part of the payment now due to him. At the time appointed, however, the Professor was invisible; but had left orders with the porter to take in the model, which was left accordingly. Although, thus disappointed of the needful advances, Mr. Bain continued his labours on the second or more complex model, until at length he found that the money in arrear amounted to as much as he had received. Becoming impatient, he was

desired to carry the second model, in its unfinished state, to the Professor's house for inspection. This he complied with, and also left the model there, having evoked a small instalment of £3. But he never again set eyes on either the first finished model, nor on this the second unfinished one, nor yet on his well-earned money. Ten times over did Mr. Bain call for the unfinished work in order to resume his labour, and ten times over was the Professor denied to him. At last, although the most unsuspicious of human beings, Mr. Bain began to fancy that his models were in some sort purloined, and that he himself was little better than a dupe. About the middle of December, 1840, determined to have an explanation with Mr. Wheatstone, he called at his house at the unusual hour of eight o'clock in the evening, and had his final interview. To his utter astonishment the Professor put himself into a violent passion, the cause of which *rabies* Mr. Bain could at first by no means comprehend. Being reproached however, and in a tone of "*Non tibi sunt integra lintea,*" with the inutility of his inventions, and that they were inferior to those of the Professor himself, Mr. Bain at once saw that he was not only to be choused, but bullied, and he retorted accordingly. The learned Professor prepared to "*darraigne battaile,*" and the artist, nothing loth, put himself in the position of defendant. Mr. Bain, however, was the first to recover his decorum and retired from this disgraceful scene, he being *minus* and the Professor *plus* his models and £25 of arrears, to say nothing of his further expectation of £150 eventually.

Next day Mr. Bain waited on Mr. Irving for explanation, whom up to this hour he believed to be a party concerned in the construction of the two working models so oft referred to. Mr. Irving however, informed him, that being told in the previous month of September by Mr. Wheatstone, that Mr. Bain was then his workman, which he still believed, he could not interfere in the matter.

No wonder that at this time Mr. Bain laboured under the

severest depression of spirits. He was in London alone and without a single friend to console his wounded feelings while smarting under a sense of such base and unmerited usage. Thoughts of home and the scenes of early life rushed on his imagination, and he was tempted most strongly to return and renounce for ever all further exercise of his inventive faculties. To return, however, was then out of his power.

"Nil habet infelix paupertas durius in se
Quam quod ridiculos homines facit."

But notwithstanding a moment of deep despondency, his creative genius came immediately to his aid. He completed in a few days a beautiful little instrument, now in universal use, and carried it to a generous tradesman, who eventually paid him £50 for the invention. It will not here be particularized, because being secured by patent, the purchaser. for commercial reasons, is for the present averse to the publication of its history. But it is a fact, that the fabrication of this useful article, is now carried on to the almost incredible extent of many a gross per week. There is another of his inventions worth notice. It is a very beautiful species of clock, now to be seen at a watchmaker's on Cornhill, in which the use of the pendulum is supplied by the two diverging balls so well known as the "governor" of a steam-engine. Mr. Bain has moreover, at this moment, just presented to the fabricators of Birmingham, a novel improvement which, when carried out in practice, cannot fail to increase very essentially the commerce even of that immense domain of Vulcan. And thus it comes to pass, that the solitary fancies of the humble artist, shut up in his little arsenal, become the means of giving bread to the families of thousands of the industrious classes, while the author of those benefits is himself left to pine in obscurity. How seldom do mankind know who their benefactors really are!—how still more rarely do they evince any gratitude when they do know them! In this respect men are the genuine guests of Amphitryon, who care nothing for their host, but very much for his good cheer.

The writer is aware of more of Mr. Bain's inventions than he can find time to describe. One was for preventing accidents on railways—another for an improved sounding line, which, by an electric current, indicates the moment at which the lead comes in contact with the bottom of the sea, a thing now difficult to be known at great depths—while a third was a still more important discovery for giving instant warning when the heat in the hold of ships becomes dangerous.

These and many other most useful contrivances are, however, for the present, in abeyance, from the want of that patronage which men of genius are proverbially doomed to endure.

Mr. Wheatstone exhibited the clock to the Royal Society at their first meeting, with a Memoir, in which he claims the exclusive merit of the invention. It was afterwards shown to the Society of Civil Engineers, at the conversazione of Mr. Walker, their president; and its properties explained by Mr. Dent, the eminent chronometer-maker of the Strand. The same artist attended the British Association, subsequently at their Annual Meeting, which, in 1841, was at Plymouth, and exhibited the clock, with ample details of its manifold merits, as the invention of Mr. Wheatstone, which he really believed.

The proceedings of those illustrious bodies were, however, far beyond the ken of such a retired student as Mr. Bain; but one day, in January 1841, Mr. Barwise having accidentally learned that this pretended invention was to be exhibited that same evening at the Adelaide Gallery, was just in time to serve Mr. Wheatstone and Mr. Dent, one of the directors of that institution, with notice of an injunction. Thus the Professor's model was perforce withdrawn, and Mr. Bain's clock very soon afterwards exhibited at the Polytechnic.

What version will the man of learning give of these facts? In his first letter of 13th of June, 1842, Mr. Wheatstone, referring to the exhibition of his Clock at the Royal Society, on the 26th November, 1840, says, with surprising gravity,

"It was not until the January following that I became aware that an attempt was about to be made to question my right to the invention, by receiving a notice from a Mr. Barwise, of St. Martin's Lane, stating, that he was the inventor; some time after which it was publicly announced in the placards and advertisements of the Polytechnic exhibition, as being the joint invention of Messrs. Barwise and Bain. The latter person was a working mechanic, who was employed by me between the months of August and December of the year 1840."

But the artifice and affectation displayed in the above sentence approaches to the ludicrous. The warning him that Letters Patent under the Great Seal, had vested in Messrs. Bain and Barwise the property of this invention, is said to be only *an attempt about to be made to question his right to it*—not a word of the Patent itself. As for Mr. Bain, whose model of this very Clock the Professor had inspected on the 18th of August, 1840, and whom he kindly endeavoured to divert from following up that invention, it is *insinuated* that he, as being one of his own workmen, had picked up some of his ideas—he is to be deemed a second Cornelius Agrippa, who, having peeped into the *magic boke* of his master, had at last managed to call up a spirit on his own account. He suppresses the fact, that he repeatedly called on Mr. Barwise, with a view to depreciate the invention, affirming that Mr. Bain's clock would not go for eight hours on an end—while all London knows that it has been going at the Polytechnic for the last two years, keeping perfect time, without being touched by any one for months together. He suppresses the fact, that when the Patentees applied for the extension of their patent to Scotland, he personally opposed them, in July, 1841, but unsuccessfully, before the Lord Advocate Rutherford. Finally, he gives no reason why, if he had the least pretension to originality in this invention, he did not, before its exhibition, lodge a caveat, as is usual, in which case the respective claims of Mr. Bain and himself would have been adjudicated by the proper officer, the Attorney-General. But all this is out-done in his letter of the 18th of August, in which he says, "More than

eighteen months have elapsed since Mr. Bain commenced his infringements:"—a date which can only refer to the 8th of January, 1841, when Mr. Bain's Clock was patented. *Infringements!* the reader must be informed that there lurks under this expression a subterfuge or master-quibble, by which the ingenious Professor can escape from a very palpable absurdity. The infringement hinted at will turn out to be that of the former patent, obtained by the Professor on 21st January, 1840, and specified on 21st July following—ten days only before he saw Mr. Bain, viz., the signalizing telegraph, so frequently referred to. This instrument will anon be minutely explained, with diagrams, to ensure accuracy. It will be proved to be, if not an absolute copy, yet as far as its principle goes, a very sufficient inroad on the previous inventions of two other men now living. In the meantime, in order to be intelligible, it must be thus far described:—At the seat of a galvanic battery there is an instrument, pompously called *the rheotome,* having a revolving disc, with the letters of the alphabet in due order on the margin. Projecting from the rim of this disc there are twenty-four spokes, very like those of a small capstern. The object of this instrument, as the name imports, is alternately to let on and break off the voltaic current. The finger of the operator being inserted between any two spokes, over a particular letter, turns that letter round to a fixed point or stop. At the distant place, where the message is to be delivered, there is another disc, revolving like the rheotome, which also carries on its margin the same twenty-four letters in the same order; but they are now veiled by a thin circular plate of brass, in which there is but one small aperture or window. The rheotome makes and breaks the current which, acting on electro-magnets, causes the same letter which is carried round to the stop of the former to appear at that window of the distant disc. An observer is there stationed to copy it down. Thus letter by letter of a word is copied, until the message shall be completed. This is evidently a telegraph to make signals in the

form of letters, which are to be successively recorded. The invention, even if any material portion of it had originated with Mr. Wheatstone—which most assuredly is not the case—never contemplated the idea of measuring time, nor yet the notion of delivering a message in print, a marvellous advantage over the transcript of a drowsy copyist. It has no machinery for either of those purposes. What then? Why, says the Professor, in allusion to Mr. Bain's telegraph, which contained this faculty of Printing, it is only "*a small part proposed to be added* to my Electric Telegraph (which Mr. Bain by no possibility could either have seen or heard of on the 1st of August, 1840), to effect a purpose for which I had *before* contrived far more efficient means." That no such contrivance was in existence on the 9th June, 1841, will presently be officially proved. He adds, "The part in question was simply a *mechanical addition* involving no scientific principle." He further says, "It is true, that *after* I had contrived this arrangement, Mr. Bain proposed a different and far less efficient mode of effecting the same purpose." Here the Professor ingeniously slides in an insinuation that he had himself contrived such an arrangement for printing before he saw Mr. Bain's. But the word *contrivance* is used here in a double sense, having, on the present occasion, no other meaning than that he was ruminating on the means of effecting his object. He does not pretend that any one ever saw complete drawings, or any model or other apparatus for the purpose, until the month of January, 1842, when the specification of his next patent was enrolled. His evidence of such prior contrivance is only the admission of Mr. Bain, on the 18th of August (in the agreement which he himself drew up for Mr. Bain to sign) that the idea was then on the anvil. That it was no farther advanced is proved by his own witness, as follows:

"Dear Sir, *St. Petersburg Place, Bayswater, 29th July*, 1842.

"At the time you mentioned to me that you had contrived an addition to your Electric Telegraph, by which it could be made to *print* the letters, instead

of merely *showing them*, you *asked me for some information respecting the mode of preparing the manifold writing paper, which you proposed to employ, and on the best form of type for obtaining impressions with it?* The note, in which I answered these enquiries respecting your Printing Telegraph, was dated June 10th, 1840.

"I remain, dear Sir, yours sincerely,

"(Signed) EDWARD COWPER."

"PROFESSOR WHEATSTONE, F.R.S.," &c.

Thus it is manifest that the notion of printing, though it may have been entertained by the Professor, was inchoate on the 10th of June, just fifty-one days before Mr. Bain explained how he was at that moment performing the act of printing with engines ready for the purpose. Mr. Pinkerton states, that early in July, 1840, he saw his own name printed by Mr. Bain; and Mr. M'Dowal saw the apparatus for printing and its work in the previous month, viz., at the same instant of time when the Professor was only consulting with Mr. Cowper how to set about such printing.

Nothing daunted, however, the Professor concludes his first letter by saying, "Whatever may be the merits of Mr. Bain's method, it cannot justify any person to call in question the originality *and priority* of my Electro-Magnetic *Printing* Telegraph, which is secured from infringement by two patents, one already mentioned, including the telegraph itself, and the other of more recent date, comprising my superadded printing apparatus." Thus it is admitted that the patent "already mentioned," being that specified on the 21st July, 1840, merely *showed* letters, as Mr. Cowper truly states; but never was designed to *print* them. The "other of more recent date" is that specified on 7th January, 1842, and is the first in which the invention of printing is mentioned. The reader needs scarcely to be informed that the specification of a patent is the formal publication of the various objects to which the owner by that act acquires a property, and the contrivances by which these are to be attained. Before the sealing of the patent, which in this case occurred on the 7th July, 1841, it was necessary to lodge

with the Attorney-General, under the seal of secrecy, a briefer specification, known by the name "*Deposit*," and which sets forth each and every object of the patent in general terms. Such a document was lodged by Mr. Wheatstone with Sir John Campbell, who then held that high office, on 9th June, 1841. Soon after this the ministry was changed, and Sir Frederick Pollock succeeded.

In the meantime, Mr. Bain, having greatly improved his former invention of the Printing Telegraph, had associated with Lieut. Thomas Wright, of the Royal Navy, for the purpose of obtaining a patent for the engine in this its improved state. To their infinite surprise, they were vehemently opposed by Mr. Wheatstone in person, before the new Attorney-General, on 6th October, 1841. Sir Frederick Pollock having been left in utter ignorance by that ingenuous philosopher, that he had lodged with Sir John Campbell, on the 9th June preceding, the Deposit of what he calls his Electro-Magnetic *Printing Telegraph*, and being entirely persuaded by the Professor that he, and he alone, was the inventor of telegraphic printing, absolutely refused the same privilege to Messrs. Bain and Wright. They retired in great disappointment; but having accidentally heard of the deposit, they in a few days wrote to Sir Frederick Pollock, and prayed him to unseal that paper. The officer of the crown might very naturally be somewhat annoyed at perceiving he was imposed upon by something like a trick. He examined the deposit accordingly, and the result was, that he immediately passed Mr. Bain's patent. The whole of this strange mystification is explained in the following letter, in answer to an enquiry made by Lieutenant Wright:

"Sir, *Temple, 1st Feb.*, 1843.

"The Attorney-general has opened and read the paper deposited by Professor Wheatstone, on the 9th June, 1841; *and he finds no mention made of a 'Printing Telegraph.'* I lose no time in making this communication to you.

"I remain, Sir, your humble Servant,

"(Signed) Jos. Coleman."

"Thomas Wright, Esq."

Now the Professor is here placed in the horns of a dilemma. If the mere insertion of printing in his specification, lodged on 7th January, 1842, notwithstanding the non-insertion of any such operation in his original deposit of June preceding—printing not being therefore within the purview of the Patent when sealed in July, 1841—be nevertheless sufficient to convey to him, as he says, the exclusive property in that invention, it was equally competent to him to have inserted the right of printing, in his specification of the Signalizing Telegraph, which was lodged on 21st July, 1840, ten days before he saw Mr. Bain, in which case at this earlier date he could have unquestionably secured the invention by law. But as no such right was ever claimed, the inference is inevitable—that up to his first interview with Mr. Bain, he had not in fact matured any practical contrivance for the purpose, notwithstanding his reiterated assurances to the contrary.

But if the Professor shall perch himself on the other horn, and say, that although he had, *before* he saw Mr. Bain, contrived "*far more efficient means*" than he for printing, but was deterred from the insertion of those means in his specification of 21st July, 1840, by reason that printing was not in the purview of the Patent so specified, and could not therefore be protected by it, then it results, of necessity, that his Patent "of more recent date, comprising his superadded *Printing Apparatus*" is, as far as printing goes, not worth a farthing. But he says, nevertheless, that his Electro-Magnetic *Printing Telegraph* is "secured from infringement," by both the Patents just referred to—*neither of which in the slightest degree contemplated the art of printing*. He concludes his second letter with the following flourish *in terrorem*: "I have now done with those unjustifiable charges which have been brought forward solely for the purpose of giving a colourable pretext to infringements, which certain parties are endeavouring to make of the Patents for the Electric Telegraph, obtained by myself and Mr. Cooke. Those infringements, if attempted to be carried into effect, will be the subject of inquiry in a court of law."

Thus Mr. Wheatstone's claim to priority of invention in printing is demolished. But "*latet anguis in herba*," he will presently fall back on the master-quibble before referred to. Every possible application of the Electric fluid, whether to the act of printing or to that of measuring time—in short to any thing—will all and each of them be denounced as infringements of the Patent of July, 1840—the Telegraph that only *shows* letters. But the machinery adapted to show letters is altogether different from that which is to print them. It is pretended that the latter is only a "small part proposed to be added" to the former—"a mechanical addition involving no scientific principle." But this is an abuse of language—and a gross abuse of the reader's credulity. The mechanism for *printing* is almost a complete supercession of that for *showing* letters—not an addition. The two trains cannot operate simultaneously in the same engine; and with the small exception shown in italics *infra*, they have nothing in common, unless it be the motive power derived from Electro-Magnetism.

This much at least is proved by the Professor's own admission.

"The following are the means by which I effect this purpose. For the paper disc of the Telegraph, on the circumference of which the letters are printed, a thin disc of brass *is substituted*, cut from the circumference to the centre so as to form four-and-twenty springs, on the extremities of which types or punches are fixed. *This type wheel is brought to any desired position just as the paper disc is.* The additional part consists of a mechanism which, acted upon by an Electro-Magnet, occasions a hammer to strike the punch brought opposite to it, against a cylinder, round which are rolled alternately several sheets of thin white paper, and of the blackened paper used in the manifold writing apparatus."

In like manner, to measure time, a pendulum is necessary, with all the machinery of a perfect time-piece or clock, from which Parent Clock the Electro-Magnetic force may be made to issue and act upon a great number of dial-plates at considerable distances, so that each and all of them shall simultaneously repeat the hour and minute marked by the one progenitor. The idea of accomplishing this action had occurred to Mr. Bain as early as in March, 1838, which fact is certified by Mr.

M'Dowall. But between this system of machinery and that of the Telegraph there is nothing in common, except that Electro-Magnetism is equally the moving power in each case—the two objects, as well as the apparatus by which they are respectively attained, being in all other respects essentially different. If the mere discovery that the Electric fluid can be made to move wheels, is to confer a monopoly of that motion, then is Mr. Wheatstone out of court, for others have made that discovery; some of them twenty years before him, as will presently be shown. There are indeed some who assert, that all the mechanical powers may be reduced to two—the lever and the inclined plane; yet the pulley, the screw, the wheel, the spring, and the wedge, are very convenient implements notwithstanding. Suppose that the first application of the spring had been to work the bottle-jack, would the inventor of that humble but useful instrument be entitled to debar men from its application to chronometers? Could no one have a watch without infringing his Patent? The case is exactly in point. By mankind at large, however, the various purposes to which the Electro-Magnetic force has as yet been, and is still destined hereafter to be applied, more especially the mechanical contrivances by which those objects are to be attained, will each of them ever be deemed original inventions, although the motive principle which pervades them all may have been used to some extent more or less on former occasions.

With reference to Mr. Bain's claim to the invention of the Electro-Magnetic Clock, the Professor's defence is, as it was in the case of the Printing Telegraph, of a twofold and rather contradictory character. 1st. His patent, for "showing" letters, of 1840 is, he maintains, the germ of both inventions—is what the acorn was to the future "monarch of the wood"—what the bar of iron was to the subsequent polished scissors and pen-knife. 2d. He glides in, but very timidly, a sort of claim to priority of invention, in which he will signally fail.

To sustain him in the first line of defence, he adduces the

following most ill-advised document. The reader is requested to note,

1st. The instruments treated of were examined by the subscribers in the summer of 1842, and in the state in which they *then* were. It is not to be inferred that the latest of them, in point of date, and the last undermentioned was in that same state at any previous period.

2d. Three instruments are referred to—the Telegraph, patented in 1840, which never was constructed either for printing or marking time—the clock shown about by Mr. Dent, in 1841, which is not patented—and the *Printing* "TELEGRAPH." It was officially shown that the act of *printing* was not in the purview of the patent, by which this last is claimed, but, by way of after-thought, was smuggled into its specification, on the 7th January, 1842.

"*August* 10, 1842.

"There cannot be the slightest doubt that Professor Wheatstone's *Printing Telegraph* consists of his previously invented Electro-magnet Telegraph, with an addition, viz., that of an apparatus for printing the signals, which the original instrument only exhibits to view. When this addition is removed, the Telegraph itself remains complete in all its details, without requiring the least alteration.* It is equally clear that Professor Wheatstone's Telegraph Clock is merely an application to a particular purpose of his Electro-magnet Telegraph.

"ROBERT WILLIS,
"Jacksonian Professor of Natural and Experimental Philosophy in the University of Cambridge.

"J. F. DANIELL,
"Professor of Chemistry, in King's College, London.

"N. ARNOTT, M.D.

"HENRY MOSELEY,
"Professor of Natural Philosophy, in King's College.

"W. SNOW HARRIS."

Theorem.—On a post or pillar, *A*, let another body, *B*, be made to impinge and adhere. Remove the body *B*, so shall

* This assertion is incorrect; the stellated disc, containing the types to be punched, must now in its turn be replaced by the original paper disc, with the printed letters, as also its brazen disc which veils them, except at the one aperture or window where each letter is shown. It is somewhat remarkable that this is the third occasion on which Mr. Daniell allows himself publicly to appear as a compurgator for Mr. Wheatstone; first, in the arbitration with Sir I. Brunel; secondly, in the preface to his own work on chemistry; and thirdly, as above.

the post or pillar *A* "remain complete in all its details without requiring the least alteration."

