

Colonel COLT, in answer to questions from the President, explained, that the course of this invention did not differ from that of almost every other innovation; it had to combat the prejudices of those using the old arms and the interested opposition of the manufacturers, and on that account he had been driven, not only to labour at attaining simplicity and efficiency in the arms themselves, but to contrive and adapt the tools and machinery for their production, with uniformity and rapidity and at the lowest cost. After he had undergone all the anxiety, labour and risk, attendant on bringing the arms to their present state, it was objected that the idea was not new, indeed that from an early period, repeating fire-arms with revolving chamber-breeches had been well known; he was now aware of this fact, but when he first commenced his experiments, he had not the most remote notion of anything of the kind having ever been previously attempted. At that time he was a very young man, and with only limited mechanical knowledge. His first invention was a fire-arm which would, in these days, be considered a very clumsy affair, although it was very similar to several of the weapons now being made in this country, and which were asserted to be superior to his pistols. It was necessary to explain, that the weapons first made were almost skeleton arms, but when he took out his patent and commenced their manufacture, the front end of the revolving-chamber was closed in, and the base end covered with a shield, to make the arm look well; the consequence was, that simultaneous explosion of several chambers frequently occurred, and this serious defect was only remedied by removing the plate, and the shield, and chamfering the orifices of the chambers. The first weapons also were made to be cocked and fired by the same action of pulling the trigger, but it was found impossible to take a certain aim with them, as it was necessary to exert as much force with the finger, as would overcome the resistance of the main spring in cocking, and the weapon deviated from the line of sight; besides which it could not be carried on half cock and was liable to explode the cap, if it received any accidental concussion.

Fig. 16, Plate 2, a combination of a bowie-knife and repeating pistol, made in 1836, would explain what he meant, and show how objectionable such an arrangement was in practice. Another modification consisted in having a ring trigger beneath the lock, on pulling which the hammer was raised and the chamber rotated, whilst the gun was fired by pulling an ordinary trigger. This construction required four, or five additional parts in the lock. At last, the present simple arrangement was arrived at, and he believed that it was almost impossible to have an accident, from the simul-

taneous explosion of several caps, or chambers, or to injure the weapons, without subjecting them to very rough usage, and the perfection of their fitting was so great, that they had been fired after immersion in water, or lying in the open air for a length of time.

The Honorable ABBOTT LAWRENCE, U.S. Minister, said, no words of his could so emphatically, or thoroughly express the general approval of these arms, as the Report to Congress of the Committee on Military Affairs, printed January 30, 1851, wherein it was stated, that experience had proved how difficult it was to contend successfully against savages with the usual arms of mounted men, the ordinary dragoon pistol and carbine ; whilst General Harney, an experienced officer, who had successfully used Colt's arms in Florida stated, that they were the only weapons with which the United States' troops could ever hope to subdue the wild and daring tribes, against whom they were called to act ; but that with them, a few bold men, well skilled in the use of these weapons, could encounter and scatter almost any number of savages.

Being a civilian, Mr. Lawrence only knew the merits of these weapons from general reputation, and from their having been adopted by the United States' Government, after long trials and considerable experience in their use. In the army generally, they were considered the most efficient weapons ever introduced, particularly for border warfare, against savage tribes, whose cunning, hardihood, courage and skill, rendered them very formidable enemies. It was his opinion, that the British troops would never successfully oppose the Kaffirs, until they were supplied with these repeating fire-arms, and he was much gratified, that one of his countrymen should have produced a weapon, which was admitted, as far as it was yet known in Europe, to be superior to any other arm of the kind, and he was assured, this gratification would be participated in by all around him, as they must remember, that the British and the Americans were brethren, sprung from the same Anglo-Saxon stock, speaking the same language, and inheriting the same feelings which animated the subjects of these realms. He felt convinced, that the arm would have a fair trial in England, that no undue prejudice would be permitted to prevail, and that the invention would be examined and tested as if it had been brought forward by a British subject. There was room enough for inventions of all countries, and all that could be desired was, that in a fair and proper spirit of rivalry, this invention should be considered and examined with that good feeling and kindness which should animate all men, in the great cause of promoting the arts and sciences, and the application of science to art.

When he came to the meeting he had not any idea of being called on to express an opinion, but having risen, he must thank the members for the manner in which they had received his countryman's paper, and he trusted, that though apparently a warlike subject, its discussion would be as productive of harmony in the Institution, as the general use of the weapons in warfare would certainly be productive of peace, for the most effective weapons were the most efficient peace-makers, and though he was himself a peaceable man, in every sense of the word, he was convinced that to maintain peace it was necessary always to be prepared for war; every improvement in fire-arms, therefore, reduced the cruelty of war, and tended to the perpetuation of peace, and hence he should be an advocate for any improvement, which would tend to diminish the ravages of war, whether between civilized nations, or against savage tribes, in the now inevitable spread of the white man, in his course of emigration.

