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Journal of the Society of Arts.

FRIDAY, DECEMBER 18, 1857.

EXAMINATIONS.

The following resolutions have been received from the Institutional Association of Lancashire and Cheshire:—

Resolved unanimously,—

"That the Council of the Institutional Association, in addition to their own Examinations, undertake to conduct the preliminary local Examinations of the Society of Arts, and also to supervise the working of the papers for the Society's Examinations."

"That the Council of the Institutional Association strongly recommend the Council of the Society of Arts to allow the preliminary Examination for 1858, in Lancashire and Cheshire, to be held in Easter week, six weeks before Whitsuntide; the report to be furnished to the Council within one week of the days of Examination, or not less than five weeks before Whitsuntide, and for the following reasons specially applicable to 1858:—First. That the pupils in the evening classes, in our Institutions, may have sufficient notice to prepare themselves for Examination; and, secondly, because the present depressed state of trade in the manufacturing districts materially retards the progress and efficiency of the classes in the Institutions in Union in Lancashire and Cheshire."

FIFTH ORDINARY MEETING.

Wednesday, Dec. 16, 1857.

The Fifth Ordinary Meeting of the One Hundred and Fourth Session, was held on Wednesday, the 16th inst., Mr. Thomas Winkworth, V.P., in the chair.

The following Candidates were balloted for and duly elected members of the Society:—

Blackwood, James	Letheby, Henry, M.D.
Blaine, Delabere Roberton	Milnes, William
Haines, Henry	Nightingale, Charles

The Paper read was:

ON THE HISTORY AND CHEMISTRY OF WRITING, PRINTING, AND COPYING INKS, AND A NEW PLAN OF TAKING MANIFOLD COPIES OF WRITTEN AND PRINTED DOCUMENTS, MAPS, CHARTS, PLANS, AND DRAWINGS.

By John Underwood.

Prior to the invention of printing, when all the business of the world was carried on in writing, and its literature and science deposited in manuscript, the manufacture of a black and durable ink was evidently not only of the first importance, but was recognized as such; and that we have seriously retrograded in this, as well as in many other branches of the Arts cannot be denied; in proof of which we have only to refer to the manuscripts in our possession, when we find that those from the 5th to the 12th century, notwithstanding their greater age, are in a far better state of preservation than those of the last four centuries; for while the writing in the former is always perfect, and, in many cases, as black as if it had just been written, that in the latter is often really not legible. The grounds for this disparity arise partly from the spirit of competition, so rife in the present day, which is always looking after the cheapest article that can be obtained, and also from the rapidity with which it is thought necessary to carry on all business transactions, and which does not allow time for the use of the comparatively thick ink of ancient times; but when we think of the enormous amount of property that depends, for its proper transmission, upon the permanence and durability of the ink used in the preparation of title-deeds, wills, &c., I consider that no expense of time or money ought to weigh with us in so preparing them that they shall be unalterable by either age or the skilled arts of those who may desire fraudulently to tamper with them.

Many experiments have been made with a view to discover the composition of the ink of the ancients, and the results arrived at from analysis are apparently opposed to each other. The first chemist who devoted his attention to such analysis was Dr. Lewis, to whom we are indebted for much of our present knowledge upon this subject, and who has left us an article upon it full of valuable research in the "Philosophical Commerce of Arts," published in 1763. From his analysis, he comes to the conclusion that the ink of the ancients consisted entirely of fine lamp black or charcoal, held in suspension by some mucilaginous fluid; which opinion was afterwards supported by the experiments of Mr. Thomas Astle, author of a work "On the Origin and Progress of Writing," published about the year 1780; but this view does not at all accord with the results of experiments made by Sir Charles Blagden, which were embodied in a paper read before the Royal Society, in 1787. He states that he had been led to inquiry on this subject by his friend Thomas Astle, who supplied him with several manuscripts dated from the 9th to the 15th century inclusive, some of which were still very black, while others varied from pale yellow to different shades of dark yellowish brown. All the documents he experimented upon, with one exception, agree in the general result, showing that the ink employed in these manuscripts, was of the same nature as that in present use. The letters turned of a reddish or yellowish brown on the application of alkalies; were rendered pale, and at length obliterated, by the dilute mineral acids, and the drop of acid liquor which had extracted a letter changed to a dark blue or green on the addition of a solution of prussiate of potash; moreover, the letters were changed to a deeper tinge by the infusion of galls. Hence he asserts that it was evident one of the ingredients employed was iron, which there was no reason to doubt was joined with vitriolic acid; while the colour of the more perfect manuscripts, which in some was a deep black and in others a purplish black, together with the restitution of that colour, in those which had lost it, by the infusion of galls, sufficiently proves that another of the ingredients was an astringent matter. No trace of a black pigment of any sort was discovered, the drop of acid which had completely extracted a letter appearing of an uniform pale ferruginous colour, without an atom of black powder or other extraneous matter floating in it. One of the specimens sent to him by Mr. Astle, proved very different from the rest. It was said to be a MS. of the 15th century, and the letters were those of a full engrossing hand, angular, without any fine strokes, broad, and very black, on which none of the above reagents produced any considerable effect; most of them rather seemed to make the letters blacker, probably by cleaning the surface, and the acid, after being rubbed strongly on the letters, did not strike any deeper tinge on testing with the prussiate of potash. Nothing had any sensible effect, he found, towards obliterating these letters, except what also took off part of the surface of the vellum, when small rolls, as of a dirty matter, were to be perceived. It is, therefore, unquestionable, he continues to say, that no iron was used in this ink, and, from its resistance to the chemical solvents, as well as a certain dotted appearance in the letters when examined closely, and, in some places, a slight degree of gloss, there was litttle doubt, in his opinion, that they were formed with a composition of black, sooty, or carbonaceous powder and oil, probably something like our present printer's ink, and, from these results, he was led to suspect that these marks were actually printed. It is said that a subsequent examination proved this to be part of a printed book.