[The demonstration is omitted, but it ends with the usual Q. E. D.]

But mark, reader! there is suppressed from this theorem an all-important COROLLARY.

The post or pillar *A*, when isolated from the body *B*, will not singly possess the properties which the two bodies contained while in conjunction.

This is equally true, whether *B* is a printing apparatus or a chronometer. But, seriously, it is to be lamented that five men of distinction, and of unquestionable honour, should thus yield their signatures, unintentionally it is well believed, to the practical effect of deceiving the public. That the document, as it stands, was prepared by Mr. Wheatstone, and that the names of the professors were, as the jurists say, *impetrated* (perhaps, *cum precibus*) no one can doubt; for it is to the same import, and in the very same words as a former assertion of the sort, hazarded by the Professor in his letter of the 13th June preceding, and to which the signatures of those eminent men were expected to give support and *éclat* in the eyes of the unlearned. In that letter he says, "I next proceed to the consideration of my Electro-Magnetic Printing Telegraph. This invention consists merely of *an addition* to the Electro-Magnetic Telegraph, invented by me and described in the first part of the specification [dated 21st July, 1840], of the patent granted to myself and Mr. Cooke, in January, 1840, *when this addition is removed, the Telegraph itself remains, in all its details, without the slightest alteration.* There cannot, therefore, be a question as to the invention of my *Printing Telegraph*, as a whole; but merely as to the additional apparatus, *which occasions the letters to be printed*, instead of their being merely presented to the eye."

How could it be "*a Printing Telegraph as a whole,*" previously to the addition of the apparatus which was to print?

When the reader compares the plain story of Mr. Bain with that of the Professor, let him ask his own understanding on which side is to be seen that which is commonly called prevarication.

On the theory of the first invention of the bottle-jack, the patentee might with more reason claim the time-piece, and call the chronometer his *bottle-jack time-piece*, and say, "There cannot, therefore, be a question as to the invention of my bottle-jack time-piece as a whole, but only as to the additional apparatus which occasions" hours, minutes, and seconds to be measured and shown, instead of the rotatory motion of a shoulder of mutton before the fire, "being merely presented to the eye." When this addition is removed, "the bottle-jack itself remains, in all its details, without the slightest alteration."

Referring to the model of the clock which he had exhibited at the Royal Society, on the 26th November, 1840, Mr. Wheatstone says—

"It admits of no doubt, therefore, that this invention was first publicly made known and claimed* by myself, and *I proceed to the assertion of the writer* [Mr. Bain] *that he communicated the invention to me in August*, 1840, *which was three months preceding the date of my publication.*" The assertion was that of a plain fact: Was the model of Mr. Bain's clock explained to the Professor on the 1st of August, 1840, and was it seen and handled by him on the 18th of that month, *Aye* or *No?* The fact is not denied: how then is it got rid of? Why, as follows: "To this I answer, that there is no essential difference between *my Telegraphic Clock* [he will not admit that it was *Mr. Bain's*] and ONE OF THE FORMS of the Electro-Telegraph invented by me, and described in the specification† of a patent granted to myself and Mr. Cooke,

* Not so: Messrs. Bain and Barwise had claimed (and in due time obtained) a patent for it on the 10th October—seven weeks before the Professor's exhibition on the 26th November.

† There is nothing like the form of a clock, nor any hint of such a thing, in the specification.

in January, 1840; the former is ONE OF THE NUMEROUS AND OBVIOUS APPLICATIONS WHICH I HAVE MADE, and only requires the idea of telegraphing time to present itself, for any workman of ordinary skill to put it in practice."

Unless he means to insinuate here, that Mr. Bain had leisure enough to pirate from this specification (which was only enrolled ten days before he saw the Professor) the idea, which was not in it, of marking time, and like any other "workman of ordinary skill," had got his plans all matured for a perfect clock or time-piece, moved by electro-magnetism, in ten days—a self-evident impossibility, and the contrary of which is, moreover, attested by many witnesses—the answer is nothing to the purpose. It is doctrine, not fact. Very convenient doctrine for Mr. Wheatstone certainly, for under the saving clause of "one of the forms"—one "of the numerous applications which I have made" of the Telegraph of July, 1840, there is no possible application of electro-magnetic agency, through the medium of wheels, to any of the wants of man, past, present, or to come, which he may not hereafter call "one of the forms—one of the numerous applications which I have made," abstaining cautiously in the meantime from any more particular mention of these nondescripts. The mechanism for printing is one, that for the measurement of time is another—so he says, and is supported in this doctrine by the eminent men who have unwarily lent him their names. Sir John Campbell and Sir Frederick Pollock, however, have successively repudiated the doctrine in question, by awarding to Mr. Bain his patent both for the clock and the printing telegraph, as separate and original inventions.

The Professor himself is apparently indisposed to rely on the doctrinal defence—one which is indeed very like the doctrine of developments of the expiring French philosophy. A molusk, by simply wishing it so, developes a fin. It is soon a fish. The fin is in turn developed into a paw. There arises a beast. The paw is developed into an arm with fingers, and lo! the "human form divine," endowed with reason! He therefore sets up a

claim to priority of invention on the particular contrivances themselves. Now, if he had in his own conscience the least belief in his being the original inventor of either of these two, why not rest his case on the exhibition of his models at prior dates to known witnesses, without resorting to the doctrine of developments at all? The fate of his claim, in regard to the invention of printing, has already been seen: that as to the invention of the clocks is now to be examined. He proceeds to say, "The *sole* question, then, is, Did the *idea* of applying my invention to telegraph time *originate* with myself, or was it *suggested* to me by your correspondent?"

But, with reverence to this learned man, the *sole* question is not confined to the *origin of the idea*, for Mr. Bain in that case is one of the ancients as compared to the Professor, it having been already attested that he had conceived the idea in March, 1838. The question extends to *the origin of the matured machine* for giving practical effect to that idea. Many people had a notion of the steam-engine before its recreation by James Watt; and some believe the metals to be compound bodies, which will one day be resolved into their elements, perhaps recomposed. But the philosopher's stone is still a desideratum. He continues as follows:

"Now, with reference to this [the *sole question*] I have to state, that *long before the date specified* [1st August, 1840], I had *described to many of my friends* in what manner the principles of my Telegraph might be applied to enable the time of a single clock to be shown simultaneously in all the rooms of a house, or in all the houses of a town. Among these, the following gentlemen have, from particular circumstances, been able to furnish me with the dates of the communications I made to them: Mr. Airey, the astronomer royal; Dr. W. A. Miller, of King's College; Mr. John Martin, the eminent artist; and Mr. F. O. Ward, formerly a student in King's College. In addition to this *evidence*,* I may add, that Mr. Bain's letter in the *Inventors' Advocate* was immediately answered by Mr. Lamb, '*a workman in my employ*,' *to the purport that it was impossible the statement therein contained could be true*, since I had given him instructions to make the Electro-magnetic Telegraph Clock on the 6th of January, 1840,

* What evidence? Is his own assertion, that he mentioned his cogitations to certain friends, evidence of anything?

which was more than six months before he asserted he made his communication. [Then it is not denied, although under the phrase *communication*, that Mr. Bain did show his model to the Professor in August following.] I repeat that neither as regards the idea, nor any of the details of the Telegraphic Clock, have I been in the slightest degree indebted to your correspondent; and I think, Mr. Editor, you will allow that I have satisfactorily refuted his assertions."

Mr. Bain's assertion is, that he, not Mr. Wheatstone, was the inventor of the clock. Is that refuted? Certainly not, by the mere *ipse dixit* of the latter.

Mr. Bain's letter above referred to, was as under:

"TO THE EDITOR OF THE INVENTORS' ADVOCATE.

"SIR,

"I see by recent publications in various periodicals, that Professor Wheatstone, of King's College, is stated to be the inventor of the application of Electro-Magnetism as a moving power to clocks. I beg respectfully to state, that *Mr. Wheatstone is not the author of this invention. I communicated it in confidence on the first day of August last, with the view of having his opinion on the subject*, and also to see if he would join me in bringing it forward. Since then I have, with Mr. Barwise, of St. Martin's Lane, secured exclusive right to the invention, by Her Majesty's Royal Letters Patent. By giving this a place in the *Inventor's Advocate* you will greatly oblige,

"Sir, your obedient servant,

(Signed) ALEXANDER BAIN."

"35, *Wigmore Street, Cavendish Square, March 24th*, 1841."

The answer to this is as follows:

"TO THE EDITOR OF THE INVENTORS' ADVOCATE.

"SIR,

"The statement of Alexander Bain, in your number of March 27th, does not invalidate the claim of Professor Wheatstone as the inventor of the Electro-Magnetic Clock. Professor Wheatstone gave me instructions to make his Electro-Magnetic Telegraphic Clock on January 6th, 1840, which was more than six months before Mr. Bain says he made his communication.

"Your obedient servant,

"JOHN LAMB."

"*Cooke's Buildings, Old Kent Road, April 7th*, 1841."

Now, this amounts to a rather subdued claim on the part of the Professor to the invention of an Electro-Magnetic Clock, simultaneously with that of Mr. Bain, not to a denial that the latter communicated in confidence the invention in question to the Professor, when, in a complete state, on the 1st August, 1840. But he says, that John Lamb's letter is "to the

purport, that it was impossible the statement therein contained could be true"—meaning that in Mr. Bain's letter above copied; whereas, John Lamb says no such thing.

Mr. Bain immediately had an interview with John Lamb, and elicited from him, 1mo. That though thus instructed, he, to use his own phrase, "never in fact lifted a tool" to the work in question. 2do. That John Lamb must have confused the order for a Clock, with that for the model of the Telegraph, for which a patent was under solicitation on the 6th of January, 1840, which was sealed on the 21st of that month, and which contemplated wheels, springs, and weights, like those of a Clock in it. The latter point Mr. Bain explained in the *Inventors' Advocate*, No. 90.

To this again John Lamb answered as below, in No. 91.

"TO THE EDITOR OF THE INVENTORS' ADVOCATE.

"SIR,

"Mr. Bain, in his letter published in your Journal of April 17th, has completely misstated the purport of the conversation which he had with me. I distinctly told him the instructions I had received from Professor Wheatstone on January 6th, 1840, related to the construction of an instrument, which should show the time of a clock with which it was to be connected by means of a voltaic circuit—in fact, *to the very instrument* to which Messrs. *Bain and Barwise put in their claim.* The other instrument, to which Mr. Bain alludes, was made by me for Professor Wheatstone *long before that time.** I am prepared, if called upon, to substantiate in a court of law the truth of my statement, should the unfounded claims of Messrs. Barwise and Bain render it necessary. My father-in-law (Mr. Graham), who works with me, can also speak to the same facts.

"I am Sir, your obedient Servant,

"JOHN LAMB."

"4, *Cooke's Buildings, Old Kent Road.*"

Now, there is no intention of imputing to this man any purpose of wilfully bearing false witness: he is most likely deceived himself. But the letters which he has been made to sign are not less remarkable for what they admit than for what they conceal. If he ever received such instructions, why not plainly tell whether he executed them, yes or no? In Chancery

* This is the Professor's favourite expression. He himself admits, that he only thought of the Telegraph to show letters, in October previously.

language, "if not, why not?" and if he did, *when did he commence*, and *when did he finish* his instrument? This silence leads to the irresistible conclusion, that after the Professor had inspected Mr. Bain's model of the clock, on the 18th August, 1840, John Lamb was then, *and not previously*, sent for, and put to work, under the able guidance of Mr. Dent, on an instrument which he was easily persuaded to believe was the same as that which had been talked of on the 6th of January preceding. The work was finished in November following, and, before exhibition, was tried in Mr. Dent's shop between two of his time-pieces; and then and there was John Lamb paid £6: 10*s.* for his share in the fabrication. But in April and May, 1841, when he signed the above letters, Mr. Bain's patented clock was lectured on at the Polytechnic Institution. John Lamb, having had thus the opportunity of comparing the clock he had made, under Mr. Wheatstone's directions, for exhibition at the Royal Society, with the clock shown to the public at the Polytechnic, could therefore very well certify, that the former was "*the very instrument* to which Messrs. Bain and Barwise put in their claim. But, *é contra*, Mr. Bain, all unconscious of the pretended instructions to John Lamb, never having seen the clock which he had thus fabricated for the Professor, could not by possibility have hit on the same device—"the very instrument." The first was a *fac-simile* of his own design, and easily to be derived from his previous explanations and models. No one has ever pretended, however, that Mr. Bain had received, in the shape of suggestion, drawings, models, or any other means, the smallest hint to prompt his invention in this beautiful contrivance, on which he had lavished his native genius for more than two years before he could bring it to a practical form. That with him it was the one primitive and parent idea is obviously credible, from his previous pursuits as a clock and and watchmaker, the notion of a Printing Telegraph having occurred to him at a later period. But it is Mr. Wheatstone's

good pleasure to say, that the Electro-Magnetic Clock—or "my *Telegraph* Clock," for such he insinuates Mr. Bain's invention to be—"is *one of the forms*" of his Telegraph for showing letters —"*one of the numerous and obvious applications which I have made*, and only requires the idea of telegraphing time to present itself for any workmen of ordinary skill to put it in practice. In telegraphing messages, the wheel [rheotome] for making and breaking the circuit is turned round by the finger of the operator, while in telegraphing time, it is turned round by the arbor of a clock." Aye! but what turns the arbor?—Why, the weights *regulated by a pendulum*, which is, in short, a complete time-piece, and nothing like a Telegraph.

It is curious to reflect on the many instances in which deep and apparently impenetrable designs have been unveiled, and ultimately unravelled, by the clue of very trivial circumstances.

It would seem highly probable, that when the Professor first appropriated to himself Mr. Bain's invention of the clock, he had felt some misgivings of being detected on a future day. The model shown him was that of the affiliated clock, which repeats the time, derived from the parent clock, to the pendulum of which the apparatus for making and breaking the current is attached. As this last machine could not be carried about in action by Mr. Bain, the Professor saw it not. But Mr. Bain's mode of working the electric fluid was fully explained to him, on the 18th August, 1840. The Professor, however, departed in this particular from his pattern, as appears by his own description, therein evincing the greatest ignorance of mechanics. The fact seems to be, that he encumbered the delicate wheel that moves the pendulum, with the heavy rheotome of the telegraph (perhaps to show some sort of identity in the two instruments), whereby he unnecessarily expended his power, and was guilty of just the same absurdity, as if, in a steam-engine, he had moved the cylinder instead of the piston.

Thus he faithfully imitated the far greater part of the invention, viz. the affiliated clock, which he saw, but broke down, either wilfully or ignorantly, in the imitation of the less important part, that was only described to him.

Another small circumstance presents an amusing specimen of artifice. Alluding to the compound word *rheotome*, which is derived from two words of Greek, Ῥέω (*rheo*) to flow, and Τομος (*tomos*) cutting—literally, flow-cutting, he says, "I have given this name to the wheel that makes and breaks the circuit, which in the telegraph is turned by the finger of the operator, and *in the application in question* is carried round by the arbor of a clock." So that the Electro-Magnetic Clock is still voted to be an *application* of, or an off-shoot from the letter-showing telegraph, of July 1840. It is therefore called the "*telegraph clock*" to remind one continually of its identity with the latter engine; but here he is not so happy in the name. The meaning of the word *telegraph*, as universally understood, is that of a communication between two places far distant. Nay, its meaning is literally so. Τηλε, *tele*, "from afar;" Γραφω, *grapho*, "I write"—"I write from afar;" an appellation exceedingly expressive for the apparatus in question. "The idea of telegraphing time," therefore, in its literal as well as ordinary acceptation, refers to one clock at Plymouth and another in London, connected by wires, the distant one to be moved by electricity, sent from the parent time-piece, at which ever end this may be fixed. That such a thing may be accomplished is certain. But *cui bono?* It is certain also, that the idea of telegraphing time, in this its true sense, would not "occur to any workman of ordinary skill" in all the world, because he knows the contrivance would not pay. Two good chronometers would do as well without the wires and batteries. The real use of the invention is defined by the Professor himself to be this: It is "to enable the time of a single clock to be shown simultaneously in all the rooms of a house, or in all the houses of a town." But to such a system of time-keeping

the epithet of *telegraphic clocks* is an ungrammatical misnomer, not affixed through ignorance but subtlety, to the end that even the poor verbal quibble of a name may help to sustain the assertion, that the Electro-Magnetic Clock is but an addition to, or development of an engine already contrived for purposes having no reference whatsoever to the measurement of time.

It is submitted to the judgment of the reader, whether so many and such varied devices do not, of themselves, and even in the absence of all other proof, betray a consciousness on the part of Mr. Wheatstone himself, that he was not honestly entitled to claim either priority or originality in the invention under discussion.

It is impossible that there can be any truth in the story put forth under the name of John Lamb, that, on the 6th January, 1840, the Professor had given him instructions to make an Electro-Magnetic Clock, such as "*the very instrument*" claimed by Messrs. Bain and Parwise; because this implies that the Professor's ideas in respect of that invention were mature at the time, and wanted nothing but manual labour to exhibit them in the perfect form of a model.

Such a fact is negatived by the unimpeachable testimony of three gentlemen of high respectability, which the Professor himself hereafter adduces, none of whom ever saw any model, or the drawings from which a model could be constructed, for the clock spoken of. But, it is far more formidably negatived by the fact, that Mr. Wheatstone's patent, of which he says this clock was "only one of the numerous and obvious applications," was not sealed until fifteen days after the pretended instructions to John Lamb. Its title is as follows: "Improvements in giving signals and sounding alarms in distant places by means of electric currents." Now, if after the word *alarms* nine little words had been inserted, "for the measurement of time, and for printing letters," those two inventions would have been infallibly secured as his own exclusive property. Six months longer time is allowed by law for the specification, in

the course of which he could have matured his experiments, sufficiently at least for description, if not in models.

But no such words were inserted, a proof that the idea of either the one or the other invention had *not* then crossed his imagination.

This point was strongly urged by Mr. Bain, in his reply to John Lamb's second letter, which appeared in the *Inventors' Advocate*, of 8th May, 1841, No. 93. In good sooth, it was a sore point, and no reply was or could be made to it. But what seemed next best, was the attempt to corrupt the Journal, as before set forth, and thus to shut its columns against such an unpleasant truth-teller as Mr. Bain proved to be. In No. 95 of the *Inventors' Advocate*, dated the 22d of May, there appears the advertisement (the only one ever inserted) of Messrs. Cooke and Wheatstone's Telegraph, which was paid for, with a promise that a series of these should follow, if no more letters from Mr. Bain, *on the subject of electric clocks*, were allowed to appear—a base proposal, which was indignantly spurned by the upright editor, Mr. Bakewell.

The Professor's first letter of the 13th of June, inserted in the *Literary Gazette* of the 18th of June, was answered by Mr. Bain on the 20th of June, 1842. His letter appeared not, however, till the 6th of August following, and with the subjoined note, "We regret having got entangled in this controversy, and shall only hold ourselves in justice bound to afford a place to any reply Mr. Wheatstone may think proper to give.—Ed. *L. G.*" The Professor availed himself of this exclusive privilege with a vengeance, and made such assertions, in his next letter of the 10th of August, as even he would scarcely have ventured on, but for the immunity from reply which was thus secured to him in the above little note. There lives not a more good-natured being than the highly-gifted Editor of the journal in question, but on that occasion, it would appear, that his credulity was come over with "*soft sawdur:*" that he admitted Mr. Bain's answer at all, is a

proof that he is not disposed to walk in the ways of some of his brethren, who have no objection to the insertion, in their columns, of an attack—that being a never-failing ground-bait, which is sure to attract a plentiful fishing of highly paid advertisements afterwards, in the shape of replies, rendered absolutely necessary by the attack itself. This is one of the mysteries of the trade of journalism, to which he has, it is but fair to say, hitherto never lent himself, nor is it worth while for him now to begin.

Mr. Bain stated, "at that time," [1st of August, 1840], "I knew nothing of Professor Wheatstone, but at Mr. Baddeley's recommendation I waited upon him, and described my plans, in which he seemed to take great interest. At a second interview (18th of August) I exhibited a model illustrative of my Printing Telegraph, and another of my Electric Clock. From the remarks then made by Professor Wheatstone, it was evident that both inventions were entirely new to him, nor did he in any way question their novelty or originality. It appeared subsequently, however, that as soon as he got possession of my plans, he went to another workman and got a machine made, which he exhibited at the Royal Society as his own invention, well knowing that he had obtained it from me; but of these proceedings I was kept in ignorance." He annexes the letters of Sir Peter Laurie and Mr. Baddeley.