Commodore Sir THOMAS HASTINGS, R.N. regretted, that he could add but little interest to the discussion, as the paper had fully described the weapon and its merits; he must however state, that Colonel Colt had afforded the officers of the Ordnance every facility, for attaining a complete knowledge of its merits, or defects, and he believed the general impression was, that no fire-arm of that size ever possessed so much power. It must be acknowledged, that war was a great evil, particularly between civilized nations, but it was equally true, that giving the utmost perfection to the weapons used, was the surest manner of annihilating modern warfare. It was well known, that in some of the great battles of the ancients, more combatants fell, than during a whole campaign of modern armies, and in the battle of Lepanto, the last great hand-to-hand fight, fifty thousand combatants fell, which exceeded the numbers killed in all the naval engagements of the last and present centuries. Every step towards perfection, in weapons of war, was a humane improvement, and on that ground, independently of the necessity of arming the troops in the most efficient manner, the attention of the Ordnance had been carefully directed towards these and other improved arms, and the result of the trials had been to convince him and other officers, that they had rarely seen better practice, than with Colt's pistols. The ordinary infantry musket was considered a useful weapon at one hundred yards, but beyond that distance, it was mere random firing; now Colt's large pistol was equal in effect to the musket, at that range, and for use against savage tribes it must be a most effective weapon. The tactics of the Kaffirs were to tease an out-post sentry, at a distance, until they had drawn his fire, and then to spring on him before he had time to reload; and in attacking a

convoy, which was generally done in a defile, a rush was made, which induced the fire of the whole guard and the men were left defenceless, except by the bayonet, which was not effective against long lances, or assagais. Now nothing could be more perfectly adapted to meet these tactics, than the revolvers, because after the savages had received the musket shots, they would rush up in a body to close quarters and thus render the effect of the pistols more certain. After a few experiments of this kind, the savages would have become acquainted with the nature of the weapon and the convoys might almost be sent without escort. He was of opinion, that these arms would be found extremely useful for troops on special duty and eventually it might be advantageous to introduce them generally into both services.

Captain Sir E. BELCHER, R.N. said, that some time ago he was in Texas, among the American troops, and there saw Colt's revolvers used with great effect and precision, and had never heard of an accident occurring from simultaneous explosion of the chambers. They were generally used by the mounted Rangers, who appeared to rely on them, for their effective attacks on the enemy.

He would suggest to Colonel Colt, whether it might not be advantageous so to modify the form, as to make the breech end of the barrel conical, and to introduce it into the mouth of the rotating chamber, in order to prevent the loss of power arising from the present escape of lateral fire, between the chamber and the barrel, and to throw the fire obliquely forward. In the old Chinese jinghals this arrangement was made, evidently from experience of its utility.

Colonel COLT explained, that such an arrangement, as had been suggested by Sir E. Belcher, had been tried, and was in fact now used, in some of the imitations of his revolvers, but it added to the complexity of the weapon, which he had desired to reduce to the utmost simplicity, and it was not found, in practice, that any serious loss of power resulted from the small escape of the lateral fire, that actually took place in his revolvers, as from the accurate fitting of the several parts, the mouth of the chamber was brought into very close proximity with the base of the barrel, and yet permitted the free rotation of the chamber.

Sir THOMAS HASTINGS agreed with Colonel Colt, that there was not any necessity for the arrangement suggested by Sir E. Belcher; since everything which detracted from the simplicity of construction of the weapon, must be prejudicial to it, and the essential difference between the Chinese jinghal and Colt's revolver was, that the former was a cumbrous, unwieldy instrument, whereas in the latter there

was, in the least possible compass, a weapon which, in the hands of men conversant with its use, would do as good service as the ordinary musket and could throw five, or six balls without stopping to reload. The reports of trials made under the superintendence of the Officers of the Board of Ordnance, clearly pointed out these advantages, and those gentlemen acted so conscientiously and made their reports with such fidelity, that perfect reliance could be placed in all their statements. He made these observations, because he saw on the walls some diagrams of the firing at targets, at Woolwich, which corroborated his opinion of the utility of these arms; and it was only justice to Colonel Colt to do so, as since his arrival in England, that gentleman had afforded every facility for the perfect understanding of the arm of which he was the inventor.

Sir T. Hastings entirely participated in the feelings so ably expressed by the Hon. Mr. Lawrence, and trusted that the relations with our Transatlantic brethren, and indeed with all the civilized world, would long remain on a footing of the strictest amity.