From these experiments, and with the belief on his mind that this latter document must have been printed, he concludes that ancient inks had no carbon in them, and that their greater durability depended upon the better preparation of the parchment or paper upon which the writing was made. The fact that the tinge of colour produced by the action of prussiate of potash seemed less deep than that produced by its action upon inks of more modern date, led him, also, to the belief that there was a less quantity of iron, in proportion to the astringent matter, than is used in the present day. So generally did he believe iron to have been used in the inks of ancient times, that he recommends for general adoption the use of prussiate of potash, combined with a mineral acid for reproducing writings which have been effaced by age. Indeed, in support of the view that iron was generally used in the manufacture of these inks, we find Camparius, who wrote on the subject of inks at Venice, in 1619, recommending the use of an infusion of galls in white wine for the restoration of faded MSS.

Though at first sight the experiments of Dr. Lewis and Mr. Astle seem at variance with those of Sir Charles Blagden, yet, I think, they will both serve to support a view of my own, that in the ink of the earlier centuries of the Christian era, no uniform receipt was adopted, but while in many cases it was purely carbonaceous, yet it generally consisted of a black dye, very similar to our ink, with the further addition of a large quantity of lamp black, or finely-powdered charcoal. It will be found that neither Lewis nor Astle give us the method of chemical analysis which they adopted, and, therefore, we may suppose that with the preconceived notion that the ink was simply carbonaceous matter held in suspension in some mucilaginous fluid, when their experiments proved the presence of pure carbon in the writing, they did not sufficiently prosecute their researches to discover the iron, but decided at once that it was simply what they had previously supposed. Relative to the experiments of Blagden, it must be borne in mind that we do not know on how many specimens he experimented, but we do know that none of them were of earlier date than the ninth century, and, although in some he did not find any trace of carbon, yet in one of them its presence was most clearly proved, and the tests for iron he does not say produced no effects upon it, but no considerable effects, and with regard to his suspicion that this latter was a printed document, I cannot conceive that he was correct, because, if so, it must have shown the indentation of the type; moreover, printing was hardly so far advanced at that time as to be such a perfect fac-simile of writing, as to deceive a person of Dr. Blagden's knowledge and research throughout the series of microscopic investigations which his experiments required. It must be remembered that it was not the appearance of the writing, but the chemical difference of the ink that first led him to suspect that the words were printed and not written.

From experiments I have made with inks composed of black dye and the lightest lamp-black, I find the great obstacle to their use is the difficulty of keeping the carbon in suspension, and knowing when it is so, for, if not frequently agitated, the carbon settles down, and, the colour of the ink not depending upon it, you continue your writing, little thinking that it is quite destitute of the principle upon which its permanence depends. I conceive it to be possible that in many of the MSS. of former days the writing might be destitute of carbon through the carelessness of the writer in not seeing that the ink was shaken, and I think we may fairly conclude that such was the case with those MSS. in which Dr. Blagden could discover no trace of carbon. Again, if Dr. Lewis and Mr. Astle were correct in saying that all the ink of the earlier ages was composed of lamp-black which never changes its appearance, how are we to account for the various tints of colour which those deeds exhibited. Mr. Astle refers to the following curious case, showing the various changes of tints which the ink of one period has undergone, and it does not seem to have occurred to him that this case militates most strongly against his own opinion. He tells us that he had in his possession a long roll of parchment, at the head of which was a letter that had been carried over the greatest part of England by two devout monks, requesting prayers for Lucia de Vere, Countess of Oxford, a pious lady, who died in 1199. The roll consisted of many skins of parchment sewn together, all of which, except the first, contained certificates from the different religious houses that the two monks had visited them, and that they had ordered prayers to be offered for the Countess, and had entered her name in their bead rolls. He says, "it is observable time hath had very different effects on the various inks with which these certificates were written. Some are as black and fresh as if written yesterday, while others are changed brown and some are of a yellow hue."

Now, I am inclined most strongly to contend that if those signatures had been made with a purely carbonaceous ink, they could not have changed to a yellow hue, while I do think it, nevertheless, highly probable that in all, or most of them, carbon had been used, although in some cases it might have settled to the bottom, and not been taken up by the pen. Some of the MSS. at the British Museum give remarkable support to my opinion, for on closely inspecting them it will be seen that while some words and letters, even parts of letters, have retained their full depth of blackness, yet the remaining parts of these letters are of a yellowish colour, in some places with black particles in them, and in others without a trace of any black matter, and so regularly does this remarkable change occur throughout some of the MSS., that by noticing where the blackness commences and runs off to pale yellow, you can almost point out every place where the pen has been freshly dipped into the ink, showing beyond a doubt that such writing was done with an iron ink that had free carbon in it, but, through want of care in keeping it agitated, there was not sufficient carbon for it to be distributed through all the letters. The statements of Pliny and Dioscorides also confirm me in my view. Pliny discoursed on so many subjects, of which he had no practical knowledge, that his remarks are often difficult to understand, yet both he and Dioscorides plainly tell us that the Romans and Greeks used inks made otherwise than from lamp-black and charcoal, and, as Dr. Lewis and Mr. Astle, as well as the authors of articles in many of the encyclopediæ, tell us, that both these ancient writers support their view, that the only inks used in former times were carbonaceous, I will here give the literal translation of their remarks on the subject.