To this very plain statement the Professor replies as under:

"TO THE EDITOR OF THE LITERARY GAZETTE.

"*Conduit Street, August 10th*, 1842.

"It is really, Sir, with a feeling of indignation that I find myself once more called upon to defend myself against *the unjust statements and actually false averments* of Alexander Bain, who has again attempted to fix upon the minds of those of your readers, who are not disposed to enter into a minute examination of the questions at issue, the belief that I have appropriated to myself inventions to which he alleges himself entitled. As your space is, doubtless, as valuable as my time, I shall at once place before you the following documents in refutation of his charges; the first of which is, that the Telegraph Clock and the Printing Telegraph are not my inventions."

But the reader is aware that the charges go much further

than this. Not only do they reach to the point that those two engines were certainly not invented by the Professor; but to this much more, that they as certainly were in all their parts invented and put practically to work by Mr. Bain, as shown in his models which the Professor handled in August, 1840. The Professor denies not the last point, as to Mr. Bain being the inventor—a matter indeed, which, after the evidence of Sir Peter Laurie and Mr. Baddeley, might be rather outrageous to his readers;—he denies not, as yet at least, that he saw the two models at the time stated. His defence is solely confined to the first point, resolving itself into this "*ed anche io sono pittore.*" He also is the inventor of the same two engines. But let it be noted that he palters with the word *invention* in a double sense, as if the phrase were applicable only to the original conception of an idea—by no means to the elaboration of that idea into a practical form for the use of man. He proceeds,

"I have already shown, in my former letter, that it is impossible for any person who sees and understands the principle and operation of my last Electro-Magnetic Telegraph, invented in 1839, to doubt for a moment that both one and the other are *direct and immediate applications* of that invention."

This is a reiteration of the old doctrine of developments, and he inserts the certificate of the five Professors to bear him out. He then says,

"The second charge is, that he communicated these inventions to me in August, 1840. *This* after what is above stated [*i. e.* the testimony of the five] can only mean, that he communicated to me the *applications in question of my invention at that time.* It is evident that the proof or disproof of *this* turns entirely on points of date, and I am thus most fortunately relieved, by the introduction of unquestionable testimony from a discussion which might be as tedious to your readers as it would be irksome to myself."

Here is a rare specimen of what Lord Byron says the learned call *rigmarole.*

The profundity of the foregoing passage is such, that a translation for the benefit of country gentlemen is absolutely necessary in order to elicit its meaning. The evidence about to be presented is only directed to the point, that the Professor had thought about the notion not only of a Printing Telegraph, but

also of an Electro-Magnetic Clock, before he saw Mr. Bain. The thing to be proved or disproved, as he says, therefore is, whether he originally and independently did so think about them, or whether Mr. Bain was the first to put the notion of each of those inventions into his head.

That Mr. Bain did originally and independently invent those two engines is not denied. That he explained and produced the models of them to the Professor in August, 1840, is equally unquestioned. But it is averred that, however unconscious Mr. Bain might have been of the circumstance, his models, when shown, involved nothing, except certain "*direct and immediate applications*" of a principle previously invented by the Professor himself, and published only ten days before his first interview with Mr. Bain.

He says, "I have already shown that long before the date he has assigned, I had unreservedly and publicly *conversed about those applications* to many persons." He then proceeds to the proof of his own original ideas on the subject of those inventions. With respect to that of printing, nothing is given except the letter of Mr. Cowper before referred to, which proves that, on the 10th of June, 1840 (just one month before Mr. Pinkerton saw Mr. Bain's telegraph print his own name.—*See ante, page* 45), he had replied to Mr. Wheatstone's perquisitions on the subject of the manifold writing paper, and the best form of the type for obtaining impressions therefrom—fifty-one days before the Professor saw Mr. Bain—an evidence that his invention of printing was then in embryo.

With regard to that of the clock, he says, "In order that no doubt of this may remain I subjoin notes from Mr. Martin, the eminent historical painter, and other gentlemen referred to in my first letter, which define the dates at which I made the communications respecting the Telegraph Clock to them. I have previously given the evidence of a workman of mine to the same effect." This refers to the letters of John Lamb,

on which it seems the Professor is now disposed to bestow paternity; but they are passed over here with a very suspicious brevity, considering the importance of the fact which they assert. If it were indeed true, that this man had been effectually instructed, on the 6th of January, 1840, to *make the very instrument* to which Mr. Bain lays claim, the exhibition of his clock, or at least of the drawings or instructions according to which it was to be made, to any of the three unimpeachable witnesses who are to be adduced, would have proved conclusively, not priority of invention, for Mr. Bain was long in the field before then, but certainly a complete case of independent invention. The contrary of all this, however, appears from the tenor of the following letters.

Mr. Martin, giving the date of just ten weeks before the Professor first saw Mr. Bain, namely, a few days after the 16th of May, 1840, says, in a letter to Mr. Wheatstone, "You explained to me at King's College the *proposed application* of your Electric Telegraph, for the purpose of showing the time of a distant clock simultaneously in as many places as might be required."— "I further remember, that when you were describing your plans, I made the observation that you proposed to lay on time through the streets of London, as we now lay on water."

But this mere proposal of applying the Electric fluid to the measurement of time does not prove that the clock which, six months afterwards Mr. Wheatstone exhibited as his own invention at the Royal Society, was not copied from Mr. Bain's models. It only proves that the Professor was, in the end of May, 1840, revolving in his mind the idea of making such a clock on some principle or other of his own. But between the conception of an invention and its effectual execution there is a wide interval.

That Mr. Bain, two years before this, had advanced thus far, is also proved by the following letter:

"Mr. BAIN, *Oxford Street, London.*

"DEAR SIR, "*August 20th*, 1842.

"In answer to your application, I beg to state that it was in the spring of 1838, at my shop in St. James's Street, and during a conversation we had on the application of my invention of the helix lever to clocks and watches, that you first mentioned to me that you intended to apply electricity to work clocks. I remember you said, you could make any number go together, and that they would require no winding nor regulating.

"To the best of my recollection it was in the beginning of June, 1840, certainly not later than the latter end of that month, you invited me to come to see your centrifugal clock,* at your apartments in Wigmore Street; when you at the same time *showed me a model of the Electro-magnetic Clock*, and also some pieces of apparatus, which you said was for the purpose of printing at a distance by means of electricity; you showed me, at the same time, several pieces of paper which had been printed upon by the apparatus. To these facts I am ready to speak at any time.

"I remain, dear Sir, yours truly,

"CHARLES MCDOWALL."

"12, *Beaufort Street, Chelsea.*"

But to resume: the Professor's next evidence is that of Dr. William Allen Miller, of King's College, who says,

"In the spring of 1840, you *frequently conversed with me on the subject of applying the principles of your Telegraph* to the purpose of making several dials at any required distances simultaneously show the time indicated by a single clock. At that time I was often in your room, and occasionally assisted you in your experiments. Your communicatious were made to me before the 17th of July, 1840, as at that period I left town."

This is distinct evidence that up to within one fortnight of his interview with Mr. Bain, the Professor had gone no further than having the idea of a clock under his meditations—not a shadow of proof that he had matured any particular plan for the measurement of time.

The last and the only other witness adduced is "Mr. F. O. Ward, formerly a student of King's College, whose evidence of what passed between himself and the Professor on 20th of June, 1840, is conclusive as to the indecision of the latter at that date, on what particular principles his clock was to be constructed. Mr. Ward says, "I was turning the handle

* The instrument now to be seen on Cornhill, as already mentioned, page 59.

of the rheotome [which was explained to be that wheel of Mr. Wheatstone's telegraph of 1840, which makes and breaks the voltaic circuit], and watching the consequent motions of the dial [in exhibiting to view the letters of the alphabet, so that a clerk could copy them down and thus compose a message] and I said if the rheotome were turned round at a uniform rate, the signals of the telegraph would indicate time. You replied 'Of course they would, and I have arranged a modification of the telegraphic apparatus, by which one clock may be made to show time in a great many places simultaneously.' I expressed a curiosity to know how this was done, and you explained to me, *by means of drawings,* the plan of making and breaking the circuit, by the alternate motion of the pendulum of a clock, so as to produce isochronous signals on any required number of dials; *you showed me some other ways of doing it,* but the plan of the pendulum particularly fixed itself on my memory on account of its simplicity."

The schoolmaster is abroad—that which was heretofore called hours and minutes, must now and in future be termed "isochronous signals." It appears, however, that the alchymist had advanced to *green dragon,* but had not yet reached the *ruddy Sol,* much less *projection,* until, to the great surprise of the adept, Bain, "*deus ex machinâ,*" dropt from the clouds on that very day six weeks, having his two models quite ready for action, viz., that of the Printing Telegraph, and that also of the Electro-Magnetic Clock. Well and truly did Sir Peter Laurie say to the Lords of the Admiralty, "I write this note for the purpose of showing that at the above date [1st of August, 1840], *Mr. Bain's inventions were in a complete state,* and only delayed for want of necessary capital."

And thus has Mr. Wheatstone signally failed to make out a complete title, even to cotemporary invention. He has not hitherto denied the prior inventions of Mr. Bain—nor that

he had inspected his two models on the 18th of August, 1840: nay, he admits that he purchased one of them on that day. With these facts, he ought not, as a man filling a chair in an English university, to have penned the following consecutive sentences:

"It is quite untrue that Mr. Bain ever exhibited to me a model of an Electro-Magnetic Clock, either before or after he was employed by me. He has not yet given the least proof of his having had in his possession, at the time he mentions, any such model; he has not yet adduced the testimony of any person who then saw it. It is equally untrue that Mr. Bain showed me, at the time he refers to, any model of an *Electric Printing Telegraph.* He had merely a model, if so rude a thing can be called a model, of a small part proposed to be added to my Electric Telegraph, to effect a purpose for which I had before contrived far more efficient means. The part in question was simply a mechanical addition involving no scientific principle. So far from the work done by him, when he was employed by me, entirely relating, as he states, to his own inventions, the mere inspection of it—and it remains at present as he left it—will show that it was essentially *copied* from the Telegraph invented by myself a year before, and this was done under my own immediate directions. More than eighteen months have elapsed since Mr. Bain commenced his infringements, and notwithstanding the assistance he has received from the proprietors of the Polytechnic Exhibition, and from *other parties* who are now connected with him, he does not seem to have advanced beyond *imitating the mechanical adaptations* of the Electric Telegraph. *Of the real principles of Telegraphic communications* by electro-magnets, *which*, assisted by the beautiful theory of Ohm, *I was the first to determine*, he evidently knows nothing."

Mr. Bain can afford to smile at this detraction. His friends will treat the calumny with profound contempt, having the evidence of their own senses to demonstrate its injustice.

The learned throughout Europe are now to judge between the Professor and Mr. Bain, as to their relative advances in electrical and mechanical philosophy. Leaving the matter to that august arbitrament it is only for the present needful to ask how Mr. Bain could *copy* or *imitate* certain *mechanical adaptations* of an unseen and undescribed engine, which adaptations were only alleged to be *in posse,* not pretended to have been *in esse,* when he constructed his models?

PART III.

In the following description it is not intended to notice all the earlier discoveries in the application of Electro-magnetism to useful purposes, nor to trace the several steps by which it has passed on from infancy to childhood—and beyond the latter point it cannot yet be said to have advanced—but merely to show, in a clear and convincing manner, the *prototypes* of some of those contrivances which have lately been so disingenuously appropriated, by Professor Wheatstone, as original inventions of his own. For the same reason, the principles of each invention are faithfully described and illustrated in their simplest form, devoid of the complexity of detail which would only confuse the reader, and is altogether unnecessary for the purpose which the writer has in view, viz. to "Give honour to whom honour is due."

Professor Oersted discovered, in the year 1819, that a current of electricity passing through a wire, parallel with and near to a freely suspended magnetic needle, deflected the needle to the right or to the left, according to the direction of the current. Professor Schweiger, of Halle, very soon after invented the wire-coil, or Electro-magnetic multiplier, an arrangement of the conducting wire, which caused the electric current to exert a greatly increased force upon the needle.

Plate 1, fig. 1, *E E* represents a magnetic needle, freely suspended on its centre within, and clear of the coil of wire, *C C*, which is supported immoveably upon the stand, *F F*. When a current of electricity is sent through the wire *G*, in the direction of the arrow, the needle, *E*, will be deflected, and point to the letter *A*; but if the current is sent in the opposite direction, through the wire *H*, the needle will then be deflected in the opposite direction, and point to the letter *B*. By this simple contrivance, therefore, two different signals can be made, and

upon this principle, are based the suggestions of Ampère, Steinhill, Ritchie, Schelling, Fechner, Sir Humphry Davy, and others, including the Electric Telegraphs of Morse, Alexander, Davy's (of Fleet Street) first telegraph, and Cooke and Wheatstone, down to the year, 1840.

The principle of Alexander's Telegraph is represented in fig. 2, plate 1. It consisted of thirty-one wires, for the purpose of showing the alphabet in full, with stops, &c. (in all thirty signals); but, for the sake of clearness, one circuit only is shown here, *A*, is a voltaic battery; *B*, a trough, filled with mercury; *C*, a key, to be pressed down by the finger of the operator; *e*, is the end of a conducting wire, which dips into the mercury when the key is depressed, and completes the electric circuit. *D D*, is the distant dial upon which the signals are to be shown; *F F*, are screens, thirty in number, each being fixed to a needle, corresponding to the finger-keys before described. When no electricity is passing, these screens remain stationary over the several letters, &c., and conceal them from view: but when a current is made to flow, by the depression of a key, the corresponding needle, in the distant instrument, is deflected, carrying the screen with it, and uncovering the letter which becomes exposed to view, as at *O*.

Another application of this principle is shown in fig. 3, plate 1, which represents what Messrs. Cooke and Wheatstone designate *their needle telegraph*. *A*, is a voltaic battery; *B* and *C*, electrodes of the same; *D D*, five metal studs, connected with the positive pole of the battery; *E E*, five similar studs in connection with the negative pole; *F F*, are five handles for making and breaking the circuit. *G G*, represents the distant dial upon which the signals are to be shown; *H H*, are five pointers, fixed to the axis of five magnetic needles, suspended within wire coils (as shown in fig. 1), and corresponding to the handles, *F F*. By means of this arrangement the needles are deflected—carrying the pointers with them—according to the directions given to their respective handles; it is necessary

to move two handles, in contrary directions, before the electric circuit is complete, which causes the two corresponding needles and pointers to move in like manner. The signal, or letter, indicated, is that which lies at the intersection of two lines continued from the deflected pointers.

In 1837, Mr. Morse made a public exhibition of an Electric Telegraph in America, upon which he had been engaged five years previously. Mr. Morse was enabled to effect the object in view with a single circuit, but he preferred to use four. Moreover, Morse's was a recording Register Telegraph, and the following account of his invention is taken from the *Franklin Journal:*

" On September 2d (1837), Professor Morse tried an experiment with a circuit of copper wire, 1,700 feet in length, and of the minimum size of No. 18 wire. The record of the register was sufficiently perfect to demonstrate the practicability of the plan. On the 4th of September some slight changes were made in the machinery, when the register recorded perfectly the following signs : (*See* plate 1, fig. 4.)

The *words* in the diagram were the intelligence transmitted. The *numbers* (in this instance arbitrary) are the numbers of the words in a telegraphic dictionary. The *points* are the markings of the register, each point being marked every time the electric fluid passes. The register marks but one kind of mark, to wit (V). This can be varied two ways. By intervals, thus (V VV VVV), signifying one, two, three, &c.; and by reversing, thus (Λ) —examples of both these varieties are seen in the diagram. The single numbers are separated by *short*, and the whole numbers by *long intervals.* To illustrate by the diagram, the word *successful*, is first found in the dictionary, and its telegraphic number 214 is set up in a species of type prepared for the purpose, and so of the other words. These types then operate upon the machinery and serve to regulate the times and intervals of the passages of electricity. Each passage of the fluid causes a pencil at the extremity of the wire to mark the points, as in the diagram. To read the marks, count the points at the bottom of each line. It will be seen that two points come first, separated by a *short* interval from the next point ; set 2, beneath it. Then comes one point, likewise separated by a *short* interval ; set 1, beneath it. Then come four points ; set 4, beneath it. But the interval in this case is a *long* interval, consequently the three numbers comprise the whole number 214. So proceed with the rest until the numbers are all set down ; then, by referring to the telegraphic dictionary, the words corresponding to the numbers are found, and the communication read.

Fig. 1, plate 2, shows the action of an Electric Clock invented by Buzengeiger, and described in the *Morgen-blatter* of September 23d, 1815, quoted by Mr. Ronalds in his work on Electricity, published in 1823.* *G G* are brass balls connected with the poles of two electric piles (De Luc's column). *A*, the pendulum which was put in motion by the alternating attraction and repulsion of the balls *G G*. *B* and *C* are two levers, one on each side of the centre of motion, *F*. *E* is a ratchet-wheel, propelled by the alternating movement of the levers *B C*, and giving motion to the other wheel-work. *D* is a spring to prevent a retrograde movement of the wheel.

Fig. 2, plate 2, exhibits the discs or dials which Mr. Ronalds employed in his Electric Telegraph of 1816, as described in his before-mentioned publication of 1823.

L, fig. 2, is a plain fixed plate, furnished with an aperture, *N*. *K* is a revolving disc, fixed upon the seconds arbor of a clock, the signals being engraved upon it in divisions, radiating from its centre to the circumference, each division being in size and shape similar to the opening *N* in the fixed plate *L*, behind which it revolved; consequently, only one division or signal could be seen at a time. L^2 and K^2 are views of the stationary plate and revolving disc seen edgeways in position, the aperture being at N^2.

Soon after Oersted's discovery of 1819, it was found that, by directing the electric current along an insulated wire, wound in a spiral direction, at right angles to its length, the iron was converted into a powerful magnet *so long as the current was passing*, but as soon as the current ceased, the magnetism ceased also. Upon the deflection of the magnetic needle, and on this arrangement, have been based all the Electro-Magnetic Telegraphs, down to, but exclusive of that of Messrs. Wright and Bain, patented in 1842.

Fig. 3, plate 2, exhibits the principle of Mr. Davy's

* Description of a Electrical Telegraph, and of some other electrical apparatus.

Electro-magnetic escapement, as employed in his second Telegraph, and published in the specification of his patent in 1838. *A*, fig. 3, is a voltaic battery; *B*, a metal finger-key; *N*, a metal stud, to which is fixed the conducting wire of the battery; *C*, an Electro-magnet, and *D* its feeder. *I* is a clock-weight; *H*, a clock-barrel, and wheel carrying the signal cylinder *K*; *G*, a fly or vane to regulate the speed; *E*, a pair of pallets fixed to the stem of the feeder *D*, on the opposite side of the centre of motion. *F*, a spring to raise the feeder from the magnet when the electric circuit is broken, and magnetism ceases. The arrangements are such, that for every complete revolution of the vane *G*, the cylinder *K*, is moved forward one character or division. Supposing the finger-key, *B*, to be pressed down upon the metal stud *N*, a metallic circuit from the voltaic battery would then be established, and a current of electricity would flow through the conducting wires, and through the wire-coil of the Electro-magnet *C*, which would instantly attract the feeder *D*, causing the upper pallet, *E*, to rise above the pin, *O*, and release the fly, *G*. When the fly has made half a revolution, however, it is arrested by the under pallet coming in contact with the pin *O*. The finger-key being then released, the circuit is instantly broken, magnetism ceases, and the feeder being no longer attracted, is raised by the action of the spring, *F*, into its original position; this movement depresses the pallet, releases the pin *O*, and enables the fly, *G*, to make another half revolution, when it is again arrested by the upper pallet; thus completing one revolution of the fly *G*, and sending the signal cylinder one division or character forward. This operation of pressing down the finger-key and then releasing it, will, therefore, upon being repeated, produce a rotary motion of the signal cylinder, step by step, similar to the second's-hand of a clock.

Fig. 6, plate 2, exhibits the principle of Mr. Wheatstone's Electro-magnetic escapement, as applied to the Telegraph, which he states he invented in 1839, and patented in 1840.

A, is a voltaic battery; *B*, the *rheotome*, or wheel for making and breaking the circuit; *C*, an electro-magnet; *D*, the feeder; *E*, a pair of pallets; *F*, a spring to draw the feeder from the magnet when its magnetism ceases; *G*, a wheel with projecting pins; *H*, a clock-barrel; and *I*, the weight. *K* is a revolving disc, carrying the signals; *L*, a stationary disc, furnished with an aperture, *N*. B^2 is a side view of the *rheotome*; its under edge consists of a circle of brass, with divisions of wood, or some other good non-conductor, inserted flush with the metal, corresponding with every alternate figure or letter. The free end of the spring, *m*, connected with the conducting wire of the battery, rests against the under part of the metal rim, while the spring *n*, rests upon that portion of the rim in which the pieces of wood are inserted, so that when the wheel is turned once round, the spring *n*, will touch every division of wood and brass alternately. Thus every division of metal makes, while that of wood breaks the circuit in the same manner as the depression and elevation of the finger-key of Mr. Davy, and produces a rotary motion of the signal disc, step by step, exactly similar to that gentleman's registering cylinder.