Captain RIDDELL, R.A., said, that such ample opportunities for proving the utility of the revolvers had been afforded, and such a clear account of the invention had been given in this paper, that it was incumbent on him, as a British officer, to add his thanks to Colonel Colt, for the efficient arm he had introduced to the notice of the Government and which, he did not doubt, would soon be employed for those branches of the service in which it was so well calculated to be useful.

Mr. A. B. RICHARDS said, that through the courtesy of Colonel Colt, with whom he had no previous acquaintance, he had ample opportunity of trying the revolvers, and having some considerable experience in the use of fire-arms, he ventured to state, that he never had met with any pistol which carried with greater precision. Out of six shots from one cylinder, five of the balls touched each other in the target, at a distance of fifteen paces, in a shooting gallery. He did not think that greater accuracy could be required, nor could it generally be attained without hair-triggers. For active service, particularly against the Kaffirs, this weapon would evidently be invaluable, and he felt convinced that the authorities would soon see the propriety of adopting it.

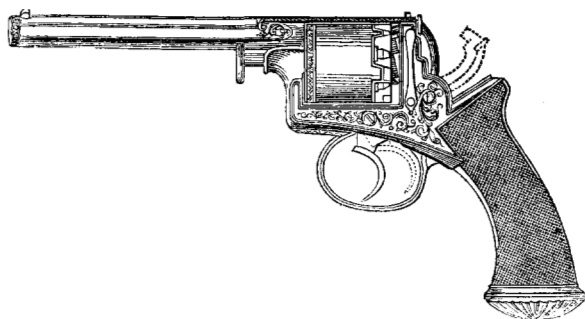
Major-General Sir C. PASLEY, R.E., had not officially any experience of the weapons under discussion, but he had examined them attentively and knowing the care with which the trials for the Board of Ordnance were conducted, and seeing the results, he formed a high opinion of their merits, particularly as subsidiary arms for troops engaged in warfare against savage tribes, or on special and

detached service, and he felt assured these capabilities would be fully appreciated by the proper authorities.

Mr. J. FREEMAN said, that during the course of the Great Exhibition, he had been attracted, in the American department, to Colonel Colt's revolvers, and perceived their merits; he begged however to direct attention to a pistol on a somewhat similar principle, made by Messrs. Deane, Adams, and Deane, and would ask one of those gentlemen to explain wherein its merits consisted.

Mr. ADAMS, exhibited and described a revolver of his invention.

Fig. 2.



The barrel, the lock-frame and top-bar were all forged out of one piece of iron; the chamber to contain five charges, revolved on a centre pin, which could be either drawn entirely, or partially out, as was required and was held in its position by a side spring; the toothed ratchet was secured to the base of the chamber by two screws, so as to admit of its being renewed, when it was abraded by use, and motion was given to it by a ratchet pall, connected with the hammer, which was lifted by pulling the trigger. The hammer moved on a transverse pin, and was pressed down on the nipple, by a back spring in the stock, being connected with it by a swivel link; the trigger was kept in position by a horizontal bent spring, and had attached to it the hammer-lifter and the ratchet pall; the point of the former fell into a notch in the base of the hammer, so that as the trigger was pulled, the hammer was raised, until the rounded portion of the base, acting as a cam, forced the lifter out of the notch, and allowed the hammer to descend on the nipple and to explode the percussion-cap. On withdrawing the finger from the trigger, the lifter and ratchet pall descended and again slipped into the notches of the hammer and the chamber, in readiness for repeating the operation of firing. The lifter was retained in contact with the hammer, by a small flat spring, the upper end of which was

attached to the pall, while the lower end acted upon the lifter, which, in turning on its centre, brought the lower prolongation against the spring, below the centre, so as to press the upper end in the proper direction, in order that its action might be certain.

The rotation of the chambers was obtained by a ratchet pall, acting on a tooth each time the trigger was pulled, thus causing the chambers to revolve, so far as to bring a nipple into the proper position for receiving the blow of the hammer, and in that situation it was held by a projecting stop on the back of the trigger.

In order to load the chambers, it was necessary that they should revolve free of the stop; this was effected by pressing inwards another stop, attached to a spring on the side of the lock, which engaged the point of the hammer and prevented it from descending on the nipple, until the chambers were loaded, when on the trigger being pulled, the side spring stop was released and resumed its original position, leaving the weapon ready for action.

The bullets were cast with a small 'tang' on them, which served to fix a wad on each, thus no ramrod was required in loading, the bullets being merely pressed in with the finger. The aperture of the barrel was slightly expanded at the lower end, to admit of the bullets entering more readily in firing. The rifling of the barrel was the reverse of the ordinary system, as it consisted of three projecting 'feathers,' or ridges, extending the length of the tube, leaving very wide grooves between them.