We read in Pliny's natural history, "Atramentum, too, must be reckoned among the artificial colours, although it is derived in two ways from the earth. For sometimes it is found exuding from the earth, like brine of salt pits, while at others an earth itself, of a sulphurous colour, is sought for the purpose. Painters, too, have been known to go so far as to dig up half-charred bones from the sepulchres for this purpose; all these plans, however, are new-fangled and troublesome, for this substance may be prepared in numerous ways from the soot that is yielded by the combustion of resin or pitch, so much so, indeed, that manufactories have been built on the principle of not allowing an escape of the smoke evolved by the process. The most esteemed black, however, that is made in this way, is prepared from the wood of the torch pine. It is adulterated by mixing it with the ordinary soot from furnaces and baths, a substance which is also employed for the purpose of writing. Others again, calcine dried wine lees, and assure us that if the wine was originally of good quality from which the colour is made, it will bear comparison with that of Indicum.

" Polygnotus and Micon, the most celebrated painters from Athens, made their black from grape husks, and called it Triginon. Apelles invented a method of preparing it from burnt ivory, the name given to it being Elephanterion. We have Indicum, also, a substance imported from India, the composition of which is at present unknown to me. Dyers, too, prepare an atramentum from the black inflorescence which adheres to the brazen dye pans. It is made also from the logs of torch pine burnt to charcoal, and pounded in a mortar. The Sepia, too, have a wonderful property of secreting a black fluid, but from this liquid no colour is prepared. The preparation of every kind of atramentum, is completed by exposure to the sun. The black for writing having an admixture of gum, and that for colouring walls an admixture of glue. Black pigment that has been dissolved in vinegar, is not easily effaced by washing."

Dioscorides says, " The ink with which we write, is composed of the smoke collected from lamps. With a pound of gum they mix three ounces of black. By another process branches or pieces of the torch pine are burnt till they become charcoal, when they are extinguished, then pounded in a mortar, and mixed with glue. These make an ink not unpleasant. A third mode is also taken, that of mixing certain proportions of painter's black, pounded charcoal, glue, and what is termed the flowers of brass, (that is the flosculent substance that forms on the surface of melted copper cooled by water)."

Now, although I have sought to show that in many cases the ink of the ancients was composed of a combination of black dye and lamp-black, yet, we know that in some cases it was simply lamp-black mixed with some viscid substance, as gum water or oil. For instance, we find in the MSS. in the Royal Library at Portici, that the letters are blacker than the papyri upon which they are written, though this is perfectly charred; and thus we know that vitriol could not have been employed in the composition of the ink which was used upon them, or the great heat to which they were exposed would have turned the writing to a yellow tint, by evaporating the acid and leaving the iron in a state of oxyde or common iron rust. Besides, the delicate nature of the papyrus would not have borne the corrosive nature of a vitriolic ink, which would have penetrated through it, as may frequently be observed in later manuscripts written on parchment, a far less delicate substance than the papyrus. These papyri manuscripts were evidently written with an ink made of oil and lamp-black, which must have been very thick, and was probably used with a brush, and any doubts as to its composition were set at rest by the discovery, at Herculaneum, of an inkstand with a small quantity of ink in it, which, upon examination, proved to be merely a thick rich oil mixed with lamp-black. The lamp-black was ground up with the oil as painters' colours are now done, and by remembering this we can understand the meaning of Demosthenes when, in a speech of his, he taunts his great rival, Æschines, for having been compelled in his youth, through poverty, to sweep the school, sponge the benches, and grind the ink. This description of ink was also, in some cases, in use in the 7th century, which we learn from a description given by Isidorus, of Seville, as to the nature of its manufacture. But the difference of views regarding the composition of these ancient inks has plainly arisen from the idea that all must have been made by some uniform receipt, which was no more probable than that it should be the case in the present day.

From the fact that there appears less change of colour in the documents written prior to the 10th century, I conclude that while in many cases the very early inks were purely carbonaceous, great care being taken in the use of them, yet, that as the art of dyeing became better understood, so the mixture of black dyes with carbon gradually came into use, till at last the trouble attending that made with carbon led gradually to its being less and less adopted, and it was at length entirely discarded, and the ink made simply with the sulphate of iron and gum combined with an astringent, such as galls or logwood. A substitute for ink was obtained by the Africans from the dark fluid which the Sepia or cuttle-fish has the property of ejecting to conceal its retreat when pursued by an enemy. From Persius, when describing the apparatus of the indolent student, using the word sepia for writing, it is probable that though not generally in use amongst the Romans, it was occasionally employed.

Besides black, the ancients used many different colours. Thus, we find the Sacrum Encaustum, a purple ink, the composition of which was kept a profound secret, was employed for signing documents by the Roman emperors, to whose use it was exclusively reserved; and, by an edict of Leo the Great, it was forbidden, under pain of death, to possess, use or even endeavour to obtain it from the vigilant officers in whose custody it was preserved. This edict was in force from A.D. 470 to 1452, except that in the 12th century the privilege of using it was extended to the members of the Imperial Family, and, in some cases, to the great officers of state. Green ink was especially reserved for the signatures of the guardians of the Greek emperors while their wards were minors.

Since the inferiority of modern ink, compared with the ancient, has become known, several parties have directed their attention to its improvement, but I regret to say with as yet very little result. Those only whose researches on this point are really worthy of much attention are Dr. Lewis, published in his work already referred to, and those of Rebaucourt, published in the 12th vol. of the French Annals of Chemistry; but, unfortunately, they arrive at very different conclusions.