Fig. 4, plate 2, exhibits another arrangement, described by Mr. Wheatstone, in his specification of 1840, for moving round the signal disc of his Telegraph, the remarkable similarity of which to the contrivance of Buzengeiger, already described, cannot fail to strike the attentive reader. *A*, fig. 4, is an electro-magnet, and *B* its feeder; *C* and *D* are propellers; *E*, a ratchet-wheel; *F*, a spring to elevate the feeder from the magnet. When magnetism is induced in the electro-magnet *A*, the feeder, *B*, is attracted downward, and causes the propeller, *D*, to move the wheel, *E*, one-half tooth forward. When magnetism ceases, the spring *F*, lifts the feeder up from the magnet into its original position, thereby causing the propeller, *C*, to move the wheel forward another half tooth. The electric current is trasmitted in an alternating manner, by the rheotome, as before described. It will be observed that the signal disc here men-

tioned, and shown in fig. 5, is identically the same as that of Mr. Ronalds', shown in fig. 2, plate 2.

Plate 5, exhibits the arrangement of Mr. Bain's Patent Electro-Magnetic Printing Telegraph in its present complete state. Figs. 1 and 2 represent two machines, one of which may be supposed to be situated at London, the other at Portsmouth. These two machines are in every respect counterparts of each other, and the letters of reference in the following description apply equally to either. *A A*, are the signal dials insulated from the machine; *B B*, hands or pointers; *C C*, are holes in the dial, one under each signal; *D*, is a similar hole over the starting point of the hand, *B*. A^2 A^2, are coils of wire freely suspended on centres; B^2 B^2, are compound permanent magnets placed within the coils, and immoveably fixed upon the frame of the machine; C^2 C^2, are sections of similar magnets; D^2 D^2, are spiral springs (there are similar ones on the opposite side), which convey the electric current to the wire coil, and at the same time leave the coil free to move in obedience to the magnetic influence. So long as the electricity is passing, the wire coils continue to be deflected, but the instant the electric current is broken, the springs D^2, bring back the coil to its natural position. E^2, is an arm fixed to, and carried by the wire coil, A^2, to stop the rotation of the machinery. F^2, is a main-spring barrel, acting on the train of wheels *G H I*, which communicate motion to the governor *K*, and the hand *B*. On the arbor of the wheel, *H*, is fixed a type-wheel, *L*, at a little distance from the paper cylinder, *M*, on which the messages are to be imprinted. *N*, is a second main-spring barrel, with its train of wheels, *O P Q*, and fly or vane, *R*. On the arbor of the wheel *P*, there is a crank, *S*, and two pallets, *t u*, which prevent the train of wheels from rotating, by coming in contact with a lever *V*.

When the Telegraph is not at work, a current of electricity is constantly passing from the *zinc* plate at Portsmouth, through the sea or moisture of the earth, whichever it may be, to the *copper* plate at London; Mr. Bain having discovered that it is

only necessary to deposit two such plates in the earth, and connect them by an insulated wire, to obtain an electric current of the required energy, without the use of any other kind of battery.

From the copper, the electric current passes up through the freely suspended multiplying coil, A^2, fig. 1. (which it deflects) into the machinery, and thence to the dial, by means of a metal pin, inserted in the hole D; from the dial, it passes by a single insulated conducting wire (fig. 3), back to the machine (fig. 2), at Portsmouth, traversing which, it passes through the freely suspended multiplied coil A^2, which it deflects, to the zinc plate from which it started, and thus completes the circuit. When a communication is to be transmitted from either end of the line, the operator draws out the metal pin from the hole, D, in the dial of his machine; the electric circuit is thus broken, and the ends of the multiplying coils, A^2, both in London and Portsmouth, are carried upwards, in the direction of the arrows, by the force of the spiral springs. The arms, E^2, attached to the coils, moving to the right, release the levers, W, which leaves the machinery free to rotate, and as the moving and regulating powers are the same, at both places, the machines go accurately together; that is, the hands of both machines pass over similar signals at the same instant of time, and similar types are continually brought opposite to the printing cylinders at the same moment. An inspection of the wheel-work will show, that this movement will have caused the governors, K, to make several revolutions, and the divergence of the balls, in obedience to centrifugal force, will have raised one end of the lever V, and depressed the other, which allows the pallet, t, to escape; but the rotation of the arbor is still opposed, by contact with the second pallet u. The operator having inserted the metal pin in the hole, under the signal which he wishes to communicate, the moment the hand of the dial comes in contact with it, the circuit is again completed, and both machines stopped instantly. The governor-balls collapsing,

depress the left hand end of the lever, *V*, clear of the pallet *u*, and this allows the crank spindle, *S*, to make one revolution. The motion of the crank, by means of the crank-rod, *x*, acting on the lever, *y*, presses the type against the paper cylinder, *M*, and leaves an impress upon the paper; at the same time, a spring *z*, attached to an arm of the lever, *y*, takes into a tooth of the small ratchet-wheel, *a*, on the spindle of the long pinion, *b*, which takes into and drives the cylinder wheel; so that the crank apparatus going back to its former position, after impressing a letter, moves the signal cylinder forward, and presents a fresh surface to the action of the next type.

As the cylinder moves round, it has also a spiral motion upward, which causes the message to be printed in a continuous spiral line until the cylinder is filled. In order to mark, in a distinct and legible manner, the letters printed by the apparatus, two thicknesses of ribband, saturated with printing ink and dried, are supported by two rollers so as to interpose between the type-wheel and the cylinder. * If a second copy of the message thus simultaneously printed at two distant places, is desired at either, a slip of white paper is placed between the ribbands to receive the imprint at the same time as the cylinder. A very effectual, and, at the same time, very economical method of insulating the long conducting wire of his telegraph, is adopted by Mr. Bain, which consists simply in embedding it in a small continuous body of asphalte. Fig. 3, exhibits a section of a single wire thus protected; and fig. 4, shows three wires, for as many distinct telegraphs, similarly embedded.

Plate 3, shows the mechanism of Mr. Bain's Electro-magnetic Clocks, in so far as his invention had advanced up to 1841. Fig. 1, exhibits his original arrangement, by which it was proposed to work a great number of clocks simultaneously; a single circuit of wire being employed to all the clocks, which would mark seconds.

---

* The rollers are not shown in the diagram, to prevent confusion.

A is a voltaic battery, *B* a back view of an ordinary clock, with a pendulum vibrating seconds; *C* a plate of ivory affixed to the frame of the clock, in the middle of which is inserted a slip of brass, in connection with the positive pole of the battery. To the pendulum is attached a very light brass spring, *F*, in such a manner, that every vibration of the pendulum brings the free end of the spring into contact with the strip of brass, *d*, thus completing the electric circuit, which is broken as soon as the spring touches the ivory. *G H I K*, are four electric clocks, connected with, and worked by, the clock *B*, the connexion being formed by the wire *L*. Fig. 2, is a back view of one of the electric clocks; *a* is an electro-magnet, and *b* its feeder, suspended by a spring, pendulum fashion; *c*, is a small screw to regulate the distance of the feeder from the electro-magnet. At the lower end of the feeder is jointed a light click lever, *d*, taking into the teeth of a ratchet-wheel, *e*; *f*, is a spring to keep the ratchet-wheel steady. When the pendulum of the clock, *B*, sends an electric current through the conducting wire, the feeder is attracted by the magnet, and the click-lever, *d*, takes over one tooth of the ratchet-wheel; upon the current being arrested (by the spring, *F*, of the pendulum, leaving the slip of brass in the primary clock) the feeder falls back into its former position, and causes the click-lever to draw the ratchet-wheel one tooth forward. The arbor of the ratchet-wheel carries the *second's-hand*, which is thus taken forward one degree every second, corresponding to the vibration of the clock *B*. A pinion on the ratchet-arbor gives motion to the other simple wheelwork, which carries the minute and hour hands.

By this arrangement, it is necessary to increase the power of the electric current, in the same ratio as the number of clocks to which motion is to be given.

To work a large number of clocks, therefore, very powerful batteries, and large conducting wires would be required. This difficulty (for such in practice it would be) is, however, entirely

obviated, by working the clocks, *not simultaneously*, but in rotation. For this purpose the ratchet-wheel, *e*, is placed on the arbor of the *minute-hand*, and is moved every minute, instead of every second, in the following manner: Fig. 3, plate 3, exhibits the face of the regulating or primary clock, *B*, upon which is fixed an ivory circle, with slips or studs of metal, inserted flush with its face, corresponding to the number of clocks, or groups of clocks, intended to be worked. In the centre of this circle is placed the arbor of the second's-hand of the clock, upon which is fixed a slight metal spring with its free end in contact with the ivory circle. The conducting-wire from the positive pole of the battery is in connexion with the framework of the clock; every time, therefore, that the second's-hand passes over a metal stud in the ivory circle, an electric circuit is completed, and a current transmitted to the clock (or group of clocks) in connexion with that particular stud. As the second's-hand passes over every portion of the circle once in each minute, the whole number of clocks thus connected with the regulating clock, will be moved forward one degree every minute. By means of this arrangement, a large proportion of the electric power is saved, where many clocks have to be worked; that is to say, a very small amount of electric power will in this way suffice to work a large number of clocks; because it has only to act on a single clock, or a small group of clocks, at the same instant of time.

Fig. 4, plate 3, shows a contrivance for making ordinary clocks keep correct time, by transmitting a current of electricity once in every hour from a regulating clock. In order to show the manner in which this is effected, a portion of the dial is removed; *a* is an electro-magnet, and *b* its feeder, to which is attached a stem, having at its upper extremity a conical fork, *e e*; *c* is a pin projecting backward from the point of the minute hand. Before the transmission of an electric current to the electro-magnet, *a*, the feeder *b*, and forks *e e*, are in the position indicated by the dotted lines. But, exactly at the

last second of the hour, the regulating clock transmits a current of electricity through the wire around the magnet, when the feeder, *b*, is instantly attracted by it and raised, carrying up the fork along with it, as shown in the diagram. If the clock should have gone too fast, the motion of the fork upon the pin would bring back the minute-hand to its place, so as to indicate the precise time. In the same way, if the clock should be too slow, the fork would carry the hand forward, so as to show the true time at the end of every hour. By this means one good clock would keep a great number of very indifferent ones so as to show the same time as itself.

Fig. 5, plate 3, shows the method adopted by Mr. Bain for working the Electric Clock by the deflection of the wire coil (or electric conductor), instead of the attractive power of the electro-magnet. *A* is a coil of insulated copper wire freely suspended on centres; *B* is a compound permanent steel magnet, immovably fixed within the coil; *C C*, are two spiral springs (one on each side for the purpose of conveying the electric current from the stationary conducting wire *D*, to the movable coil. *F* is a click-lever attached to the coil; *E* is a ratchet-wheel fixed upon the minute-hand arbor of the clock, and *G* a spring to keep the wheel steady. The regulating clock transmits the electric currents to the wire coil, upon which the left-hand end is instantly depressed, and the click-lever, *F*, draws the wheel, *E*, forward one tooth. When the flow of electricity from the regulating clock is discontinued, the wire coil resumes its original horizontal position by the action of the springs, *c*. If the clock receives an electric current once in every second, the wheel, *E*, is placed on the arbor of the second's-hand; but, if the electricity is only transmitted once in each minute, then the wheel, *E*, must be placed on the spindle of the minute-hand.

Having thus briefly described the principles upon which the performances of a certain class of electrical machines depend, as well as the more important mechanical arrangements by which it has been sought to apply these principles to purposes

of utility, we now proceed to examine the extent of Professor Wheatstone's claim, to be considered either an *original inventor* or a *skilful mechanician.*

The first patent of Messrs. Cooke and Wheatstone (sealed June 1837), "for improvements in giving signals and sounding alarums at distant places, by means of electric currents transmitted through metallic circuits"—was (admittedly) founded on Oersted's discovery of the deflecting influence of an electric current upon a magnetic needle, as already explained and illustrated—an application which had been long previously suggested by the celebrated Ampère, who proposed to employ as many needles and electric circuits as there were characters to be indicated. Baron Schelling, and Fechner, proposed *to limit this number to fewer needles,* and to notice *their combined motions.*

Messrs. Cooke and Wheatstone, together, in the first instance then, did no more than follow out the suggestions of the latter gentlemen, and produced the electric telegraph described at page 89, and shown in plate 1, fig. 3. Contemporaneously (that is during the year 1837), Morse, in America; Alexander, in Edinburgh; and Davy, in London, also publicly exhibited electrical telegraphs, upon this principle of deflected needles. That of Mr. Davy, exhibited at Exeter Hall, attracted much attention. In his apparatus the signals appeared as luminous characters within a dark aperture. From this it is evident, that during the year 1837, several individuals, in different parts of the world, were actively engaged in working out the suggestions which had been often previously made for the application of the subtle agency of the electric fluid to the purposes of rapid and distant communication.

In July of the following year (1838), Mr. Davy took out a patent "for improvements in apparatus for making telegraphic communications or signals by means of electric currents, the specification of which was published in the *Repertory of Patent Inventions,* for July, 1839; it was also reprinted by Mr.

Davy, and extensively circulated in the form of a pamphlet. Among several other novel and ingenious arrangements included in this patent, was that already fully described and shown in plate 2, fig. 3.

In 1838, Messrs. Cooke and Wheatstone took out a second patent, for certain improvements in their previously patented electric telegraph; relating principally to a method of fixing the needles, and which eventually turned out to be no improvement at all.

By the latter end of 1839, however, Messrs. Cooke and Wheatstone had got together such a budget of further "improvements in giving signals and sounding alarums at distant places, by means of electric currents," as seemed to justify the taking out of a third patent for their protection, which bears date January 21st, 1840.

In their two first patents, the whole merit of these two gentlemen consisted in working out, or reducing to practice, the suggestions of others, a course which had been attended with so much *éclat*, that they seem to have been actuated by a desire to appropriate to themselves the merit of all possible applications of electric currents, past, present, and to come. Accordingly, they now proceeded so to appropriate, by royal letters patent, the separate inventions of no less than three different individuals, which our readers will find placed in convenient juxta-position, in plate 2. In the first place, we have the *ratchet-propeller* of Buzengeiger (fig. 1), with this slight difference, that whereas that gentleman employed the motive power of De Luc's column to effect his object; Messrs. Cooke and Wheatstone availed themselves of the electro-magnet, which the progress of modern science had placed at their disposal.

In the second place, we have the electro-magnetic escapement of Mr. Davy (fig. 6), which, however, instead of carrying *his signal printing cylinder*, was equipped with the *revolving signal disc*, and stationary dial, of Mr. Ronalds. The only novelty in the whole of Messrs. Cooke and Wheatstone's

patent of 1840, was the *rheotome*, or instrument by which the electric current was alternately let on to, and cut off from, the wheel-work of the telegraph; which, we may suppose, to have been invented between them. Mr. Wheatstone, in his first patent, reminds us of that proverbially known besom-vendor, who appropriated to his own use other people's materials, and made up his simple utensils himself; in his latter patent, however, he resembles that more consummate adept of the same craft, who somehow or other procured his brooms ready made.

Matters had proceeded thus far, when, on the 1st of August, as already explained, Mr. Alexander Bain had the misfortune to be, in some sort, recommended to Mr. Wheatstone, in order to show the latter great man his inventions of Electro-magnetic Printing Telegraphs, and Electro-magnetic Clocks. The Professor evidently jumped at these prizes, and he proceeded in the artful manner already recorded to make them his own.

We would beg the reader's particular attention to the several contrivances of Buzengeiger, Ronalds, and Davy, before described, which, with the *rheotome*, comprised the whole subject matter of Messrs. Cooke and Wheatstone's patent of 1840; and it is upon this patent alone that Mr. Wheatstone has attempted to found a claim to the inventions of the *Electro-magnetic Printing Telegraph*, and of the *Electric Clocks*. There is not the slightest allusion made to either of these inventions in the title, nor yet in the specification of that patent. The Professor, nevertheless, artfully endeavours to show, that these two inventions are but modifications of, or rather additions to, "*his telegraph.*" If this position was as true as it is really false, it would still avail the Professor nothing. If the inventions in question are modifications, or additions to any thing previously invented, they are modifications of, or additions to the contrivances of inventors, who date long before Mr. Wheatstone!

In order to bring home to the Professor the charge of unscrupulous appropriation, we again repeat, that in the year

1823, Francis Ronalds, Esq., a gentleman with whom Mr. Wheatstone was intimately acquainted, published a description of an electric telegraph, and some other electrical apparatus, with a copy of which there cannot be the smallest doubt that Mr. Wheatstone was presented. In that work he saw descriptions of the following apparatus:—

1st. Mr. Ronalds' Electrograph, worked by a *common clock*, which it might have been supposed would have been quite sufficient to give a man of ordinary ingenuity, engaged in electro-mechanical pursuits, *an idea* of employing this agent to mark time, or of applying *clock-work* to telegraphic purposes.

2d. Mr. Ronalds' pendulum doubler, which was employed to collect small charges of electricity for his telegraphic-wire at each vibration, which still more strongly suggests *an idea* of time measuring.

3d. Professor Wheatstone therein saw the actual application of electricity to the measurement of time, as quoted by Mr. Ronalds from the *Stutgard Morgen-blatter* of September 23d, 1815! This might, surely, have been sufficient to have forced the idea upon a man with the enlarged perceptions of Professor Wheatstone, during the sixteen years of his acquaintance with this publication. The *idea*, no doubt, he had imbibed, but how to carry it out was a problem altogether beyond the powers of his mechanical genius. The only advantage the Professor seems to have taken from these applications of *electricity* and *clock-work* combined, was the adoption of the ratchet-wheel and propellers, and that only as applied to *telegraphs*, in his patent of 1840.

4th. Mr. Ronalds employed *clocks* to work his electric telegraph in 1816, whereby he was enabled to send communications by a *single circuit;* and yet, with a knowledge of this fact before him, we find Professor Wheatstone putting the proprietors of the Great Western Railway to an expense of from £250 to £300 per mile, and floundering with his needles and five-wires, up to 1840, when he boldly seized on the disc of *Ronalds*, the

ratchet-wheel and propellers of *Buzengeiger*, with the electro-magnet escapement of *Davy*, and, without compunction, called them his own "by Royal Letters Patent!" Mr. Ronalds relinquished his experiments in electricity prior to 1823, when, in consequence of ill-health, he went into the south of Europe. This is much to be regretted, for had he continued his labours when the nature of electro-magnetism became better understood, there is little doubt, that, with his very evident abilities and application, which had placed him far in advance of all other experimentalists of his day, in the branch of study to which he had devoted himself, that he would long since have established Electric Telegraphs from one end of the country to the other.

But to return to Professor Wheatstone, who had thus obtained *an idea*—nothing more—an idea of telegraphing time—a vague notion of applying electricity to work clocks, after the same thing had been actually done by another, and the fact widely published. The Professor was unable, however, to work out the *idea* until after the 18th of August, 1840, when Mr. Bain showed him *how it was to be done:* he then went "ahead" famously, and by the following November managed to get an electro-magnetic clock finished agreeably to Mr. Bain's pattern, but with one important difference; for Mr. Bain did not show the Professor how he intended to make and break the circuit, and in this part he was left to shift for himself: he soon supplied what was wanting, however, by the introduction of his *rheotome.* Whether it was from sheer want of mechanical skill, or from subtilty, in order to create an apparent resemblance between his electric cloek and his telegraph, it is hard to say; but he did commit the mechanical absurdity of placing his *rheotome* on the *escape-wheel* of the clock! Who, in the name of common sense, besides Charles Wheatstone, would ever have thought of making the most delicate wheel in the clock carry round a piece of brass, with thirty divisions of wood in it, under the friction of a spring pressing on its periphery?

If he had a conceit for the employment of the rheotome, why did he not affix it to the clock-frame, and let the wheel carry the spring only, which would not be a hundredth part the weight of the rheotome. The beautifully simple and effectual manner in which Mr. Bain accomplished the same thing, has been already explained. (*See* plate 3, figs. 1 and 3.)

In the one case we have a *learned Professor*, surrounded by the accumulated knowledge of ages, producing a most *outré* and unmechanical arrangement; while the natural genius of a self-taught mechanic accomplishes the very same object in the simplest and most philosophical manner.