It would be observed, that the cocking and firing were performed by the same action of the trigger; therefore the rapidity of firing was proportionally great; the arm was very light, its construction simple, and its action certain.

With respect to the mode of manufacture, every portion to which self-acting tools had been found applicable, was planed, bored, turned, slotted and rifled by machinery.

Mr. A. B. RICHARDS inquired, whether the principle of the weapon just described by Mr. Adams, was not identical with that brought before the public many years ago, in connexion with a pistol with five, or six revolving barrels, which he believed had been laid aside, because it was found, that after being used for a short time, the spring did not retain sufficient power to bring down the hammer with force enough to explode the cap, and if the spring was made stronger, it required the exertion of so much strength, that the weapon was depressed in firing, and taking a correct aim was nearly impossible. There did not appear to be any advantage in the power of firing so rapidly, as on service it was certainly not necessary to put five, or six bullets into the same adversary, and whilst directing

Colt's revolvers from one point to another, there was no difficulty in cocking the pistol with the thumb, using only one hand.

He begged also to ask, whether a paper, headed "Experiments with Fire-arms," dated "Woolwich, 10th September 1851," purporting to be a report of some trials of Colonel Colt's and Mr. Adams' revolvers, was issued officially, as the results were very different from those which were generally understood to have been attained; and as the paper appeared to have been extensively circulated, it was well to arrive at a true understanding of its value.

Sir T. HASTINGS stated, that so far as he was cognizant of the matter, no report of the comparative merits of Colonel Colt's and Mr. Adams' revolvers had been officially published by the Board of Ordnance.

Captain RIDDELL corroborated the statement of Sir T. Hastings.

The SECRETARY, at the request of the President, read two communications from Colonel Chalmers, R.A., relative to the diagrams of practice with Colonel Colt's arms,* permitted by him to be transmitted to the Institution, in which he stated "I have seen the printed document entitled 'Experiments with Fire-arms,' as published by Mr. Adams; it is not official."—"I have for some time had two of Colonel Colt's revolvers under severe trial, and with good caps they never miss fire."

Mr. PLINY MILES said, the principle of construction of Mr. Adams' revolver had been tried in America long ago, and had been abandoned. Colonel Colt had at one time fallen into the error of using it, as was evident from the bowie-knife pistol exhibited. Mr. Miles carried a weapon like that described by Mr. Adams, for nearly two years, in the Western States and the valley of the Mississippi, but he never could make it a serviceable arm, as it required the exertion of so much strength in the finger, to revolve the cylinder, and lift the hammer by the same pull on the trigger, as fired the charge, that the muzzle was almost invariably depressed, or turned out of range, and he never could be certain of hitting a mark: he therefore got rid of it, and purchased one of Colt's revolvers, which he found just as effective, as the other was inefficient. He now rarely missed a shot, even at birds, and the revolving of the cylinder, being performed by the operation of cocking, the firing could be rendered almost as delicate as by a hair-trigger, so that the most accurate aim could be taken.

Mr. C. MAY, as the only member of the Society of Friends present, rose to order: he thought the meeting had erred, in quitting the

* Vide ante p. 48, and Plate 3.

question of the mode of manufacture of these weapons, for a discussion upon their relative merits, or their destructive qualities, which he submitted, were not proper topics for the Institution of Civil Engineers; he thought all weapons might be dispensed with, except for protection against wild beasts.

From an examination of the specimens before the meeting, he was of opinion, that the machinery used in the manufacture was not of the accurate description generally employed in this country, the tool marks were more evident, than in the machine-made work produced at Manchester, and no information had yet been given as to the price of production. He begged Colonel Colt to give such information on these points as he considered could with propriety be imparted to the meeting.

MR. RENDEL, *V.P.*, agreed with Mr. May, that the efficiency of the arms was a question which would be more properly considered by the authorities at Woolwich; it would be more interesting to the meeting to know what kind of machinery was used in the manufacture of the arms, and to be informed what process each piece went through, in arriving at the state to form component parts of so apparently well-constructed a weapon, as that now submitted by Colonel Colt, who he would beg to enter into such details as he judged fit, relative to the manufacture.

Colonel COLT said, he thought the process of manufacturing had been as fully described in the paper, as could be done without prolixity; he would however revert to whatever had been omitted in the paper, or in the previous part of the discussion; but it was scarcely practicable to give a clear idea of the process of manufacture, without diagrams of the machines employed, and even they would hardly convey a correct impression of the action of such tools.