Dr. Lewis considers the rapid decay of many modern inks to arise from a deficiency in the quantity of galls, for, these being perishable, he conceives that the amount which gives the deepest colour at first may be insufficient to maintain it afterwards, and says the great art of making inks is to have a superabundance of astringent matter, so as to counteract the tendency of the iron to oxidation, which is the cause of the ink turning brown and afterwards to a yellow hue, and he recommends that the galls be finely powdered.

Rebaucourt, on the other hand, tells us that none of the principles should be in excess. " For," he says, " if there be more galls than the iron requires, the remainder will be nearly in the state of a decoction of galls, subject to change by becoming mouldy, and undergoing an alteration in the writing which will destroy its legibility much more completely than the change undergone by ink containing too small a proportion of galls; while, on the other hand, if there be a deficiency of them, part only of the salt of iron is decomposed, and the remaining portion will, by exposure, become oxidised and change its colour." He recommends bruising the galls, and not pounding them, and proposes, in addition to the iron, to use the sulphate of copper; but this, though Pliny and Dioscorides tell us copper was used in former times, has great practical objections in modern days, because, in using steel pens, the metal immediately becomes coated with copper, and the acid, set free, soon corrodes them, and they become brittle and useless, while with quills, the knife used in making them is in like manner covered with copper, and the acid, acting on the steel edge, causes it to require constant sharpening.

But I am convinced there is more to be considered in connection with the permanence of our written documents than merely the composition of the ink which is used upon them, and that there is much truth in the opinion of Sir Charles Blagden, that the permanence of ancient writings greatly arose from the quality of the paper or vellum upon which they were written. The tannic acid formerly retained to a considerable extent in the paper made from linen rags is entirely destroyed by the bleaching processes to which both the linen and the paper are subjected in modern days; and the rolling of our paper, while it brings up the highly glazed surface, so much admired since the introduction of steel pens, yet leaves the ink upon the surface so exposed to the action of the air as to cause it to fade far more rapidly than when used on the rough paper of olden times into which it soaked, and the iron, combining with the tannic acid present, would throw down a black precipitate into the very pores of the paper, which time, though it might change its tints, could not entirely efface.

The same principle we shall see applied to the permanence of ancient writings on vellum. If we look into the method of its preparation, we shall find that it underwent much the same tedious process by which we prepare leather, and in the course of which tannic acid was largely imparted to it. The cause of the deep brown colour of old vellum arises more from its process of manufacture than from the effect of age, as is generally supposed. But to attempt to introduce unbleached paper made of linen rags, and with the same surface as formerly, would be useless, as while in colour it would not suit the taste of the present day, its surface would be very inconvenient for rapid writing with steel pens.

We must, therefore, see if it is not possible so to prepare our paper hat without perceptibly altering its colour and surface, it may possess the quality of retaining the writing as permanently as the paper or parchment of former ages.

Dr. Lewis tried preparing paper with gallic acid, and found that the writing upon it was unchanged after many years, while that done on unprepared paper, at the same time, and exposed equally to the action of the light and air, had entirely faded; and it was afterwards suggested, in the Monthly Review of the *Philosophical Transactions* for 1787, when noticing the paper of Sir Charles Blagden, that a greater permanence might be given to our documents by washing the paper or parchment, previously to writing on it, with a weak mixture of prussic acid and water, or a solution of prussiate of potash, which, without injuring the material, would cause a thin film of Prussian blue to be formed wherever the ink came in contact with it.

I prefer preparing the paper, after it is finished and sized, by soaking each sheet in a solution of the neutral chromate of potash, and then slightly glazing it by rolling, and writing on paper so prepared with an ink made with galls, iron, and logwood.

In the manufacture of this and all ink, the quality of the water used is of far more importance than is generally supposed, for it will be found that if to a decoction of galls we add a few drops of sulphate of iron, it soon mixes with the liquor, and turns it uniformly of a bluish black colour; but if the minutest quantity of an alkaline salt be present, too small to be discovered by any common test, or if the water be in the least degree putrid, the colour will be of a purplish red. Thus, if the decoction be made with rain-water caught in clean glass or earthen vessels as it descends, it turns a bluish black on the addition of the sulphate of iron, but if collected from the tops of buildings, it turns a purplish-red with the same test; and though both the blue-black and purplish-red liquors deepen to a black by evaporation, yet, as we find these liquors respectively, upon dilution, show their blue-black or purplish-red tinge, I conceive that to obtain the best and purest ink, nothing but distilled water should be used.

The next point of importance is the purchase of the galls, which should be the rough blue Aleppo, as they contain more gallic and tannic acids than the inferior sorts, and these should be bruised fine, though not powdered. As the inferior, or white galls, are often dyed blue by dishonest traders, the ink manufacturer should make himself thoroughly acquainted with the different sorts, that he may not be imposed upon.