This little circumstance is a good illustration of the relative capacities of the two men, and is confirmed by every step of their progress. The *philosopher, stored with book knowledge and familiar with all the discoveries of previous and contemporary sages,* is unable to work out a single idea, or to produce the most trifling invention, while the self-taught mechanic, by the strength of his own untutored genius, and unacquainted with any of those facts which the pioneers in science had made plain for their successors, produces, nevertheless, inventions and combinations replete with harmony and beauty, which carry us far onward towards the practical application, to purposes of general utility, that mighty though subtle power, which, even in his own day, was but a mere toy in the hands of experimentalists and lecturers.

Another proof of the mechanical incapacity of the "*learned Professor*" may as well be pointed out. Although he adopted the ratchet-wheel and propellers of Buzengeiger's clock, as applied to his Telegraph (patent 1840), he never did, and never can use it, from its taking too much power; of this he is aware —indeed, it is admitted in the *Companion to the Almanack for* 1843. There is another and a stronger reason, however, why it could not answer, of which, perhaps, the Professor is not aware; at any rate, he does not mention it. It is this, such an apparatus is incapable of giving three signals without the

liability of going wrong, and sending a false signal. This serious defect, however, is one of *construction* not of *principle*, and arises from the unskilful manner in which the Professor has attempted to carry out the *idea*. It is a well known law in mechanics, that a body will be moved through a definite space in a given time, by the action of a force that is uniform; but, if the force varies in intensity, so will the distances and times vary in a corresponding ratio. While Professor Wheatstone's electric current is *exactly* of the proper strength, the propellers will move the ratchet-wheel forward a distance equal to half a tooth at each vibration, and that with a certain velocity. But if the current becomes stronger than is required (and it would be impossible by Mr. Wheatstone's method to keep it uniform) the wheel would be brought forward with an undue velocity, and a liability arise of moving forward a whole tooth instead of one-half; and if *A* was the signal intended to be shown, *B* would actually be indicated. On the other hand, if the electric current grew weaker than the required strength, then the velocity given to the wheel would be insufficient to carry it to the proper point; and if *B* was to be signalled, *A* would be shown. Now, it will be found that wherever Mr. Bain has employed the power of an occasional electro-magnet to give motion to wheels, he does not propel the wheel by the direct action of the electro-magnet, but by means of the unerring and unvarying force of the return spring, which always remains the same, however much the electric current, and the energies of the electro-magnet may exceed or fall short of the regular quantity. Here, then, is a beautiful principle made wholly *useless* by the *Professor*, and eminently *useful* by the self-taught *mechanician*.

Professor Wheatstone's claim to the invention of the Electro-Magnetic Printing Telegraph requires a few words. The Professor endeavours to show, that he had the *idea* of such a contrivance previous to his interview with Mr. Bain. No doubt he had! and from whence did he get it? Was it from Morse,

the American philosopher, who was engaged from 1832 till 1837, in working out the *idea*, when it was published to the world—where the signals were actually marked in lines (*See* plate 1, fig. 4.) on paper placed for the purpose? or, did he take the *idea* from Mr. Davy's patent of 1838, where the signals were actually marked in dots on the revolving cylinder? Doubtless, Mr. Wheatstone will be very loth to admit that *his idea* was obtained from either of these sources; but one thing is certain, he can produce no shadow of a proof that he had even an *idea* of an Electro-Magnetic *Printing* Telegraph prior to these dates! There cannot possibly be any great degree of merit or originality in the *abstract idea* of printing messages after a knowledge of Morse and Davy's inventions. The Professor would hardly venture to deny his acquaintance with the former, after its extensive publication in the old as well as the new world; acquaintance with the latter he cannot deny, as he harassed Mr. Davy for several months, before the Solicitor-General, in opposing his patent, until the question at issue between them was, it is said, referred to Professor Wheatstone's own personal friend, Dr. Faraday, who, to his great honour, decided in favour of the real man of science, consequently Davy forthwith got his patent.

Mr. Bain's Electro-Magnetic *Printing* Telegraph consists of three principal parts, to none of which is there the slightest resemblance in any one of the patented contrivances of Mr. Wheatstone, *prior to the latter's acquaintance with Mr. Bain.* These are first, The rotatory motion given to the *type-wheel*, step after step, like the second's-hand of a clock,* until the required letter arrives opposite the paper. Secondly, The means of inking the types, or otherwise making permanent the imprint of the type upon the paper. Thirdly, The motion communicated to the paper, so as to bring a fresh surface under the types, and receive the printed intelligence in a con-

* This motion he has recently superseded by a continuous uniform motion regulated by centrifugal force.—*See* diagram, plate 5.

tinuous spiral line, until the paper is filled : thus producing in print, precisely as in the pages of a book, the letters composing the message. The admirable adaptation of all these parts to each other, and the precision of their combined working, are evidence of a master mind, which is conclusive as to the party with whom they originated, and a still greater evidence is, we think, afforded by the fact of the rapid progress which Mr. Bain has since made, and is still making ; while Professor Wheatstone sticks at the point where Mr. Bain left him !

It is certainly possible that one man may have a *legal* right to an invention, while the *moral* claim belongs to another; in this work we trust we have brought forward proofs enough to convince the most sceptical mind that the *moral* as well as the *legal* right to the inventions of the *Electro-Magnetic Printing Telegraph* and *Electric Clocks*, both belong to Mr. Alexander Bain ; and that the claims to these inventions set up by Professor Wheatstone, are, in the last degree, the reverse of doing "unto others as ye would wish that they should do unto you."

A TABLE

OF THE

DATES REFERRED TO IN THE FOREGOING TREATISE,

IN CHRONOLOGICAL ORDER.

N.B. The Documents marked thus * being those necessary for the vindication of Mr. Bain, are lodged in original with Messrs. Casterton and Dixon, Solicitors, No. 1, Angel Court, Throgmorton Street, where they may be inspected by any one desirous of testing their authenticity.

1816.—Mr. Ronalds, of Hammersmith, invented and constructed an Electric Telegraph, which he worked by a single circuit through eight miles of wire, in the presence of several scientific men.

1823.—*Mr. Ronalds published a work, in which he very fully described his Telegraph, in both letter-press and plates, together with several other electrical instruments of his invention. This work is referred to in the last edition of the Encyclop. Brit. page 582.

1828.—During this and following years, Dr. Ritchie, Sir H. Davy, and others, published many papers, respecting the application of Electricity to Telegraphic purposes.

1830.—Mr. Ampère suggested the application of deflected needles by means of voltaic circuits, so as to effect telegraphic communication.

1837, 25th April.—*Mr. Alexander, W. S., of Edinburgh, lodged a caveat for Great Britain and Ireland, published a description, and showed a complete model of an electric telegraph, in accordance with Ampère's suggestion. See page 89, and plate 1, fig. 2.

1837, 4th September.—Mr. Morse, in America, also acting on Mr. Ampère's suggestion, showed the model of an electric telegraph, in which deflected needles and pencils recorded signals. See Professor Silliman's *Journal of Science* for October, 1837, and see *ante* page 90.

1837, November.—Mr. Davy exhibited at Exeter Hall an electric-telegraph, by means of deflected needles. See page 100.

1837, 12th December.—Mr. Wheatstone (with Mr. Cooke) specified his first patent (sealed on the previous 12th of June) for an Electric Telegraph on the principle of deflecting *needles*, reducing the number of wires to five, "by using more than one needle at a time, and observing their combined motions," as had been recommended by Baron Schelling and by Fechner. See page 100, and see *Companion to the Year Book of* 1843.

1838.—*Mr. Bain, in the spring of this year, *spoke to a friend respecting his intended Electric Clock.* See Mr. M'Dowall's letter, page 85.

1838, 18th October.—Mr. Wheatstone (by his partner, Mr. Cooke), specified a second patent (for improvements), still making his signals by deflecting the needles.

1839, 4th January.—*Mr. Davy, of Fleet Street, specified his patent Electro-Magnetic Telegraph, *in which he used clock-work acted upon by electro-magnets, producing a step-by-step motion similar to the second's hand.* He registered the signals by dots upon a prepared fabric placed in the machine, *the number of wires being two, or sometimes three.* See page 92, and fig. 3, plate 2, see also *Repertory of Inventions.*

1839, 19th April—Mr. Davy left England for one of the Australian Colonies.

1839, 10th October.—It is to be inferred from Mr. Wheatstone's letters in *Lit. Gazette* of 20th August, 1842, that on or after this date he *invented* the Electro-Magnet-Telegraph, specified as undermentioned, on 21st July, 1840.

1840, January 6th.—Mr. Wheatstone *states,* that he gave directions to John Lamb to make a Telegraphic Clock.

1840, 21st January, Mr. Wheatstone had a third patent sealed for the invention of the Electro-Magnet-Telegraph, as above referred to.

1840, 6th February.—*Mr. Wheatstone gave evidence before a Select Committee of the House of Commons as to what he had done, and what he intended to do, towards perfecting the Electric Telegraph, in which no *mention is made of clocks or printing.* See Fifth Report of Select Committee upon Railways, July 10, 1840.

1840.—(From May to July) Mr. Wheatstone *spoke to some of his friends respecting his intended Electric Clocks.* See pages 84 and 85.

1840.—*Early in June, Mr. Bain showed working models of his Electric Clock, and his Electro-Magnetic Printing Telegraph, and several pieces of paper that had been printed upon by the latter instrument. See page 85.

1840, 10th June.—Mr. Wheatstone made some inquiries respecting types and transfer paper for his *intended Printing Telegraph.* See page 83.

1840.—*Early in July, Mr. Bain printed the name of one of his friends by his Printing Telegraph. See page 45.

1840, 21st July.—Mr. Wheatstone specified his third patent, being that for his Electro-Magnet Telegraph, *in which he used clock-work acted upon by electro-magnets producing a step-by-step motion similar to the second's-hand; the number of wires being two or sometimes three;*† in the same instrument is appropriated

† The Professor having strenuously opposed the patent solicited by Mr. Davy, his attention would naturally be directed to the specification of that patent, when lodged on 4th January, 1839. This, when coupled with the fact, that Mr. Davy had gone to Australia, and was not, therefore, able to protect his patent from invasion, explains at once how it came to pass that Mr. Wheatstone, in January, 1840, appropriated without opposition that which is the Soul, and Master-principle of the other's invention, namely, the escapement. The reader's attention is particularly requested to the instruments described in this document, as upon it the Professor founds his claims to the Electric-Clock and the Printing Telegraph.

the signal disc of Mr. Ronalds, and the ratchet-wheel of Buzengeiger, *no allusion being made either to printing or measuring time.* See page 93, plate 2, fig. 4.

1840, 1st August.—**(Just ten days from the last date).* Mr. Bain called upon the Professor and explained the two instruments of his invention; viz., the Electro-Magnetic Clock, and the Printing Telegraph. See Mr. Baddeley's letter in Appendix.

1840, 18th August.—*Mr. Bain waited upon the Professor, by appointment, taking with him the two rough models showing the principle of both inventions, when the Professor bought the one of the Printing Telegraph, under certain conditions. See page 50.

1840, September.—Mr. Bain entered into an arrangement, to make models of two Electro-Magnetic Printing Telegraphs *of his own invention*, upon the understanding that the Professor was to pay the expense of materials and workmanship, and give Mr. Bain £150 for the inventions.

1840, 10th October.—Mr. Bain (with Mr. Barwise), applied for a patent for his Electro-Magnetic Clocks. *N.B.*—Mr. Wheatstone by means of a caveat for Telegraphs was enabled, in 1838, to oppose Mr. Davy's patent; but not having lodged any caveat in respect of clocks, this patent of Mr. Bain's passed without opposition.

1840, 26th November.—Mr. Wheatstone exhibited an electro-magnetic clock at the Royal Society, which he announced as his own invention.

1840, December.—Mr. Wheatstone having *(see* page 57) obtained possession of Mr. Bain's models of the two Electro-Magnetic Printing Telegraphs, then refused to pay either the balance of cost (about 25*l.*) or the contemplated 150*l.*, setting Mr. Bain at defiance.

1841, 8th January.—Mr. Bain's patent for the clocks was sealed. Soon after this Mr. Wheatstone's clock was announced to be exhibited at the Adelaide Gallery, when Mr. Barwise (co-patentee with Mr. Bain) sent him notice of an injunction, which prevented its being shown.

1841, 25th January.—Mr. Bain published a description of his Printing Telegraph in the *John O'Groat's Journal*, being that of his native place.

1841, 24th March.—Mr. Bain laid claim, in the *Inventors' Advocate*, to the invention of the Electro-Magnetic Clock.

1841, 28th March.—Mr. Bain's Electro-Magnetic Clock was exhibited and lectured on at the Polytechnic Institution.

1841, 7th April.—A letter from Mr. Wheatstone, in the name of John Lamb, one of his workmen, claimed for the former Mr. Bain's invention of the Clock. See page 14.

1841, 27th April.—*Messrs. Cooke and Wheatstone obtained a document from Sir I. Brunel and Professor Daniel, purporting to be an award in respect to an imaginary quarrel. See page 41.

1841, 22d May.—*Some person, on behalf of Messrs. Cooke and Wheatstone, proposed to bribe the proprietors of the *Inventors' Advocate*, if Mr. Bain's letters, concerning his invention of the Electro-Magnetic Clocks, were excluded from that journal.

1841, 9th June.—Mr. Wheatstone having applied for a patent, "For Improvements in producing, regulating, and applying Electric Currents," he was directed by Sir John Campbell to deposit an account of what he intended to protect under this comprehensive title.

1841, July.—Mr. Wheatstone opposed, but unsuccessfully, the extension of Mr. Bain's patent for the Clocks to Scotland, before the Lord Advocate Rutherford.

1841, July.—Mr. Bain's Printing Telegraph was exhibited and lectured on at the Polytechnic Institution. See its description in the *Polytechnic Journal* for September.

1841, 9th September.—Mr. Bain (with Lieutenant Wright, R.N.), applied for a patent for an Electric Printing Telegraph, and some other electric machines.

1841, 6th October.—Mr. Wheatstone opposed the patent being granted, when he stated to Sir Frederick Pollock, that one object contemplated in his patent, then in progress, "was a plan to enable a man in London to print a letter in Edinburgh,†" and upon this statement the Attorney-General refused to grant the patent solicited by Lieut. Wright and Mr. Bain, as far as related to printing.

1841, 9th October. — Mr. Bain ascertained the fact of the Professor having deposited the paper of *the 9th of June* with the *former* Attorney-General. Sir Frederick Pollock was therefore requested to open that paper, and if he found the Professor's *verbal* statement made to him, not to agree with his *written* statement made two months previously to Sir John Campbell, it was submitted that he should revise his judgment. See the result at page 65.

1842, 7th January.—Mr. Wheatstone lodged his specification in which he describes an Electro-Magnetic Printing Telegraph, but makes no mention of conducting the electricity, other than by wires in the ordinary way.

1842, January.—Mr. Wheatstone's partner, Mr. Cooke, published a book upon Electric Telegraphs in connection with railways, in which, when speaking of the number of wires, no idea is suggested that the electricity is to be conducted in any other than the usual manner.

1842, 2d June.—*Mr. Bain (with Lieutenant Wright) publicly repeated in Hyde Park some previous experiments, when amongst other results it was demonstrated, that in the construction of electric telegraphs, the moisture *of the Earth*, or any natural body of water, could be used with great advantage as part of the voltaic circuit, it being necessary to *place at the ends of the wire large surfaces of metal in contact with the moisture*, and a description of the experiments were published in the daily and weekly papers of the period. See *Literary Gazette* of 4th June, and *Mechanics' Magazine* of 11th June, 1842.

1842, 7th June.—Mr. Bain's patent for the improved Printing Telegraph and other machines was specified, in which he claimed the natural agency of water, as half of the electric circuit.

---

† He carefully avoided all mention of the deposit caused to be lodged by the former Attorney-General, containing his plans, &c.

1842, 11th June.—Mr. Bain's letter, claiming the invention of the Electric Clock, and also that of the Printing Telegraph, appeared in the *Literary Gazette.*

1842, 18th June.—Mr. Wheatstone's answer of 13th June appeared in the same paper.

1842, 6th August.—Mr. Bain's rejoinder of 18th June, appeared in the same.

1842, 20th August.—Mr. Wheatstone's reply also appeared in the same. See this correspondence in the Appendix.

1842, 21st August.—Mr. Wheatstone having ascertained from Mr. Bain's experiments at the Serpentine on 2d of June, and from the specification of Mr. Bain's patent on the 7th of June, 1842, that one wire would complete the voltaic circuit, provided that *large metallic surfaces* were attached to each end of it, such surfaces being immersed in water, wrote to the directors of Waterloo Bridge for leave to lay down a wire along its parapet, in order to repeat Mr. Bain's experiments by passing the current across the Thames from King's College to the shot tower on the Surrey side.

1842, 3d Sept.—Mr. Wheatstone again wrote to the directors, offering to make good any damage that should be occasioned to the bridge by these experiments.

1842, Sept.—Mr. Wheatstone repeated Mr. Bain's experiments accordingly, and worked a telegraph on the summit of the shot tower, thus sending the electric current from a galvanic battery across the river Thames.

1842, 11th Sept.—Mr. Wheatstone, in his partner's (Mr. Cooke's) name, took out a fifth patent for "improvements in apparatus to transmit electric currents," with a view to appropriate to themselves Mr. Bain's discovery of the sufficiency of one wire to pass electric currents from galvanic batteries for telegraphic and other purposes, the moisture of the earth or water completing the circuit.

1842, 10th Oct.—Mr. Bain made his greater discovery of passing the electric current with an unvarying flow through the earth itself, without any galvanic battery whatsoever, at Loughton, in Epping Forest, in the grounds of Mr. Finlaison, see page 21.

1843, 6th Feb.—Mr. Bain applied for a patent to secure this discovery for Telegraphs, the measurement of time, and other purposes.

1843, 11th March.—Messrs. Cooke and Wheatstone specified their fifth patent, in which they claim Mr. Bain's discovery for Telegraphs, as stated under 11th Sept. previously. — *N.B.* This is the first specification of theirs in which electric clocks are mentioned.

1843, 24th March.—Mr. Wheatstone opposed, but unsuccessfully, Mr. Bain's new patent before Sir William Follett, which passed the privy seal, on 3d April.

1843, 6th April.—Mr. Bain found it necessary to make a verbal alteration in the title of his patent.

1843, 21st April.—Mr. Wheatstone opposed this alteration, but as before, unsuccessfully.

1843, 17th May.—Mr. Cooke had read at the Society of Arts a paper, in which it is stated that he had used the earth as part of the voltaic circuit two years previously, notwithstanding his silence as to any such aid in his book, published by Simpkin, Marshall, & Co., in 1842!

1843, 23d May.—Mr. Wheatstone, at the Society of Civil Engineers, stated, that in the beginning of 1842, he had put up at Berlin two telegraphs, worked by a single wire, having metallic surfaces at each end buried in the earth, the earth itself thus completing the circuit — another assertion which is flatly disproved at page 32. He also claims, as an original discovery, his passing the current over the Thames, in Sept. 1842, making no mention of Mr. Bain nor of his experiments on the previous 2d of June, when the current was passed a much greater distance. (*See* page 30.)—*N.B.* He was at this date ignorant of Mr. Bain's greater discovery of dispensing with galvanic batteries, by producing electric currents from the earth or water, or, there is little doubt, he would have claimed it likewise.

1843, 27th May.—Mr. Bain's new patent passed the great seal.

1843, 16th and 17th June.—Mr. Bain's electric pendulum, referred to at page 36, was publicly exhibited at the conversazione of Mr. Walker, President of the Institution of Civil Engineers.

APPENDIX.

No. 1.

From the LITERARY GAZETTE, 11th June, 1842.

"320, *Oxford Street, 7th June*, 1842.

"SIR

"IN an article headed Royal Institution, in the N° 1323 of the Literary Gazette, you have made some remarks in reference to what you term Professor Wheatstone's Electro-Magnetic Clock, in a manner which would lead any one to suppose, that the Professor was not fairly dealt with in this matter. I am aware that Professor Wheatstone has been very industriously employed in cultivating this impression among his Friends, but he has not dared to make those claims to the invention openly, although I have called upon him more than once in the pages of the *Inventors' Advocate*, at the time the invention was first brought before the Public, to state his Claims, and I would be happy to answer him.

"I now repeat what I then stated, namely, that Professor Wheatstone is not the Author of this invention. I communicated the invention, together with that of the Electro-Magnetic Printing Telegraph, to Mr. Wheatstone with the view of his joining me to bring them forward, and this took place in August, 1840, before ever Mr. Wheatstone did anything in the matter, and I again call upon Professor Wheatstone to answer these Statements, when I shall be most happy to reply to whatever he has got to say. For Truth's sake alone, Mr. Editor, I solicit the insertion of this letter, which will greatly oblige Your Ob^{t} Serv^{t}

"ALEXANDER BAIN."