Each separate piece of the arm, was forged hot, under swages, and then underwent a series of operations in machines, each adapted especially for one peculiar service. This had been found more economical than using comprehensive tools, and a greater degree of uniformity of structure was obtained. The mode of proceeding with one part would give an idea of that for all the rest. Taking, for instance, the lock frame; the swaged block of metal was held in clamps, and the centre hole drilled and tapped for the base pin, which was then inserted, in order that each subsequent operation should have relation to, and accord with the position of that part of the arm, which served as a common centre. The lower inside curve was then cut, the various slots, grooves, spring bearings, &c., were cut through clamps, by which the piece was presented to the various

automaton machines, and last of all, the operations of centring, drilling and tapping all the holes were performed, also under the guidance of clamps. That piece passed through twenty-two distinct operations, and after leaving the last machine, it was only requisite to remove by hand the rough edges left by the tools; thus a clear idea could be formed of the amount of manual labour employed.

In making the cylinder, or chamber, which was also forged from a block of steel, annealed, the centre hole was first drilled, then the exterior was turned and engraved (also by a machine), then the ratchet teeth were cut out of the solid metal, because it had been found, that the ratchets, which were attached by screws, were apt to get loosened by service and the arms were rendered inefficient and dangerous; the holes for the nipples, and the charge chambers were then bored on a kind of universal chuck, the muzzles were chamfered, the stop grooves cut and the cylinder was completed fit for use.

The barrel forged solid, by swages, from a bar of steel, was first bored, and then rifled by a very simple machine, in such a manner as that the groove, at the breech end, was almost straight, and gradually contracted the pitch to a sharp curve at the muzzle, to give to the bullet the proper rotation in delivery; the exterior of the barrel was then finished in the various machines and the lever ramrod was attached.

It was unnecessary to extend this kind of description of processes, which would be readily understood by all engineers, and it must be evident, that a degree of uniformity and precision was arrived at, which could not be attained by any other means. Nor could the quantity required be produced by manual labour; in his factory at Hartford, there were now thirty thousand weapons in various stages of progress, and the demand was so great, that he contemplated increasing the number to fifty-five thousand, to meet the requirement of the market; three hundred persons were employed, and about one hundred arms were finished per diem.* This must be evident proof of the paramount necessity for machinery, wherever combination might interfere with the work being done, and more especially in a country like the United States, where manual labour really could not have been procured, to produce such a quantity, independently of the great merit of the positive uniformity of the

* It has since been stated, that by further subdivision of the operations, and by additional machinery, two hundred and fifty pistols have been finished per diem, or fifteen hundred arms per week have been completed at the Hartford factory, by less than five hundred workpeople.—*Sec. Inst. C. E.*

arms, which had been proved, by picking up the disabled arms after an action, when seventy-five per cent. of perfect weapons were readily made up fit for use.

In round numbers it might be stated, that supposing the cost of an arm to be 100, of this the wages of those who attended to, and passed the pieces through the machines was 10 per cent., and those of the best class of workmen engaged in putting together, finishing and ornamenting the weapons, was also 10 per cent. ; thus leaving 80 per cent. for the duty done by the machinery.

The weights of the several weapons were—

		lbs.	oz.
The Army, or Hostler Pistol		4	4
The Navy, or Belt Pistol		2	6
The Pocket Pistol, 6-inch Barrel		1	12
Ditto 5-inch Barrel		1	10
Ditto 4-inch Barrel		1	8
Ditto 3-inch Barrel		1	6

Mr. HODGE was happy to have an opportunity of adding his testimony to the merits of Colonel Colt's weapons, and to the simplicity and effectiveness of the machinery employed in their manufacture. The skill displayed in the design of the various machines, was very remarkable, but it was evidently the result of necessity, arising from the difficulty and expense of obtaining skilled labour in the United States ; this had stimulated the inventive faculties of all engaged in mechanical pursuits and as a general rule, nothing was made by hand that could be executed by machinery. Perhaps one of the most striking evidences of practical skill was the variety of crooked cutters used for shaping, not only in Colonel Colt's armoury, but in all the machinery factories in America, and it would answer the purpose of English manufacturers, to send an intelligent foreman over to the States, to examine what was now being done there. The gun-makers at Birmingham might certainly learn much from studying Colonel Colt's system of manufacturing, and their work would be produced at infinitely less cost, if they abandoned the system of employing a number of men, each working independently in his own ill-lighted, badly ventilated, and inconvenient workshop, forming and filing up, without any uniformity, parts of arms, which would be produced in much larger quantities, in less time and with perfect identity of form, by the simple machines used by the Americans.