Having, then, carefully chosen the galls, we treat them with distilled water for a few hours, till they are quite soft, and then let the decoction stand for three or four days, when the clear liquid is strained off, and to it is added some of the best gum Senegal. When this is dissolved, we throw into it a quantity of clean iron filings, or several coils of fine iron wire, and agitate several times a day, till the liquid is turned of a deep black. We then draw it off from its sediment, and dissolve in it some pure extract of logwood. In the course of the operation of the liquid upon the iron, considerable effervescence takes place, which is caused by the decomposition of the water, the hydrogen escaping, and the oxygen forming with the iron an oxide, which the gallic acid in the solution dissolves. We prefer this process to that in which sulphate of iron is used, because in the latter the gallic acid, combining with the iron, leaves free sulphuric acid in the ink, which corrodes pens, paper, and parchment, and even destroys the metal inkstands into which it may be put. In using our ink on the prepared paper, the logwood being in the state of extract, combines with the neutral chromate of potash, and throws down into the very pores of the paper a black precipitate, which, when dry, is perfectly proof against most chemical re-agents. Thus we obtain an ink which, while it is jet black at the time of use, is sufficiently limpid to flow freely in the pen, leaves no surface on the writing, does not become mouldy for a very long time, and is, when used on the prepared paper, literally indelible. Although I cannot, of course, speak positively of the effects of time, yet I think, seeing that the application of chlorine makes no change on it, and that the black precipitate is formed in the texture of the paper, away from all action of the air, we may conclude that time will have as little effect as the chemical re-agents.

A new and important quality for writing inks was introduced by the indefatigable James Watt, in 1780, who, in that year, took out a patent for copying letters by pressure. The great objection to all copying inks has, hitherto, been that their copying properties depending on the ink not drying quickly, and on leaving a considerable quantity of surface on the writing, they could only be used on documents that were to be copied at once, and even these, after a few hours, lost all their copying properties. But the ink made as I suggest, if used on unprepared paper, which dries quickly and leaves no surface on the writing, may at any time after be copied on thin paper prepared with the neutral chromate of potash, and these duplicates as well as the original, when once dry are as proof against chemical re-agents as if the ink had been used on the prepared writing paper. Instead of keeping two inks in the office, we propose to have only one, and to write all letters on unprepared paper, taking a copy of them; while all deeds and other paper documents should be written on the prepared paper, which we also make up into account books, and thus we have our papers, books, and letters, all alike proof against the probable effects of time, or any endeavour wilfully to tamper with them.

The attention of myself and partner was called (last March) by the Executive Government of this country, to a requirement for the more rapid and effectual transaction of their business, and which we afterwards found to exist as extensively in the commercial world. Your Society being aware of the want, had, unknown to us, offered a premium, some two or three years back, for the discovery of some expedient to supply this deficiency, requesting the invention of some plan for rapidly taking many copies of written documents. At first, I looked upon the number of copies required by the government as an insurmountable difficulty, but being much urged by them to make experiments, and remembering that we had overcome the difficulties of making printing inks copyable, to which I shall shortly refer, I resolved to try what could be done.

I made, as you may suppose, an immense number of experiments without success, but at last the idea occurred to me, that by preparing the ink I wrote with, and the paper, with different chemicals having a strong affinity for each other, and which should throw down coloured precipitates, or by chemical reaction change colour wherever they came in contact, I might instead of one take many copies of a document at the same time, and after I had tried many chemicals I found my theory to be correct. The process which gave me most copies was by preparing the thin paper with the neutral chromate of potash, and writing with a strong solution of extract of logwood. Many experiments were required to discover the right strength of the solution of neutral chromate of potash with which the paper is to be prepared, because if I used much of it I could only take one or two copies, as the whole of the extract of logwood would be acted upon by the quantity of the chemical salt in the first sheet or two, therefore to get many copies it is necessary so to reduce the quantity, that while there is enough to have a chemical affinity for the extract, and to change colour wherever it is attracted, it shall not be enough to neutralise the extract until the desired number of copies are taken, and therefore, instead of having paper prepared with the different quantities of the salt, according to the number of copies required, which would have tended to much confusion in all offices of business, we thought it best to have one standard for the paper, and though we would only keep one ink for letter writing and general purposes, yet we make different qualities of this manifold copying fluid. We have three of these, our No. 1 is the ink formerly noticed as useful for both copying and book purposes, and from which two copies may be taken; our No. 2 has no galls or iron, but is a solution of pure extract of logwood so carefully prepared that exposure to the air in its liquid state shall not have any effect on it, although otherwise it would change in a few months, and from which six or eight copies may be taken at the same time. Another we call No. 3, which is the same, only containing more extract of logwood, and which gives twenty to thirty copies, even more if the writing is allowed thoroughly to dry before attempting to copy.

We have also produced an Indian ink on the same principle, which, when used in the preparation of architectural plans, maps, &c., will give one or more clear copies of even the finest lines, and I had hoped to have had specimens of this class of work for your inspection, but the short time I have had for preparation must be my apology for the omission. The only point to be observed in the taking of such copies, is that as they are done to a scale, they must be kept pressed in close contact with the original, till they are perfectly dry, because if not they will shrink in drying, and the scale be spoilt. While speaking of copying such plans, I may state what, I believe, has never before appeared in print, or been made public, that the ingenious Watt, who invented the plan of copying letters, turned his attention to this point also, and, instead of the ordinary China or Indian ink, used lamp-black rubbed up with the finest and oldest sherry wine, and from plans so made took off a copy on damp paper. From this, which, of course, was reversed, he could take many copies, by letting a boy overrun each of the lines with a mixture of lamp-black and sherry, and after each time of its being so overrun he could take 4 or 6 copies on damp paper. But though the process is adopted by one or two engineering houses in the present day, it is very troublesome, and unless very many copies are needed, it has always been found easier to take tracings. But in all architect's and engineer's offices we believe that our process will be adopted and save an immense deal of time and labour.