No. 2.

From the LITERARY GAZETTE, 18th June, 1842.

"SIR,

"IN answer to a letter, signed "Alexander Bain," which appeared in the *Literary Gazette* of Saturday last, I beg to offer the following observations:

"The writer states that the electro-magnetic telegraph clock is not my invention, and that I have not dared to claim it openly. To this my answer is, that on November the 26th, 1840, a paper of mine was read at the Royal Society, fully describing it as my invention; and the telegraph-clock itself was shown in action in the library on the same evening, and during several days. An abstract of this paper was published in the society's proceedings; and the communication was noticed in the *Literary Gazette* of 28th November, 1840. It was not until the January following that I became aware that an attempt was about to be made to question my right to the invention, by receiving a notice from a Mr. Barwise, of St. Martin's Lane, stating that he was the inventor: some time after which it was publicly announced in the placards and advertisements of the Polytechnic Exhibition as being the joint invention of Messrs. Barwise and Bain. The latter person was a working mechanic, who had been employed by me between the months of August and December of the year 1840.

"It admits of no doubt, therefore, that this invention was first publicly made known and claimed by myself; and I proceed to the assertion of the writer, that he communicated the invention to me in August, 1840, which was three months preceding the date of my publication. To this I answer, that there is no essential difference between my telegraph-clock and one of the forms of the electro-magnetic telegraph, invented by me, and described in the specification of a patent granted to myself and Mr. Cooke in January, 1840; the former is one of the numerous and obvious applications which I have made, and only requires the idea of telegraphing time to present itself for any workman of ordinary skill to put it into practice. In telegraphing messages, the wheel for making and breaking the circuit is turned round by the finger of the operator, while in telegraphing time it is carried round by the arbor of a clock. The sole question, then, is, Did the idea of applying my invention to telegraph time originate with myself, or was it suggested to me by your correspondent? Now, with reference to this, I have to state, that long before the date specified I had described to many of my friends in what manner the principles of my telegraph might be applied, to enable the time of a

single clock to be shown simultaneously in all the rooms of a house, or in all the houses of a town. Among these the following gentlemen have, from particular circumstances, been able to furnish me with the dates of the communications I made to them: Mr. Airy, the astronomer royal; Dr. W. A. Miller, of King's College; Mr. John Martin, the eminent artist; and Mr. F. O. Ward, formerly a student in King's College. In addition to this evidence, I may add, that Mr Bain's letter, in the *Inventors' Advocate*, was immediately answered by Mr. Lamb, a workman in my employ, to the purport, that it was impossible the statement therein contained could be true, since I had given him instructions to make the electro-magnetic telegraph-clock on January 6, 1840, which was more than six months before Mr. Bain asserted he made his communication. I repeat that, neither as regards the idea, nor any of the details of the telegraph-clock, have I been in the slightest degree indebted to your correspondent; and I think, Mr. Editor, you must allow that I have satisfactorily refuted his assertions.

"I next proceed to the consideration of my electro-magnetic printing-telegraph. This invention consists merely of an addition to the electro-magnetic telegraph invented by me, and described in the first part of the specification of the patent granted to myself and Mr. Cooke in January, 1840; when this addition is removed, the telegraph itself remains, in all its details, without the slightest alteration. There cannot, therefore, be a question as to the invention of my printing telegraph as a whole, but merely as to the additional apparatus which occasions the letters to be printed, instead of their being merely presented to the eye. The following are the means by which I effect this purpose:—For the paper disc of the telegraph, on the circumference of which the letters are printed, a thin disc of brass is substituted, cut from the circumference to the centre, so as to form four-and-twenty springs, on the extremities of which types or punches are fixed; this type-wheel is brought to any desired position, just as the paper disc is. The additional part consists of a mechanism which, acted upon by an electro-magnet, occasions a hammer to strike the punch, brought opposite to it, against a cylinder, round which are rolled alternately several sheets of thin white paper and of the blackened paper used in the manifold-writing apparatus; by this means, without presenting any resistance to the type-wheel, I obtain at the same time several distinct printed copies of the message transmitted. This plan originated with and has been carried out solely by myself. It is true, that after I had contrived this arrangement, Mr. Bain proposed a different and far less efficient mode of effecting the same purpose: this was, to move the type-wheel bodily towards the cylinder, round which wet paper was to be

rolled to receive the impression, and to employ an inking-apparatus similar to that of the common printing-machine, in order to supply the type-wheel with ink. Though I purchased from him the rude model which he made to explain his notions, and subsequently employed him to see how far it was capable of practical application to my telegraph, I have never made, nor do I ever intend to make use of any of his suggestions, nor have I ever laid the slightest claim to them. The truth of this statement admits of no dispute, since, in a receipt in my possession, signed and dated by himself on August 18, 1840, he acknowledges receiving payment for a model of his proposed "modification of the printing-apparatus to be added to the electric telegraph," and admits that 'it differs from the instrument devised by myself for the same purpose by an inking-roller being employed, and by the wheel, on the circumference of which the types are placed, being bodily moved forward, in order to impress the types on the cylinder carrying the paper, instead of the types being pressed individually, as in my instrument.' Whatever may be the merits of Mr. Bain's method, it cannot justify any person to call into question the originality and priority of my electro-magnetic printing-telegraph, which is secured from infringement by two patents, one, already mentioned, including the telegraph itself; and the other, of more recent date, comprising my superadded printing-apparatus.

"As I have advanced nothing in this communication but what can be supported by documents, or the evidence of other persons, I shall consider any further unsupported assertions unworthy of notice, and shall therefore decline any further correspondence.

"I remain your obedient Servant,

"C. Wheatstone."

"*King's College, June* 13, 1842."

No. 3.

From the Literary Gazette, 6th August, 1842.

"Sir

"In order to counteract the prejudicial tendency of Professor Wheatstone's letter in your *Gazette* of the 18th of June, as well as to enable your readers to form a correct judgment upon the points at issue between the Professor and myself, I have to request a place for the following brief but faithful narrative. I first came to London in 1837, to seek employment as a journeyman clockmaker. I had at that time some knowledge of electricity, and a strong desire to know more. As soon as I obtained

employment, I devoted all my leisure to my favourite study, and attended lectures at the Adelaide Gallery and Polytechnic Institution; and seeing the beautiful electro-magnetic machines in action at those places, first drew my attention to how they could be applied to useful purposes. The application of this mysterious power to the mechanism of my own business was naturally the first to suggest itself; afterwards I thought on various ways of applying it to telegraphs; and, among other methods which occurred to me, was that of printing the intelligence, instead of showing it by signs, which I knew had been done before. I therefore confined my exertions to the electric clocks and electric printing-telegraph; and by July, 1840, I had so far matured both these inventions, that I was desirous of meeting with some party who would assist me with the means of bringing them into operation. Being a stranger in London, I called, first, on Sir Peter Laurie (as a countryman of mine), who kindly gave me a letter of introduction to the late Dr. Birkbeck; the Doctor was unfortunately confined to a sick-bed, and I never saw him. I next called at the *Mechanics' Magazine* office, in Fleet-street, and saw Mr. Baddeley (a gentleman well known in the scientific world), to whom I explained my wants. Mr. Baddeley advised me to call upon Professor Wheatstone, whom he knew to be deeply engaged in the science of electro-magnetism, and thought him a likely person to enter into my views. At that time I knew nothing of Professor Wheatstone; but at Mr. Baddeley's recommendation I waited upon him and described my plans, in which he seemed to take great interest.

"At a second interview, I exhibited a model illustrative of my printing-telegraph, and another of my electric clock: from the remarks then made by Professor Wheatstone, it was evident that both inventions were entirely new to him, nor did he in any way question their novelty or originality. It appeared subsequently, however, that as soon as he got possession of my plans, he went to another workman, and got a machine made, which he exhibited at the Royal Society as his own invention, well knowing that he had obtained it from me: but of these proceedings I was kept in ignorance.

"The model illustrative of my printing-telegraph, which I exhibited to Professor Wheatstone at our second meeting, he purchased of me; but he said that he also had a printing-machine which was to be added to his telegraph; and under this impression I sold him my printing model, and signed the receipt mentioned in his letter, the receipt being written by himself. At that time I had every confidence in the Professor, and implicitly believed his statements. Shortly afterwards I showed him an-

other printing-telegraph, different from the first, when we came to the following arrangement, viz.—That I was to make working models of my printing-telegraph (including the two arrangements), for which I was to be remunerated as the work progressed: the invention was to become his property, on his paying me a stipulated sum of money. Accordingly I proceeded with the work, until one of the models was finished, and the other partly so; when the Professor contrived to get both into his possession, and then refused to fulfil his part of the agreement.....

"Shortly afterwards, I learnt that Professor Wheatstone was applying for a new patent, the title of which would have enabled him to appropriate to himself my inventions; to prevent this, I immediately made fresh models, and publicly exhibited them at the Polytechnic Institution.

"Professor Wheatstone's assertion, that I 'was employed by him as a working mechanic,' is wholly untrue; the only transactions which ever took place between us related entirely to my own inventions, as I have already described; and I was never engaged or employed for a single hour upon any piece of mechanism or invention emanating from Professor Wheatstone.

"The Professor asserts, that there is no essential difference between some part of his patent electric telegraph of 1840, and the electric clock—that it only requires the idea of telegraphing time instead of signals; forgetting that in the idea and its application consists the fundamental part of the electric clock. The very principle of the invention consists in applying the synchronism of the pendulum to regulate the transmission of the electric currents. Professor Wheatstone states, that he directed his workman, in January 1840, to make an electro-magnetic telegraph clock; but it was *not* made, nor anything done in the matter, until after I had communicated my method to him; it was then gone on with so quickly that several were soon completed.

"Professor Wheatstone states, that he described to many of his friends how the principle of his telegraph could be applied to clocks, so as that the time of a single cloek should be shown simultaneously in all the houses of a town. This assertion proves him to be a professor of a practical impossibility, and shows that he does not even yet understand much of the invention. To work the clocks of a very small town, simultaneously, would require a source of electricity of such immense power, that instead of being able to transmit it through wires, it would make bars of metal hot in a few minutes. In the electric clocks of Mr. Barwise and myself this difficulty is got over by working the clocks in rotation.

"Professor Wheatstone took out a patent in January 1840, in which he

might have secured the inventions of the printing-telegraph and the electric clock, had he been acquainted with either previous to lodging his specification in July, 1840. Any body who knows the Professor will agree with me that, had he known of these inventions, he would have secured them in his patent, the more especially as they are far more valuable than what he patented.

"The specification of that patent is open to public inspection, and does not contain the slightest allusion to either, which goes far to prove that his assertion of having a printing machine when I showed him mine (in August) must have been entirely destitute of truth. The only features of resemblance between the patented electric telegraph of Mr. Wheatstone and my electric clock are, that they both contain electro-magnets, and wheels and pinions—and so did the electric telegraph of Mr. Davy, patented in 1838.

"Did your space permit, I could state many other circumstances connected with the inventions of which Professor Wheatstone has endeavoured to deprive me; but, in conclusion, will merely request insertion of the two following letters, which are corroborative of the first and most important part of my narrative.—I remain, Sir, your obedient and obliged humble servant,

"Alexander Bain.*"

"320, *Oxford Street, June* 29, 1842.

(Copy.)

'*To the Right Hon. the Lords Commissioners of the Admiralty.*

'My Lords,—Mr. Alexander Bain called on me on the 1st August, 1840, for the purpose of learning whether I could introduce him to some one possessing capital to join him in bringing his inventions of the electro-magnetic clock and electro-magnetic printing telegraph into full operation; and I wrote to my late friend, Dr. Birkbeck, as more able than myself to promote Mr. Bain's wishes; and I write this note for the purpose of showing that, at the above date, Mr. Bain's inventions were in a complete state, and only delayed from want of the necessary capital.—I have the honour to be your lordships' faithful servant,

'P. Laurie.'

'*Park Square, June* 20, 1842.

---

* We regret having got entangled in this controversy, and shall only hold ourselves in justice bound to afford a place to any reply Mr. Wheatstone may think proper to give.—*Ed. L. G.*

To Mr. A. Bain.

'Sir,

'In reply to your application, I beg to say, that I most distinctly recollect your calling upon me in Fleet Street, in August 1840, and consulting with me as to the best mode of proceeding with your inventions of an electric clock and an electric printing-telegraph, both of which you explained to me. I also beg to state, that I then recommend you to call upon Professor Wheatstone, the inventor and patentee of the electric telegraph, as the most likely person to appreciate the merits of your inventions, as well as to further your views respecting them. Professor Wheatstone was at that time unknown to you; but, at my recommendation, you waited upon him, and submitted your plans to his inspection; and I only regret that I should have been the means of introducing you to a gentleman who should so far have forgotten what is due to real merit, as to attempt to dispute with you the two important inventions of which you are unquestionably the author. To these facts I am quite ready to speak, at any time and place that your occasions may require; and remain yours very faithfully,

'W. Baddeley.'

'20, *Alfred Street, Islington, June* 8, 1842.'

No. 4.

From the Literary Gazette, 20th August, 1842.

"*Conduit Street, August* 10, 1842.

"It is really, Sir, with a feeling of indignation that I find myself once more called upon to defend myself against the unjust statements and actually false averments of Alexander Bain, who has again attempted to fix upon the minds of those of your readers who are not disposed to enter into a minute examination of the question at issue, the belief that I have appropriated to myself inventions to which he alleges himself entitled. As your space is doubtless as valuable as my time, I shall at once place before you the following documents in refutation of his charges; the first of which is, that the telegraph-clock and the printing-telegraph are not my inventions. I have already shown, in my former letter, that it is impossible for any person who sees and understands the principle and operation of my last electro-magnetic telegraph, invented in 1839, to doubt for a moment that both one and the other are direct and immediate applications of that invention. I shall, therefore, not press any further observations of my own, but present to your readers the conclusions arrived at upon this point by eminent practical men of science:—

'August 10, 1842.

'There cannot be the slightest doubt that Professor Wheatstone's printing-telegraph consists of his previously invented electro-magnet* telegraph, with an addition, *viz.* that of an apparatus for printing the signals, which the original instrument only exhibits to view. When this addition is removed, the telegraph itself remains complete in all its details without requiring the least alteration. It is equally clear that Professor Wheatstone's telegraph-clock is merely an application to a particular purpose of his electro-magnet telegraph.

'Robert Willis,

'Jacksonian Professor of Natural and Experimental Philosophy in the University of Cambridge.

'J. F. Daniell,

'Professor of Chemistry in King's College, London.

'N. Arnott, M.D.

'Henry Moseley,

'Professor of Natural Philosophy in King's College.

'W. Snow Harris.'

"The second charge is, that he communicated these inventions to me in August 1840. This, after what is above stated, can only mean that he communicated to me the applications in question of my invention at that time. It is evident that the proof or disproof of this turns entirely on points of date; and I am thus most fortunately relieved, by the introduction of unquestionable testimony, from a discussion which might be as tedious to your readers as it would be irksome to myself. I have already shown, that long before the date he has assigned, I had unreservedly and publicly conversed about those applications to many persons. In order that no doubt of this may remain, I subjoin notes from Mr. Martin, the eminent historical painter, and other gentlemen referred to in my first letter, which define the dates at which I made the communications respecting the telegraph-clock to them. I have previously given the evidence of a workman of mine to the same effect. Absence on the Continent prevents me at present from obtaining a similar corroboration from the astronomer royal:—

'30, Allsop Terrace, New Road, July 18, 1842.

'My dear Wheatstone,

'It was in May, 1840, when you explained to me, at King's College, the proposed application of your electric telegraph for the pur-

"* This expression is used to distinguish the telegraph referred to from my magnetic-needle telegraph, invented in 1837."

pose of showing the time of a distant clock simultaneously in as many places as might be required. I am able to speak to the time with tolerable accuracy, as it was a few days after we had dined together at the house of a mutual friend, which I have the means of knowing was on the 16th May, 1840; and I further remember, that when you were describing your plans, I made the observation, that "you proposed to lay on time through the streets of London as we now lay on water."—I remain, my dear Wheatstone, ever faithfully yours,

'*Prof. Charles Wheatstone, &c.* 'JOHN MARTIN.'

'King's College, July 18, 1842.

'DEAR SIR,

'In the spring of 1840, you frequently conversed with me on the subject of applying the principles of your telegraph to the purpose of making several dials, at any required distances, simultaneously show the time indicated by a single clock. At that time I was often in your room, and occasionally assisted you in your experiments. Your communications to me were made before the 17th of July, 1840, as at that period I left town, and did not return until the winter. Believe me, dear Sir, yours truly,

'*Prof. Wheatstone, &c.* 'WM. ALLEN MILLER.'

'Erechtheium Club, July 21, 1842.

'MY DEAR SIR,

'You described to me your plan for telegraphing time on the 20th of June, 1840, at King's College. I am able to recall the exact date, because a friend of mine, who had been invited to witness your experiments that day, was prevented from coming by an engagement to be present at a public breakfast given by the Directors of the Southampton Railway. The substance of our conversation was as follows:—I was turning the handle of the rheotome*, and watching the consequent motions of the dial, and I said, "If the rheotome were turned round at a uniform rate, the signals of the telegraph would indicate time." You replied, "Of course they would; and I have arranged a modification of the telegraphic apparatus by which one clock may be made to show time in a great many places simultaneously." I expressed a curiosity to know how this was done; and you explained to me, by means of drawings, the plan of making and breaking the circuit by the alternate motion of the

"* I have given this name to the wheel that makes and breaks the circuit, which in the telegraph is turned by the finger of the operator, and in the application in question is carried round by the motion of a clock."

pendulum of a clock, so as to produce isochronous signals on any required number of dials. You showed me some other ways of doing it; but the plan of the pendulum particularly fixed itself in my memory on account of its simplicity. I am, my dear Sir, yours very truly,

'F. O. WARD.'

"The following note from Mr. E. Cowper, a gentleman well known to the mechanical world for his improvements on the printing-machine, refers my printing-telegraph to June, 1840. This evidence is in addition to the document signed by Bain in August, to which I formerly referred:—

'St. Petersburgh Place, Bayswater, July 29, 1842.

'DEAR SIR,

'At the time you mentioned to me that you had contrived an addition to your electric-telegraph, by which it could be made to *print* the letters instead of merely *showing* them, you asked me for some information respecting the mode of preparing the manifold writing-paper, which you proposed to employ, and on the best form of type for obtaining impressions with it. The note in which I answered these inquiries respecting your printing-telegraph, was dated June 10, 1840. I remain, dear Sir, yours sincerely,

'*Prof. Wheatstone, F.R.S., &c.* 'EDW. COWPER.'

"As the only questions at issue are conclusively settled by these statements of disinterested parties, I might be justified in passing over your Correspondent's assertions, which relate to circumstances subsequent to the dates given; but as this might appear to be acquiescing in their truth, I will trespass on your space with a few observations.

"It is quite untrue that Mr. Bain ever exhibited to me a model of an electro-magnetic clock, either before or after he was employed by me. He has not yet given the least proof of his having had in his possession at the time he mentions any such model; he has not yet adduced the testimony of any person who then saw it.

"It is equally untrue that Mr. Bain showed me at the time he refers to, any model of an *electric printing-telegraph*. He had merely a model, if so rude a thing can be called a model, of a small part proposed to be added to my electric-telegraph, to effect a purpose for which I had before contrived far more efficient means. The part in question was simply a mechanical addition, involving no scientific principle. So far from the work done by him when he was employed by me, entirely relating, as he states, to his own inventions, the mere inspection of it,—and it remains

at present as he left it,—will show that it was essentially copied from the telegraph invented by myself a year before; and this was done under my own immediate directions.

"More than eighteen months have elapsed since Mr. Bain commenced his infringements; and notwithstanding the assistance he has received from the Proprietors of the Polytechnic Exhibition, and from other parties who are now connected with him, he does not seem to have advanced beyond imitating the mechanical adaptations of the electric-telegraph. Of the real principles of telegraphic communication by electro-magnets, which, assisted by the beautiful theory of Ohm, I was the first to determine, some years since, he evidently knows nothing. The instrument lately shown as his at the above Exhibition, might work, indeed, like any other usual electro-magnetic apparatus, in a room with a powerful battery, but it would utterly have failed to work through any considerable length of wire; while it is well known that my telegraphs are caused to act through many miles of wire by a few voltaic elements of very inconsiderable dimensions. Nothing more is requisite to show the utter ignorance of the writer and his advisers on points relating to the laws of electricity than his assertion, that a wire would be made red-hot before a current could be obtained sufficiently strong to make a great number of electro-magnets act simultaneously in the same circuit. Every one acquainted with the subject knows, that to produce a given effect in each electro-magnet, the number of elements of the voltaic pile would require to be in proportion to the added resistances in the circuit; but, this condition being fulfilled, the intensity at every section of the wire, and consequently its temperature would remain the same.