He thought much was due to the greater amount of intelligence to be found among the working classes in the States, than among the corresponding class in England. Most of the American mechanics were not only good handy-craftsmen, but from their habits of thought and determination to 'go a-head,' were continually devising means of

executing their work with rapidity; thus new machines were constantly invented, and the education and intelligence of the working classes increased daily, because there was stimulus for thought and a consciousness in the mind of every man, that there was an ample field before him, in which he must prosper, if he used any exertion. It was ardently to be hoped, that by the extension of education among the working mechanics in England, the intelligence and inventive genius, which at present appeared confined in a great measure to a certain class, would extend to the working mechanics, whose manual skill was beyond all praise.

Colonel COLT, in answer to questions by Professor Cowper, explained, that the majority of the tools used were revolving cutters, at a slow speed for heavy coarse work, and with great velocity for fine finishing, or light operations; in slotting, shaping, and drilling, the tools were guided by steel clamps, which insured that uniformity in the several parts, which was one of the distinguishing features of his manufacture: Special machines were used, for all special operations, as general planing machines had not been found advantageous.

Mr. HODGE said, that although revolving cutters were certainly used in machine shops in England, they were not employed to the extent they might be; it was, however, the use of the shaping cutter that should be more extensively introduced; he had never seen such good work in any factory as in Colonel Colt's, and it must be entirely attributed to the judicious use of the tools he had mentioned.

The machine for rifling two barrels at the same time, by means of an excentric wheel, was very beautiful, and he must repeat his regret, that machines were not more used in the manufacture of arms in this country.

Mr. EVANS stated, that in the year 1822, he manufactured a number of flint lock revolving chambered-breech fire-arms, for Mr. E. H. Collier, whose patent, with that of Mr. Coolidge, had been mentioned in the paper.* Those arms were chiefly made by machinery which was still in his possession.

Mr. Evans had also made machinery for the Government establishment at Enfield, by order of Mr. Lovell, Inspector General of Small Arms, and the arms made there were, to a considerable extent, produced by those machines.† The rifling especially was so executed, and the machine permitted the pitch of the groove to be varied, according to the will of the operator.

Mr. HODGE expressed his gratification at hearing from Mr. Evans,

* Vide ante page 36.

† Vide ante page 45.

that machinery had been introduced into the Government Small Arms Manufactory, as Mr. Hodge had suggested it to Mr. Evans six years ago and had for some time pressed it unavailingly on his notice.

Mr. C. MAY begged to inquire of those who were well acquainted with the working classes in both countries, whether it was their deliberate opinion, that the American mechanics were better educated than their brethren in England. He had not been in the States, but from all he could collect he had arrived at the conviction, that the best English mechanics were better than the Americans; and he must say, that no work he had ever seen from America was equal to that produced in the machine shops of Manchester, Leeds, and other places, enjoying a reputation for good work.

Mr. GLYNN was much inclined to agree with Mr. May, and the eminence so frequently, and at times so rapidly, attained by English mechanics, would seem to corroborate those views: indeed there was scarcely any field in which more men had risen to distinction, by the exercise of skill and talent, than in civil and mechanical engineering. This could not be the case, if they had not education as well as innate talent.

Mr. HAWKSHAW was of opinion, that if the term 'education,' meant 'book-learning,' the working classes in America, particularly in the cotton factories, possessed a greater amount of education, than the corresponding class in England; but if 'education' meant the special instruction, which enabled a working mechanic to perform his daily labour, with credit to himself and with profit to his employer, the English mechanics were the better educated class. He however thought, that as far as general education was concerned, the American workmen might be considered as more advanced.

Mr. J. SCOTT RUSSELL apprehended, that the comparison must be drawn between the better men of the working classes and not between the mere handicraftsmen, who he believed to be nearly identical in attainments in both countries. He thought, that Mr. May must have formed his opinion, from observations made at that paradise for the workmen, the works of Messrs. Ransomes and May, at Ipswich, where they were generally better educated, better conducted and better cared for, by their employers, than in almost any other establishment he had ever visited. Now Mr. Russell did entertain some alarm as to the ultimate position of English mechanics, with respect to that of the workmen in Prussia and in other parts of the continent. For the last fifteen years, the artisans of Germany had been receiving an amount of education, which could not fail, eventually, to render them formidable competitors,

unless the English workman added education to his present almost matchless manipulative skill. He was glad, that the subject of the education of the working classes had been mentioned at the Institution, because he felt assured, it was from thence, that the first movement should emanate, for the introduction of a comprehensive scheme of education for that valuable class of men, the English mechanics.

Mr. W. B. ADAMS said the men worked harder in the United States, under the influence of better wages, but he did not think the produce was generally so well finished as in England. There was certainly room for a greater extent of education among the working mechanics here, and more especially for instruction in the mechanical principles of the tools and machines, the application of which was their daily occupation. The employers would find great benefit result, from encouraging and even enforcing education among the working classes.