Relative to printing ink, your time requires that my remarks be comparatively brief. In examining the earliest printed works, one particularly notices, that while the ink used in the first stages of block-printing was of a very inferior sort, yet that which was used in the first works printed from moveable types, was far superior to that in use towards the end of the last and beginning of the present century. The former still retain a depth, brilliancy, and richness of colour, both in the letter-press and illuminated capitals, apparently as perfect as the day they were printed, while in the latter the ink is brown, withered-looking, and destitute of all clear, distinct, and brilliant appearance.

Within the last few years, however, great improvement has been made in this branch of art, and the best inks of the present day, equal, if not excel those of Caxton and the early printers. For these improvements we are greatly indebted to the chemical knowledge brought to bear upon this branch of manufacture by the Messrs. Flemmings, of Leith, and as they carried off the prize medals for printing inks at both the New York and Paris Exhibitions, I have consulted them, and would here acknowledge their kindness in fully explaining to me the most important points in the manufacture of really good printing ink.

We will first consider the necessary qualifications for it, and then see how best to attain these.

1st. It must distribute freely and easily, and work sharp and clean.

2nd. It must not have too great tenacity for the type, but have a much greater affinity for the paper, and so come off freely upon it.

3rdly. It must dry almost immediately on the paper but not dry at all on the type or rollers; this is a great desideratum especially for newspapers; this drying should be so rapid, that the sheets on being delivered from the machine, will allow the thumb nail to be drawn swiftly over the surface of the newly printed matter without smearing; and though this constant drying on the paper and never drying on the roller or type seems a contradiction and absurdity, yet it is one of the easiest points to be obtained if the manufacturer has any chemical knowledge, and if he is destitute of this it will be in vain for him to attempt to perfect the ink in this respect.

4th. It should be literally proof against the effects of time and chemical re-agents, and never change its colour.

To attain these objects, great experience and care are required in the purchase of the raw materials. Of one of these, linseed, there are many varieties, the Baltic, Black Sea, and East Indian, each yielding oil very materially different, the one kind giving by pressure a thin limpid oil, another a thick mucilaginous oil, which produce very different results under the same application of temperature. The ink-maker having, then, tried his seed previous to purchase, to see that it yields the best oil, must be careful in its mode of crushing, and should only use the oil which comes from the first crushing, because the increase of pressure, after the first oil has been expressed, or the method of steaming the seed and crushing again, gives an additional quantity of fatty matter, which spoils the ink, and which, when present in large quantities, cannot be effectually extracted.

The oil is now clarified from the fatty matters, which will come away, even with the first pressing, and the pure oil is then boiled with great care, regulating the temperature with thermometers, and when in a proper state, the best pale yellow soap is added, to give it consistency. During the boiling, the dryers are added with great care, the proportion varying with the strength of the varnish required. The soap should be previously tested, and the ingredients known. The boiled oil, with these additions, becomes a varnish. In the making of ink for some of the finer descriptions of book-work, palm oil and cocoa-nut oil are valuable additions.

The next point is the manufacture of the blacks, which is a far more scientific operation than one would at first imagine. The finest naptha only, very carefully rectified, should be used, and on burning it the application of oxygen must be regulated to the combustion, otherwise the sudden expansion of the gases with limited vent would cause a serious explosion, and care is requisite, not only for the safety but for the quality of the blacks, as, if you have not the right quantity of oxygen. the blacks will have more or less of a brown tinge and be very inferior in quality. The empyreumatic oil must now be burnt off, but the secret of making good blacks, which only practice and chemical knowledge will give, is to have as little of this oil present as possible, so that the more experienced manufacturers have far less to get rid of than others. The black, if of a sufficiently deep and rich colour, is now to be ground up carefully with the varnish, which completes the manufacture of the ink, and thus made, it can never turn of a brown colour. But most black requires to be mixed with blue to give it depth of colour, and the blue being fugitive, will, after a time, fade and leave the printing of a brown tint.

Relative to this blue, I would advise the manufacturer to see that his prussiate of potash, nitro-muriate of iron, and acids, are chemically pure, and to use leaden or enamel boilers, instead of the iron ones which they too generally employ. These should be heated by steam passing through leaden or enamelled tubes, as the brightness of the colour depends entirely on chemical purity. Ink made upon this plan, while doubtless the best for book purposes, does not answer for many of the requirements of commerce, and some of the railway companies and large mercantile firms have long been anxious to obtain an ink capable of having copies taken from it by the ordinary copying press. This difficulty we have, at least, got over, by using a deep-coloured varnish, which will freely dissolve in water, instead of the oily one just described, with which we grind our black, or, if we desire more than one duplicate, using a chemical in it such as logwood, and taking our copies on the prepared copying paper, regulating the proportions of logwood to the number of copies required. These copies, with the original, being based on the same principles as our plan of taking duplicates of written documents, are, like them, proof against chemical re-agents, or the probable effects of time.

I had proposed to have explained how, by varying the chemicals used, the same principles may be carried out to take manifold coloured copies of drawings, paintings, &c., but time forbids. I trust, however, I have succeeded in stirring up inquiry on this subject, and in showing you that it is possible to have our writings as lasting as those of ancient days, and that our plan of taking multiplied copies of written and printed documents is very simple, and of no small literary and commercial value.

DISCUSSION.