"In conclusion, I will merely refer to the letters of Sir P. Laurie and Mr. Baddeley. And what are these letters, after all, brought forward to prove? that Mr. Bain, long subsequently to the dates I have referred to, called upon these parties, and told them he had made certain inventions, which it does not appear they ever saw. Sir P. Laurie's letter seems to have been written with a kind wish of introducing a countryman to the Lords of the Admiralty, and apparently without any intention of its being applied to its present use. It cannot be any disparagement to this gentleman's judgment to observe, that the highest mechanical attainments could not enable a person, after the lapse of nearly two years, to pronounce of *his own knowledge*, from a single conversation about a machine which he had never seen, that such machine was then "in a complete state."

"With respect to the note written by Mr. Baddeley, with whom I have not the honour of being acquainted, I will merely observe, that

several of the assertions and negations which it contains, could not have been within the *personal knowledge* of the writer. Several of those which Mr. Baddeley has stated as facts, could only have been derived directly, or by inference, from the *statements* of Mr. Bain. Perhaps, Mr. Baddeley may find some reasons for doubting the perfect accuracy of his friend Mr. Bain's information, *viz.* that 'Prof. Wheatstone was at that time unknown to him' (Mr. Bain), if he will refer to the 87th Number of the *Inventors' Advocate*, where he will find that person stating, that he had made communications to me on 'the 1st day of August,' 1840. If his visit to Mr. Baddeley, therefore, was on any other day in that month, he must, from his own admission, have previously known me. I have strong grounds for thinking this was the case; for not many weeks after Mr. Bain was employed by me, and while he was under a written engagement not to communicate what he was about to any other person without my permission, he called upon other parties in the same manner as Mr. Baddeley says he called upon him, and stated also, on these occasions, that he had made the inventions in question, and was looking for some person to assist him in bringing them before the public. I have been informed of this by Mr. Irving, one of the gentlemen to whom he so applied.

"I have now done with these unjustifiable charges, which have been brought forward solely for the purpose of giving a colourable pretext to infringements, which certain parties are endeavouring to make, of the patents for the electric telegraph obtained by myself and Mr. Cooke. These infringements, if attempted to be carried into effect, will be the subject of inquiry in a court of law—a more proper place for the discussion of such matters than the columns of a literary journal.

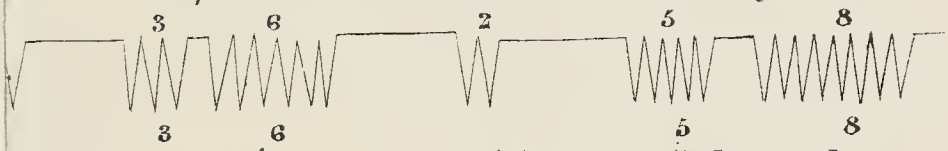
"C. Wheatstone."

THE END.

C. Whiting, Beaufort House, Strand.

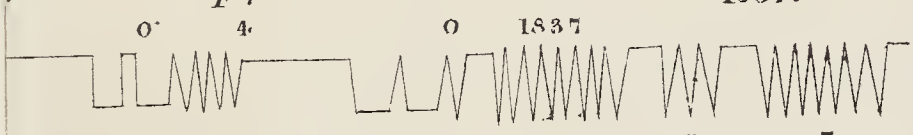
elegraphic writing made by means of electricity at the distance of one third of a mile.

experiment with Telegraph.



experiment with Telegraph.

4th. 1837.



4th. 1837.

Fig: 4.

r: 3.

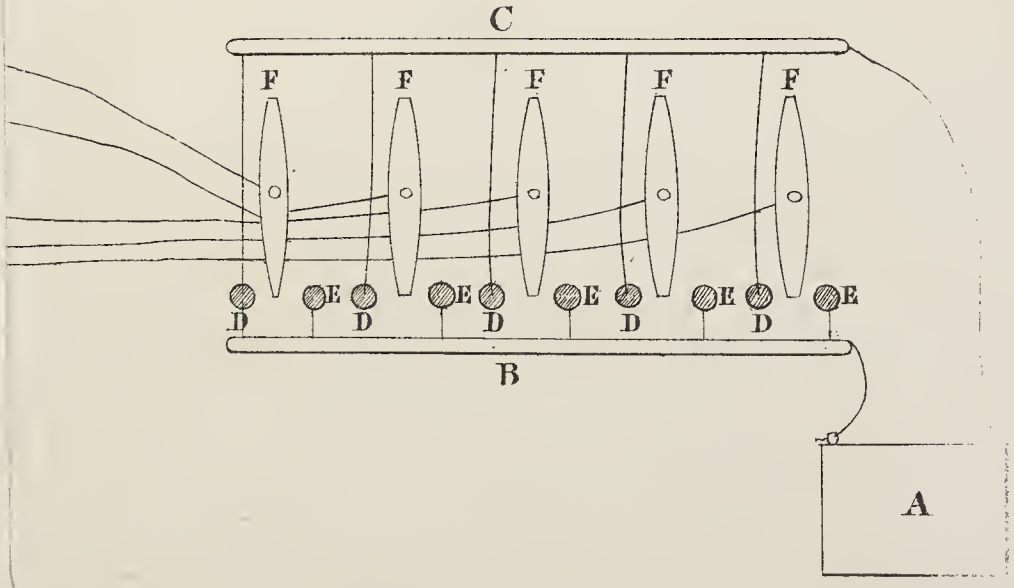


PLATE 1.

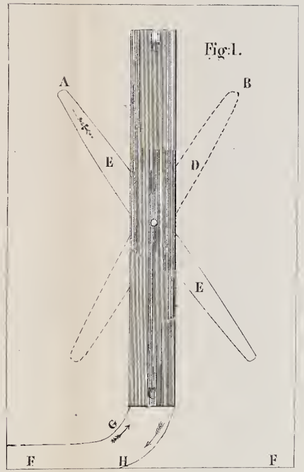


Fig: 1.

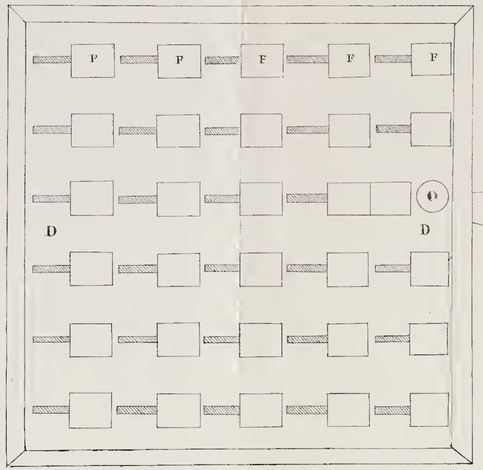
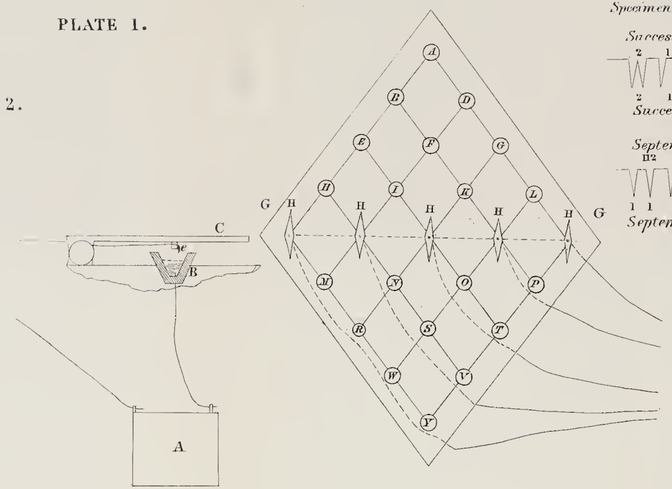


Fig: 2.



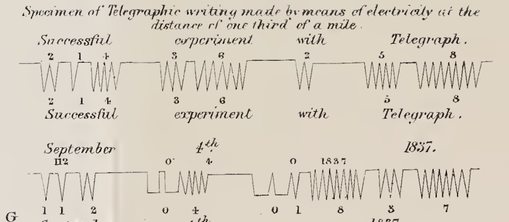
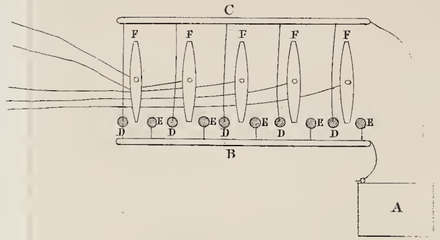
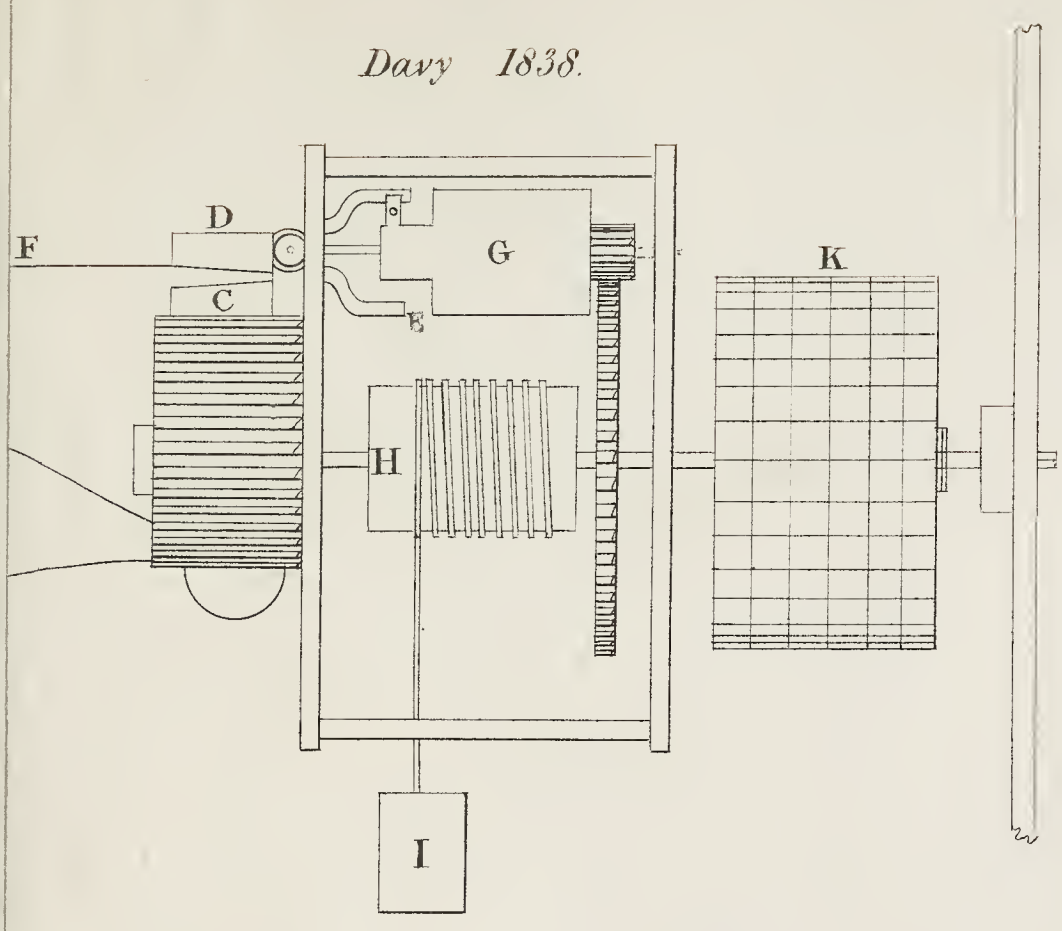


Fig: 4.

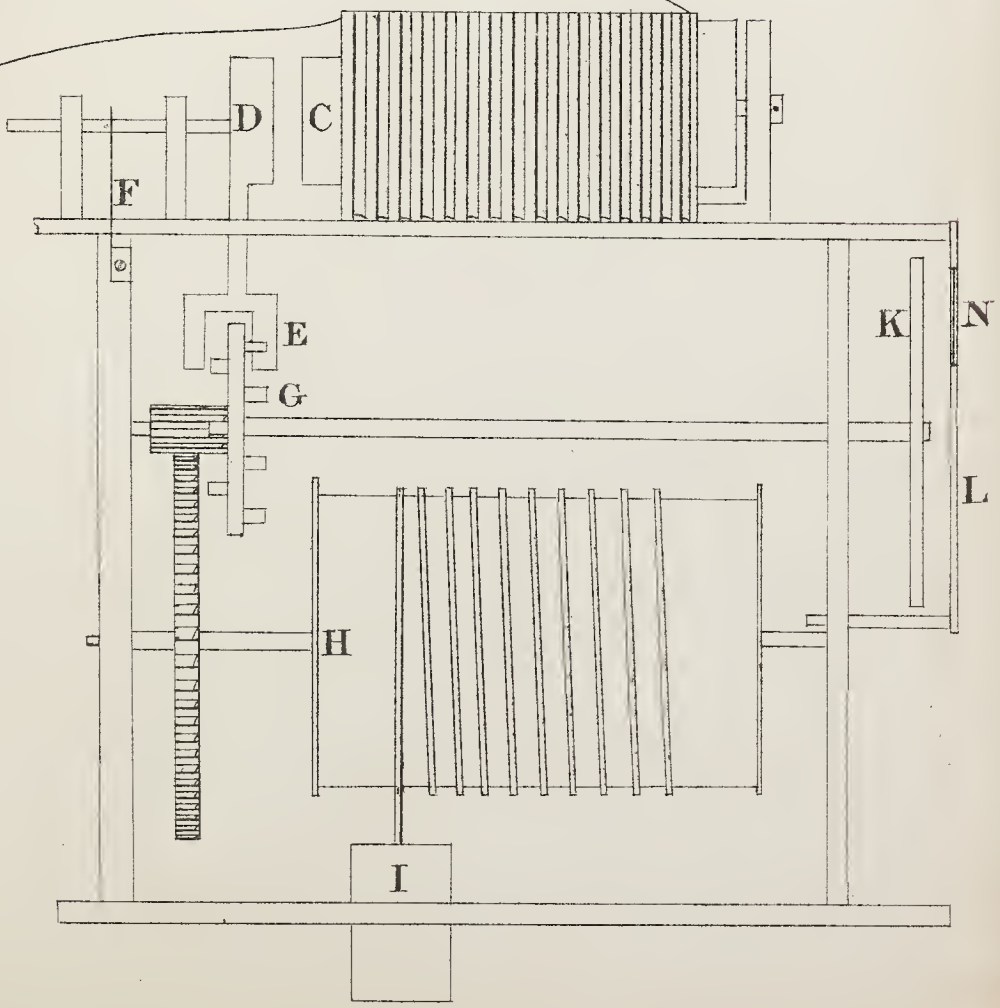
Fig: 3.



Davy 1838.

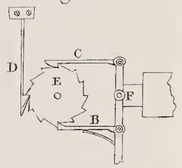


Wheatstone 1840.



Buzengeiger 1815

Fig. 1.



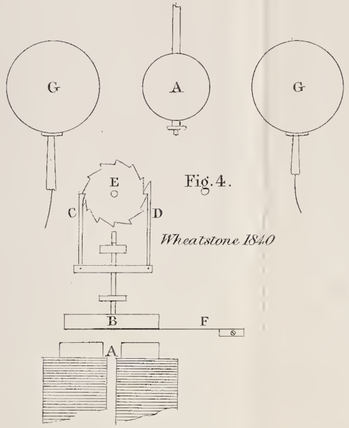
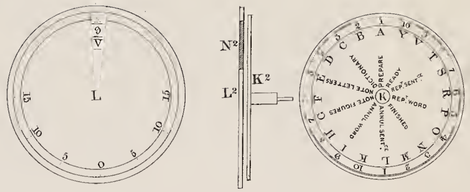


Fig. 4.

Wheatstone 1840

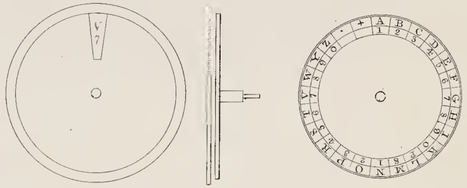
Ronalds 1823.

Fig. 2.



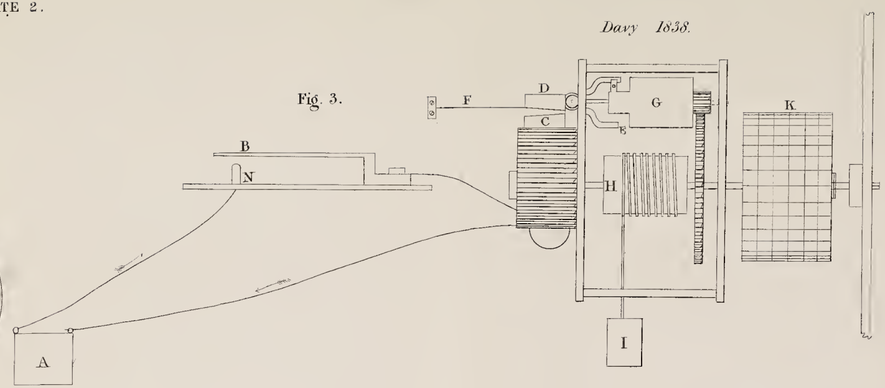
Wheatstone 1840.

Fig. 5.



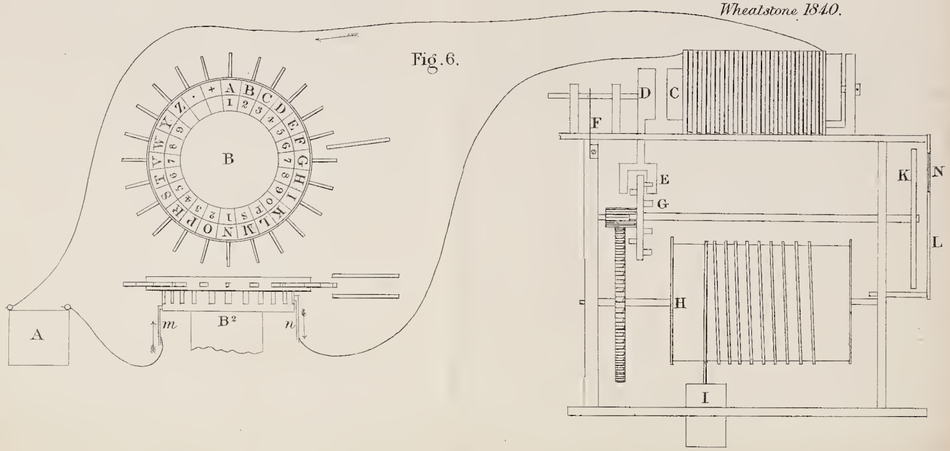
Davy 1838.

Fig. 3.