Mr. HEPPEL said, he had for some time a considerable number of Prussian workmen in his employment, manufacturing engines and general machinery; they were better informed on general topics, but the English mechanics made themselves more really valuable, by their more positive knowledge of their duties, their greater appreciation of the necessity of precision and of accurate adjustment, and their greater readiness in emergencies.

The Hon. ROBERT JAMES WALKER (late Secretary U. S. Treasury) said he rose with diffidence to speak of civil engineering, in an assembly where the best authorities were continually heard on that important subject; his attention had been chiefly directed to finance, political economy, and jurisprudence, but he was fully alive to the advantages of cultivating a science which conferred such inestimable benefits on mankind generally. He felt but little qualified to enlarge on the character and use of the celebrated revolver, of his friend and countryman Colonel Colt, as the principal object of his social and political course had been, to encourage free commerce and intercourse between all countries and thus to render gunpowder and fire-arms unknown quantities in the future career of England and America.

It must be evident to all thinking men, that civil engineering was one of the most important professions connected with the advance and progress of the human race. To that profession was due the praise of having constructed railroads, bridges, and canals—improving rivers and harbours—building steam engines, for locomotion upon land and water—and substituting machinery for manual labour, (greatly for its benefit) in nearly all industrial pursuits.

To the engineers must be attributed the construction, in the

United States, of nearly 4,000 miles of canals, and upwards of 10,000 miles of railroads; and by their aid, at least one great railroad would be constructed across the American continent, from the Atlantic to the Pacific.

By the aid of the same great profession, a ship canal would no doubt, eventually, be cut through the American isthmus. This would be, in its consequences, the greatest work of civil engineering yet undertaken by man; and the American pioneers, now engaged in the preliminary railroad, would be greatly pleased, to obtain the aid of the Institution of Civil Engineers, and of its distinguished members, in connection with their own eminent engineers, in promoting the speedy construction of that great work, not only for the benefit of England and America, but of the world at large.

Civil engineering was the application of mind to matter, and was perhaps more important in its general effects, in America, than in Europe, inasmuch as labour being much dearer in America than in England, it became necessary, in order to enter into successful competition, to substitute more machinery for manual labour, in all manufacturing operations, and thus the inventive faculties were roused, and innumerable machines were introduced which, but for necessity, would never have been thought of. And here he might be permitted to remark, that, whilst it would not perhaps be possible at present to assemble in America so large a number of distinguished and scientific engineers, as were found in this Institution, yet he thought, that, education was more widely diffused among the industrial classes in the United States; that among the operatives, there were more educated heads at work than in England; and that must in a great degree be received as one of the chief causes of the progress and success of America. The educated industrial classes applied their intellect, from day to day, to improvements in the operations in which they are concerned, and hence it was, that many of the most useful inventions and discoveries had originated with the working mechanic handicraftsman.

With respect to the repeating fire-arms, the account of which had been read to the meeting, he was bound to state, that, during the last war with Mexico, the use of those weapons became a subject of careful discussion in the American Cabinet, of which he was then a member. From the evidence laid before the members, the decision was unanimously in favour of the employment of Colonel Colt's revolvers, in conformity with the recommendations of the distinguished officers who had used them. The results were most brilliant and successful in those campaigns, more especially in guerilla warfare; and he believed, that the sentiment of the army, the navy, and

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those who were from necessity obliged to be prepared for offensive, or defensive warfare, was clearly and decidedly in favour of the general use of Colt's repeating fire-arms.

General MACNEILL hoped he might be permitted to revert very briefly to the merits of the repeating arms invented by his friend and countryman Colonel Sam Colt; he used the term 'invented' advisedly, because he was aware of the progressive steps, by which the present efficient form of the weapon had been arrived at; he knew also, that Colonel Colt was not cognizant of any previous attempts to produce such weapons, until he visited Europe to secure his first patents, and he had watched, with more than ordinary interest, the gradual application of the ingenious self-acting tools employed in the manufacture of those arms.

As an old military man he had the means of obtaining the private opinions of most of the distinguished officers of all grades, whose public testimony of the merits of the arms in actual warfare, was embodied in the "Report of the Committee on Military Affairs" addressed to the Senate of the United States, January 30th, 1851 (31st Congress, 2nd Session) and without trespassing on the time of the meeting by entering into particulars, which had been so extensively circulated in that report, he might state, that all military men coincided in the opinion, that for detached service, reconnoitring parties, convoys, out-post sentries, and generally for service against savage tribes, or border warfare, Colt's repeating arms were most efficient and it was an acknowledged fact, that without their use, the late campaigns of the United States armies could not have been so speedily, or so satisfactorily terminated. It was proverbially difficult to induce old soldiers to try new weapons, and there had been the usual amount of reluctance to try, and then to recommend the adoption of the repeating arms, but there was no resisting the evidence of actual practice, and the demand for them in the frontier corps, soon became as urgent, as it was among the borderers, who were not so slow to appreciate the advantages of such weapons.