The Chairman said that it now became his duty to invite discussion on the subject opened up by the paper of Mr. Underwood, which was one of great commercial and economic importance, as well to the professional and literary world as to merchants, bankers, and traders. The statement which they had heard, and in which was traced the history of the art of writing and of the materials employed, from the earliest times, through the middle ages, when the chief scribes were monks and friars, down to our own times, was replete with interest, and did credit to the research of the author of the paper. The Society was favoured that evening with the attendance of many gentlemen who, from their scientific and professional knowledge were eminently competent to discuss the subject. His friend Mr. Deputy Lott, for instance, was not only a solicitor, and therefore interested in the success of Mr. Underwood's invention, but, being an active member of the Antiquarian Society, he was always alive to the progress of antiquarian research, and the citizens of London were largely indebted to him for the preservation of many important specimens of ancient architecture. He begged therefore to invite Mr. Lott and other gentlemen to join in the discussion.

Mr. Deputy Lott said the importance of this subject could scarcely be overrated. He felt an interest in it, because six or seven years ago, when he had the honour of a seat in the Council of the Society, he induced his colleagues to offer a premium for a process of copying manuscripts superior to any that was then in use. As a lawyer he felt it to be a matter of immense importance, and, notwithstanding what had been stated by the author of the paper, he was still of opinion that, up to the present time, the inventions that had been brought out were far from producing results so satisfactory as he desired. As far as he was aware, there were only two principles which had been practically carried out in the copying processes hitherto used; one of them had been discussed by Mr. Underwood, and he (Mr. Lott), could not but hope that the process described was an improvement on what had hitherto been done, Still, however, it was too often found in practice—whether from the defect of the ink or the paper he could not say—that the copy was minus half the original, or that in the lapse of three or four years the document was not in a state to be produced in a court of justice as an authentic copy. It was of the greatest importance in his own profession that documents should be capable of verification beyond all dispute, but as far as he was acquainted with what had been accomplished up to this time, he was sorry to say, the objections he had stated had not been removed. The other mode of copying was that known as the manifold writer, and this he thought by no means satisfactory, and the writing with the style, was much objected to. With reference to the mode of copying introduced by Mr. Underwood the results certainly appeared, judging from the specimens exhibited, fairly successful. Still he (Mr. Lott) thought much remained to be done in that direction. The specimen which he had examined was somewhat imperfect, and appeared to be fading; but the scientific investigations which had been made into the question would probably ultimately lead to these defects being obviated. The author of the paper had dwelt upon the superiority of the inks used in former times. In illustration of that he would mention that he had seen in Durham Cathedral a copy of the Scriptures transcribed by the Venerable Bede, in which the ink used must have been of the very best description, inasmuch as at this distant period the writing was perfect, and the ink a beautiful black. Some years ago he laid upon the table of the Antiquarian Society a grant from the crown, signed by Queen Katherine as regent of the kingdom, during the temporary absence of Henry VIII. at the Field of the Cloth of Gold. It was the most beautiful specimen of writing he had ever seen, and the ink was a perfect black. There was another method of copying to which he would advert, in which the sun was the agent—he alluded to photography; having seen wonderful reproductions of the title pages of books as well as MSS., he thought that its application might be extended to more useful and practical purposes. If this agent could be brought into general use it would prove a very great desideratum to the members of his own profession, as he believed, by that means, a perfect copy of a MS. could be secured.

Mr. Charles May said, this was a subject which had occupied much of his attention for many years. In the early transaction of the Society, there was to be seen a copy of the specification of James Watt, for an ink for copying purposes, and the mode of preparation was described. The paper upon which the copy was taken was prepared with a weak solution of galls. He had seen copies of MSS. in the possession of the present firm of James Watt and Co., which had been in existence for upwards of 70 years, and which, although they had lost their pristine blackness, were nevertheless perfectly legible, owing to the quantity of oxyde of iron deposited upon the paper by the ink employed. He (Mr. May) was inclined to believe that no preparation of vegetable acids, in combination with iron, would for any great length of time retain its blackness, so long as paper bleached with chlorine was used. It was to this circumstance that he chiefly attributed the marked difference which was observable between the state of preservation of the colour of ink in ancient and modern MSS., rather than to any special difference in the ingredients of the ink itself. With reference to the periods of time at which written documents could be copied, he would mention that for some years he used in his business transactions Arnold's ink, and he could obtain a distinct copy from that three weeks after it was written. It was not a pleasant coloured ink in the first using, being very dull, but it afterwards became a good black. With a little management three or four copies could be taken. He was rather surprised that Mr. Underwood had not referred to the use of indigo in inks. Indigo was capable of preparation for such purposes, and the blue inks of the present day, he believed, consisted of indigo, partly deoxydised, so as to become soluble with an admixture of a small proportion of gallic acid and iron. This had the effect of producing a black colour after some time, and from that description of ink he thought several copies could be taken. With reference to the use of logwood, he very much doubted whether any preparation of this substance would be permanent. It was a most beautiful dye, being the chief ingredient in the dyeing of beaver hats, but it was invariably found that exposure to sea air turned them brown, and he had great doubts as to the propriety of using vegetable matter as the basis of an ink in which permanence of colour was a consideration, especially when employed on paper bleached with chlorine, which he believed could not be effectually got rid of by any amount of washing. The subject was one of great importance, and he agreed with Mr. Lott as to the great desirability of securing copies of documents which could be authenticated in courts of justice. He believed that much of the fading of documents copied by the ordinary process was caused by want of attention on the part of the clerks entrusted with the work. The copies were not taken so well as might be done even with the present appliances. The great object to be attained in all copying processes was an uniform dampness, without a surcharge of water in the paper. He would mention that inks which through age had become of a yellow tint, might be restored to blackness by the use of gallic acid; but this fact was frequently observable,—that the iron held in solution in the ink penetrated the fibres of the paper, and distributed itself beyond the line described by the pen; therefore, if the copy was taken upon paper too much damped (and perhaps the book being shut up damp), the iron constituent of the ink travelled out of its line, and when such writing was restored by the use of gallic acid, much confusion was the result.