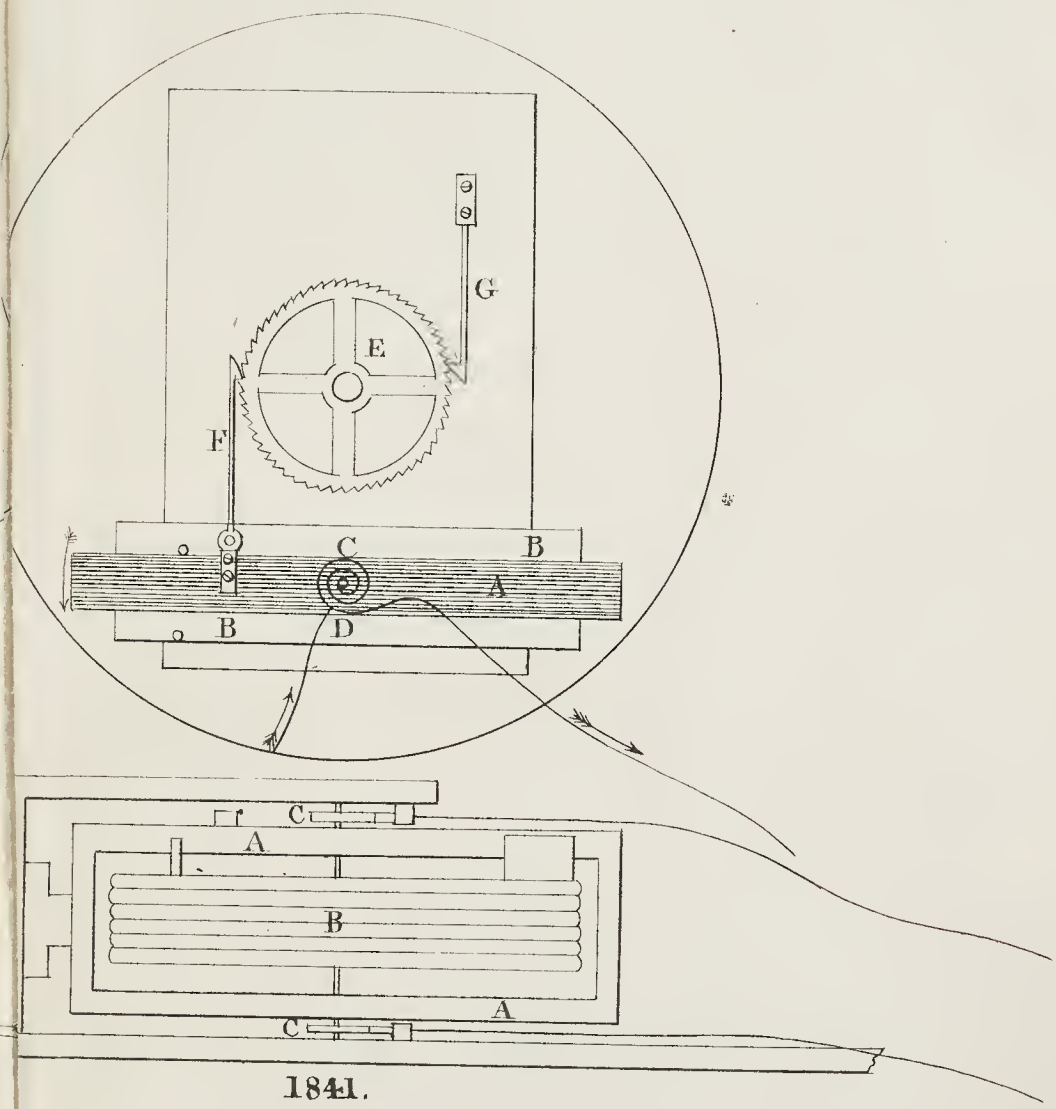
Wheatstone 1840.

Fig. 6.



Madeley lith. 3 Wellington St. Strand.

Fig. 5.

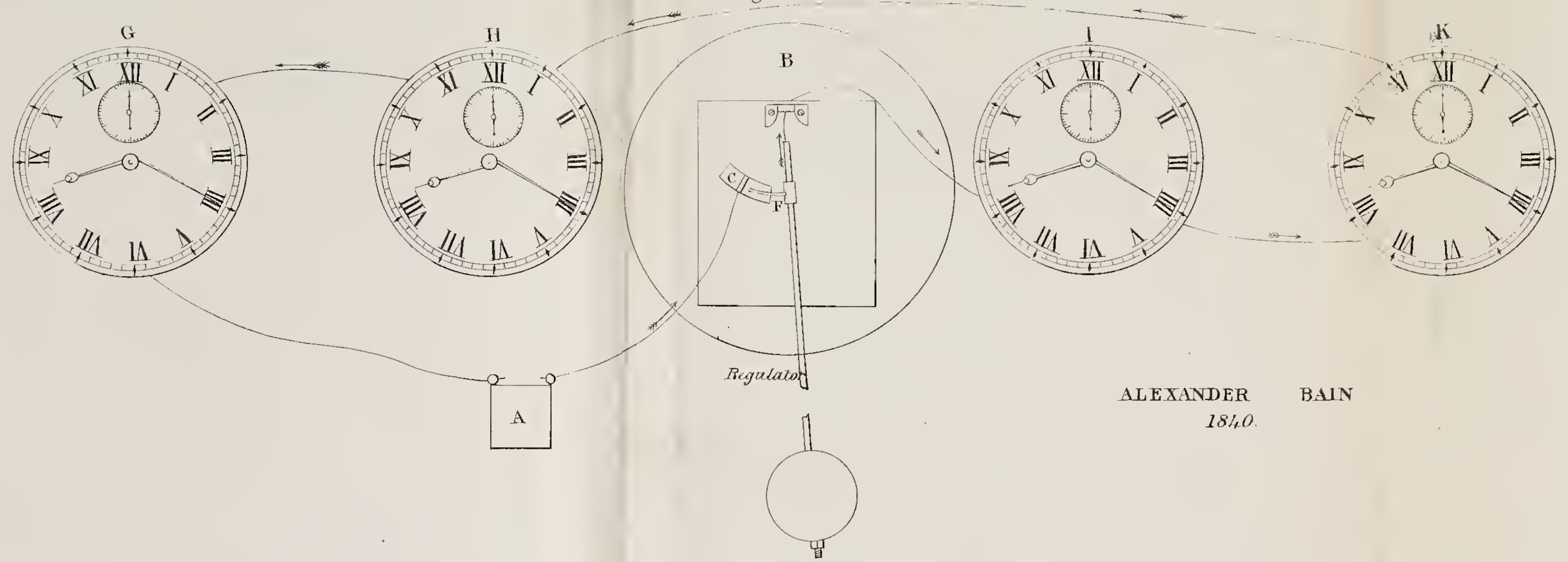


1841.

Madeley lith. 3 Wellington St. Strand.

Plate 3.

Fig. 1



ALEXANDER BAIN
1840.

Fig. 2.

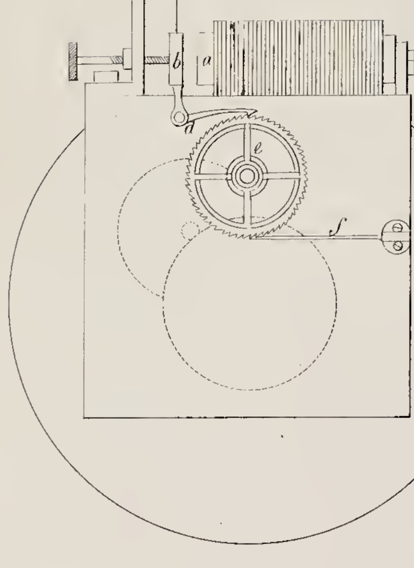
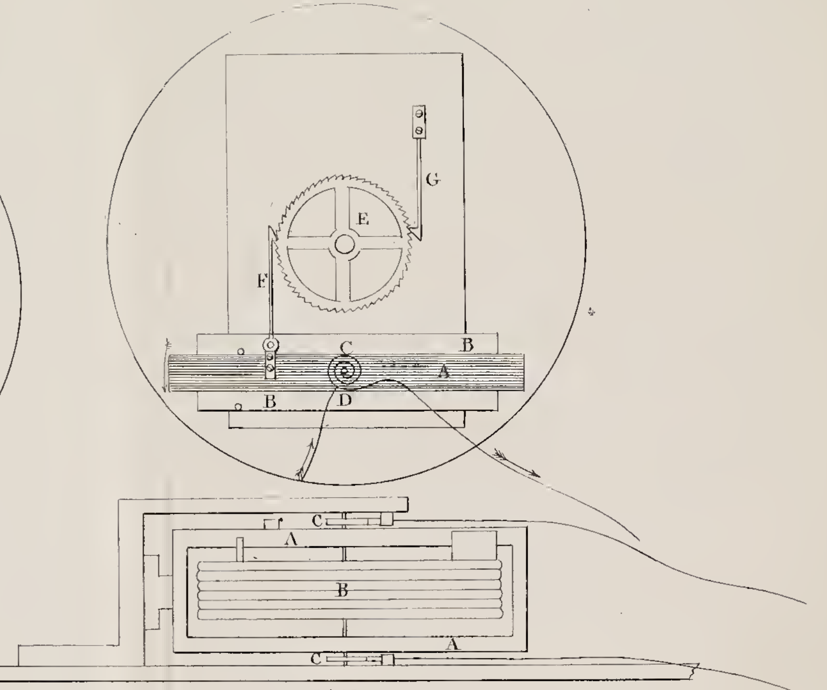


Fig. 5.



1841.

Fig. 3.

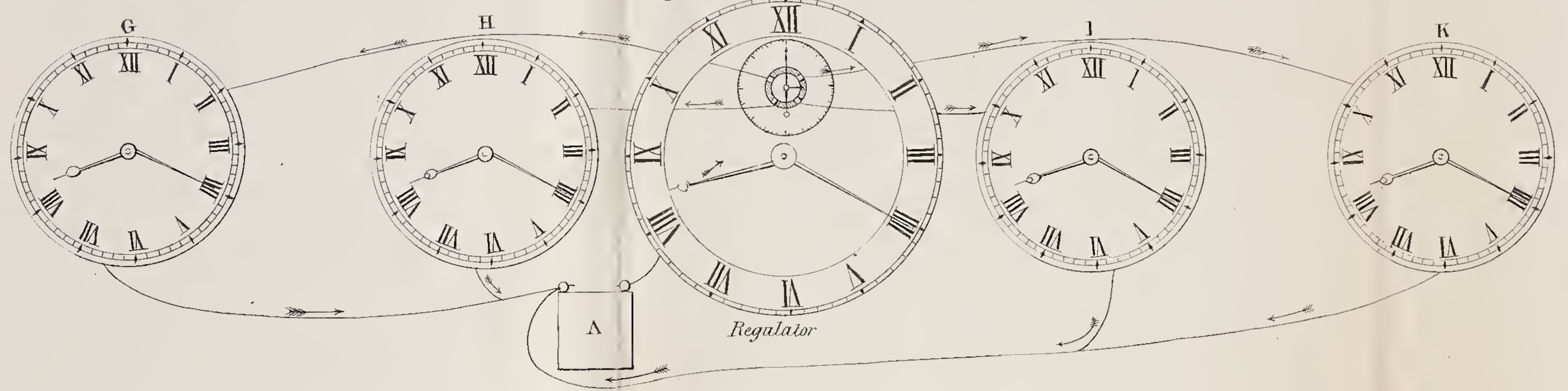
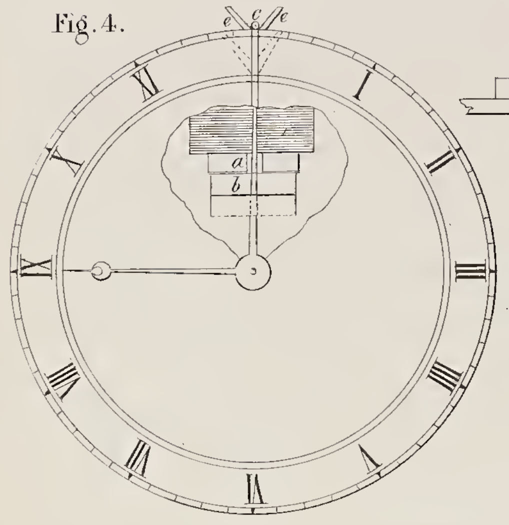
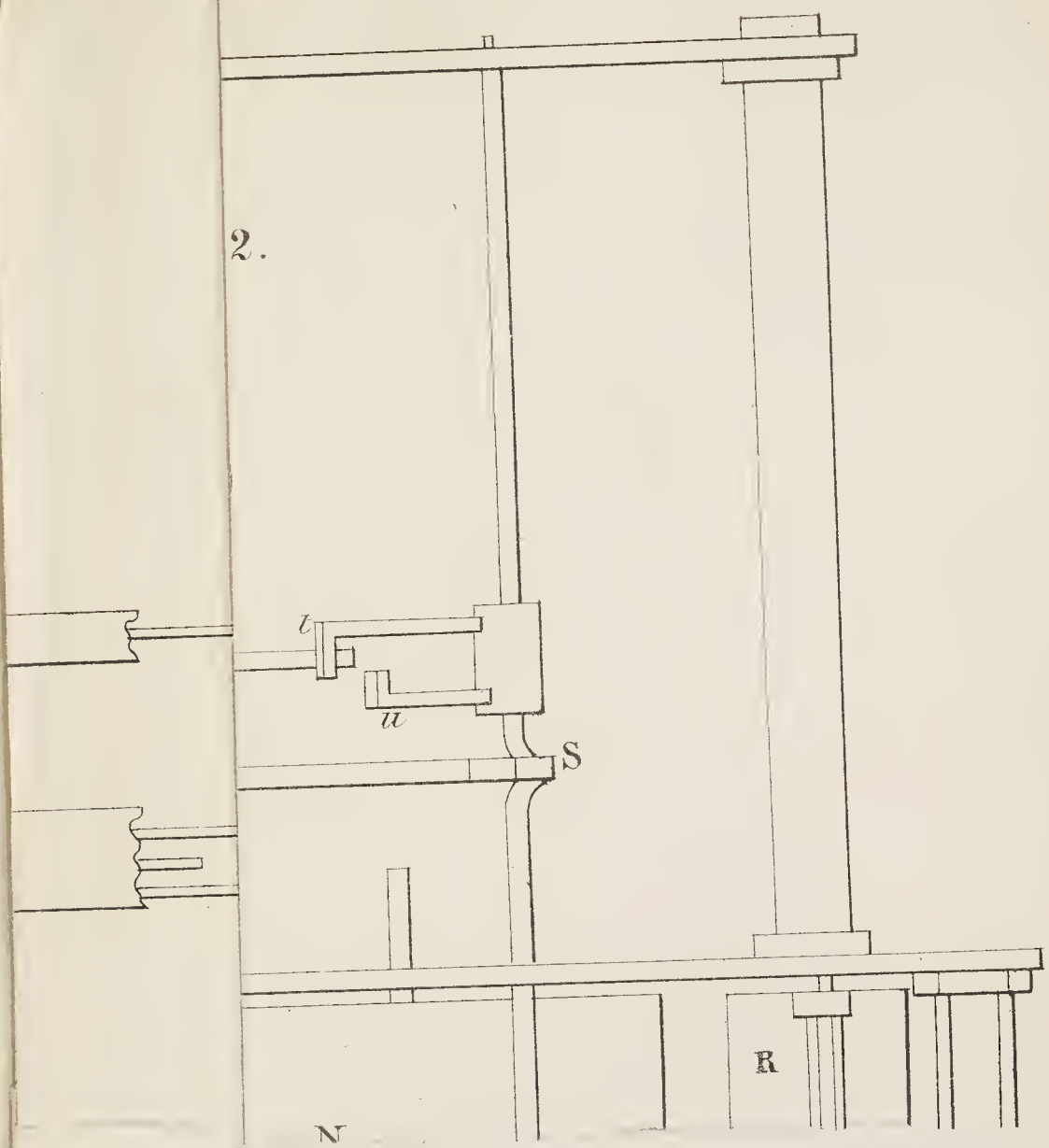


Fig. 4.



Madeley, lith. 3 Wellington St. Strand

2.



LONDON

PLATE 5.

PORTSMOUTH

ALEXANDER BAIN,
1843.

Fig. 1.

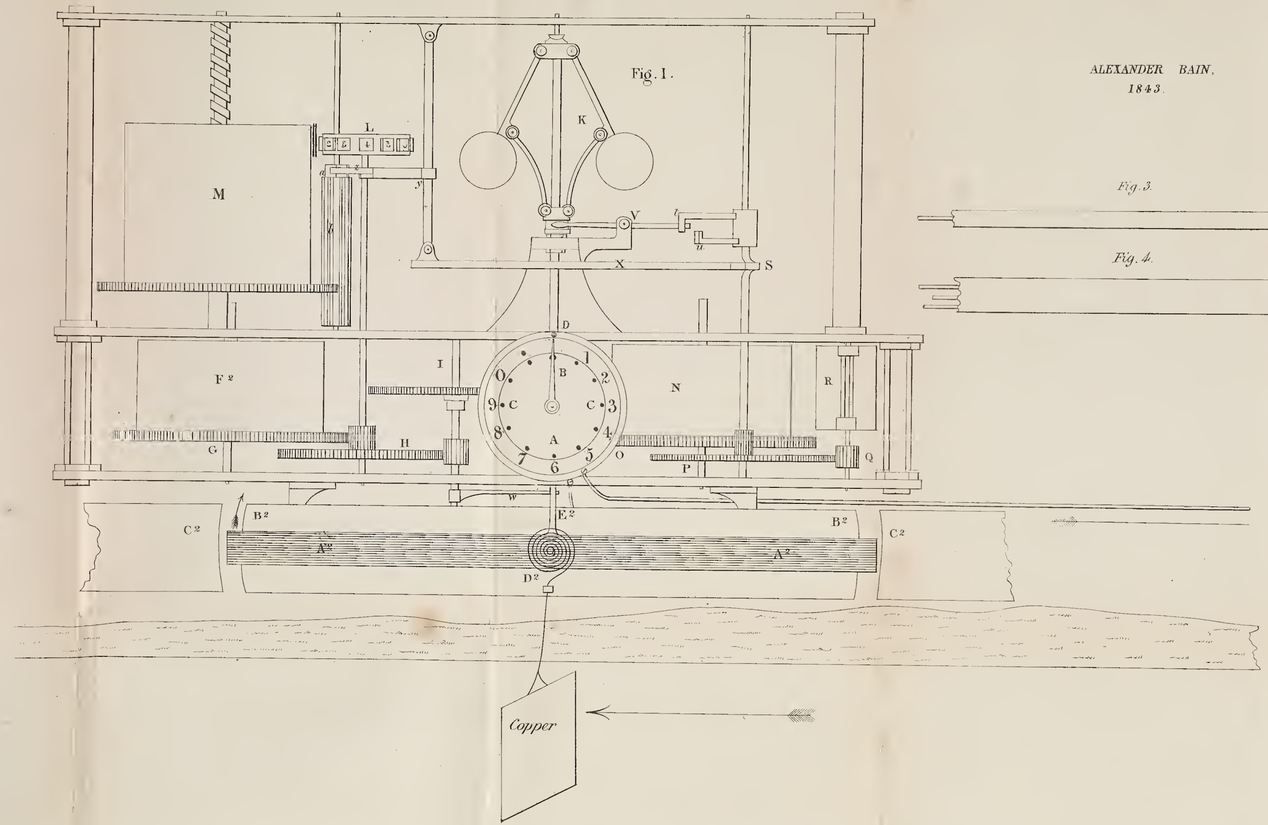
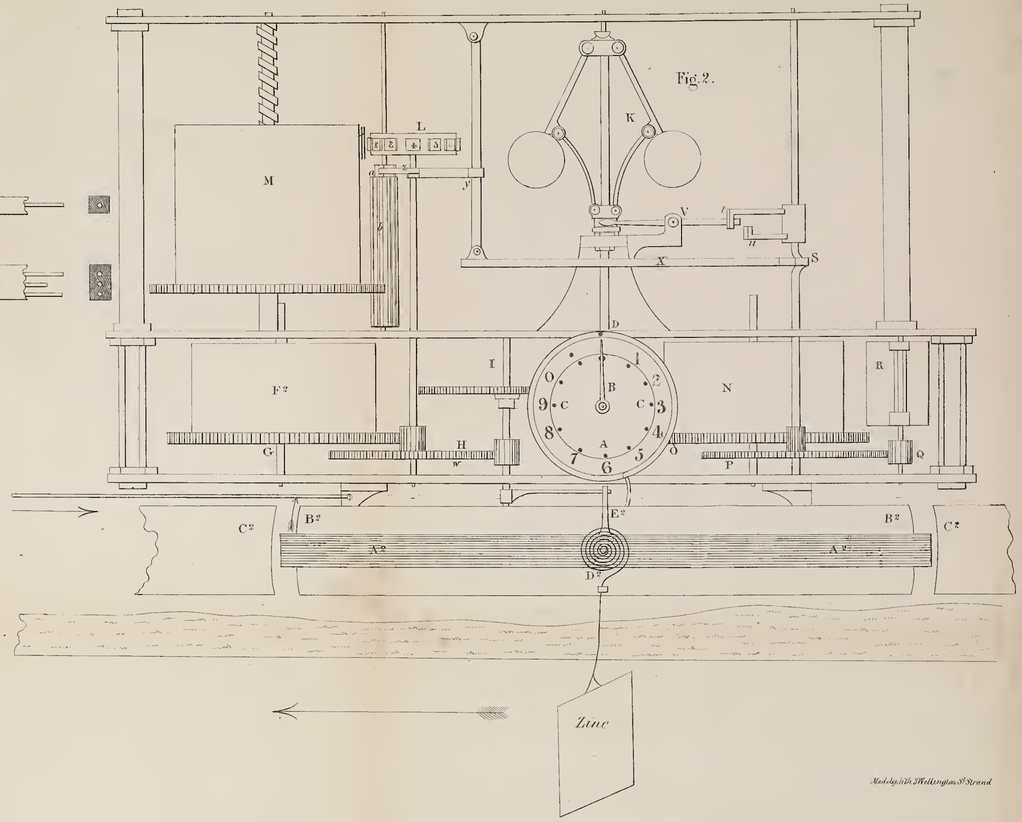


Fig. 3.

Fig. 4.

Fig. 2.



Madeley, 11 & 3 Wellington St. Strand