The machinery used in the manufacture of these arms was equally remarkable for its simplicity, the ingenuity displayed in the adaptation of the tools, and the satisfactory manner in which all the various processes were conducted, so as to produce weapons, that were not only trustworthy and efficient, but so perfectly identical in all their parts, that in assembling a pistol, the several pieces were taken promiscuously from a heap, and the arm was finished almost without manual labour. It must be evident, that this was a great advantage, in a country where labour was so costly and where the borderers, the

isolated pioneers of civilization, who most required these weapons, must repair them, as well as use them.

As however it had been General MacNeill's lot, for many years past, to devote his energies to the peaceful occupations of Civil Engineering, he would prefer reverting to the subjects so well alluded to by the Hon. Mr. Walker, and he trusted, that in future the only contest between England and America, would be for priority in undertaking, and rapidity in executing, great engineering works for the benefit of the human race. In no way could this desirable end be so well attained, as by combining the energy and comprehensive enterprise of American engineers, with the proverbial science, skill, intelligence and good faith of the English engineers, who would find in the United States a hearty welcome, and a fine field for the exercise of their professional talents.

It had been his good fortune, whilst actively engaged in the execution of extensive engineering works, to have under him many young men, Scotch, Irish, and English who all arrived with the same simple story, "they wanted work;" and though he could not give them such employment as their talents and acquirements warranted, he afforded them such occupation as he could command, and in a short time, though they might have commenced as mere chain draggers, or assistant surveyors, at the rate of a dollar per diem, they soon progressed, and in a few years some of them were realising large incomes. He did not claim any merit for thus advancing the career of these young men; they had served him well and obtained the just reward of their talents and integrity, but in all cases he felt that he was only returning, in a slight degree, the hospitality and kindness he had experienced, at the hands of Telford, George Stephenson, Walker, and other eminent engineers, when he visited England many years ago, as a young Captain of Engineers, with his brother officers Whistler and Knight, with whom he was associated, in a journey undertaken by order of the United States Government, for the inspection of the great works of art in Great Britain. On that occasion, it was his good fortune to be brought into contact with Mr. Robert Stephenson and Mr. Locke, at that time commencing the works which would hand down their names to posterity, as the worthy successors of the eminent men he had previously mentioned. He was proud to have known those two engineers, and to acknowledge, that whatever useful work he had undertaken, and whatever success he might have obtained in his own country, had been materially aided by the intercourse he had been permitted to have with those gentlemen at an early period of their professional career.

Since the period to which he alluded, a great change had taken place, in the means of acquiring engineering knowledge; at that time he was told, that "engineers, whose opinions were worth having, were too busy to write books;" but now at the meetings of the Institution, not only were papers brought forward and publicly discussed, but the most eminent authorities of all professions entered with interest into the debate, and the results were freely published to the world. Although perhaps there might not be the same class of works executed in the States, as in Great Britain, yet there was much originality in many of the works of American engineers, and it should be his study to induce a liberal interchange of scientific and professional communications, between the American societies and the Institution of Civil Engineers, and he was sure, that the Hon. Mr. Walker would induce the Government to transmit all the scientific documents published by its orders.

Science knew no distinction of country; the whole world was an open field for the exercise of engineering skill, and in that field, professional brethren of all nations should strive in the contest for the noble end of doing the greatest amount of good to the greatest number of the human race.

December 2, 1851.

SIR WILLIAM CUBITT, President, in the Chair.

The following candidates were balloted for and duly elected:—John Joseph Bagnell, William Main Crosland, John Brough Palmer, Charles Sells, John Pigott Smith, John Hooke Taunton, and John Wilkinson, as Associates.

The discussion upon the Paper No 862, "On the application of Machinery to the Manufacture of Rotating Chambered-breech Fire-arms," by Colonel S. Colt, being renewed, was extended to such a length as to preclude the reading of any communication.*

The President announced to the Meeting, that a Telford Medal had been awarded to Mr. G. B. Bruce, M. Inst. C.E., for his Paper "On the Border Bridge," and that, in consequence of his immediate departure for India, the Council proposed to present the Medal at this Meeting, if such a proceeding met with the approbation of the Members. The proposition being favourably received, the President announced to Mr. Bruce that the Medal would be immediately transmitted to him by the Secretary.

* Vide ante page 30.