Mr. Cornelius Walford remarked upon the carelessness with which copies of letters, &c., were at present taken. He believed, with ordinary precautions, the present process would be found to be all that was required.

Mr. Stephens, as a manufacturer of inks, and having extensively experimented on this subject, would refer to the use of chromate of potash in the preparation of paper, as referred to by Mr. Underwood. Some years ago, he (Mr. Stephens) introduced a marking ink, the preparation for which upon linen consisted of neutral chromate of potash. It had been found necessary that the chromate should be removed by washing after the linen was marked, and in such cases the results had been satisfactory; but, having exported a quantity of his marking ink to America, he had received a demand for compensation for linen destroyed through the use of his marking ink. The fact was, that, in the instance referred to, the chromate had not been washed out after marking. The result was the destruction of that portion of the linen to which the chromate had been applied. Mr. Stephens proceeded to state his experience in the use of indigo as a constituent of writing ink, the indigo being chemically prepared so as to render it more soluble, and the results of experiments, both as to moisture and exposure to sea air, had proved the durability of that description of ink. Ink with a vegetable basis had a tendency to decay, which was apparent even when it was kept in bottles. He thought ink made with prussiate of iron was more permanent. When first used, the writing was of a pale colour, which, upon withdrawal from the light, became more intense. Mr. Stephens mentioned the results of several experiments with this material, and observed that although prejudice against coloured inks had gone to such an extent that an American judge refused to recognize documents written in blue ink, yet he hoped such an objection would not be allowed to operate against that which had been found to be of practical utility.

Mr. Pearsall, without wishing in the least degree to detract from the merits of any invention, would state that, in his own experience, he had found that blue ink was obliterated from the accidental spilling of water over a sheet written upon with it. If that had been the experience of American judges, he could account for their objection to that description of ink.

Mr. Stephens remarked that this would not be the case with documents which had been written for any length of time.

Mr. Rudolph Appel, the inventor of the anastatic and Appelotype processes, stated, that having for twenty-eight years been engaged in transferring printed and written documents of all kinds, and in multiplying copies of them, he might fairly be presumed to know something of the subject then under discussion. About thirteen years since he exhibited to the members of the Society of Arts his anastatic process, when the chairman and various members of the Society wrote their signatures and some sentences, which were transferred, and very many copies worked therefrom within ten minutes, or thereabouts, in each case; and he further stated, that the anastatic process, unlike Mr. Underwood's, was capable of producing any number of perfect copies with a very small amount of labour, occupying only a few minutes in transferring, when the original had been recently written. He was able to reproduce drawings, maps, engineering and architectural plans, with the same facility as common writing, and he had succeeded in reproducing the finest impressions from engraved copper-plates, which had been printed from 50 to 70 years. Mr. Appel instanced the reproduction of the great Austrian maps of Russia and Turkey, occupying an area of about 60 square feet; these he was employed by the English government to reproduce and print at the beginning of the Russian war, and he then delivered fifty perfect copies of each of these great maps within a fortnight. The anastatic process was daily employed at Aldershot and other similar establishments, for the circulation of general orders and official instructions, as well as in the Privy Council Office and other government departments. He thought Mr. Underwood's process was only applicable for producing a small number of copies; certainly, if the vegetable ink made according to Mr. Underwood's method, was found in practice to be permanent, there was no doubt it would be a great improvement, but from his (Mr. Appel's) experience in the manufacture of inks, he was unable to agree with the author of the paper in the conclusions to which he had arrived; still he thought there were many purposes to which Mr. Underwood's process might be applicable.

Mr. Vaughan Prance begged to ask what had been the results of the application of Mr. Underwood's plan to the purposes of railway companies, such as the copying of way-bills, &c.

Mr. Lawrence wished to ask the lecturer whether he used the ordinary press for copying by his process, and whether the copying ink would serve for ordinary writing, as the copying ink in ordinary use was not adapted for general purposes.

Mr. Underwood replied in the affirmative.

The Chairman remarked that as the author of the paper had very properly said that the material on which to write was a very important element of durability, he might mention from his own experience, as one of the Court of the Weavers' Company, the oldest of all the City Companies (the corporation of London not excepted), that they possessed a charter granted to them in the 12th century by Henry II. (in which reference was made to one previously granted by his great grandfather William the Conqueror), the writing of which was apparently as perfect in all respects as when first produced. He might also incidentally mention that it possessed a merit which professional gentlemen, and especially law-reformers and law-makers, would appreciate, viz., distinctness and brevity. The provisions of the charter had never been disputed, and yet the document itself was compressed within dimensions not exceeding those of the palm of his hand; would that the same could be said of modern charters.

Mr. Varley could confirm the statement made as to the destructive action of chlorine used for bleaching paper. He had seen instances in which the writing was nearly obliterated through that cause. The best way of preserving documents that he was aware of was by the perfect exclusion of atmospheric air.

The Chairman then proposed a vote of thanks to Mr. Underwood for his paper, which was unanimously passed.

Mr. Underwood, in returning thanks, said he could assure those who expressed fears as to the permanence of the copies taken from a logwood ink, that the neutral chromate precipitate was not fugitive, as was that made with iron; and that the firm which he represented had in their possession copies taken nine months ago, which, instead of having faded, were of a more intense black than when freshly taken. He had tried soaking them in solutions of chloride of lime, oxalic acid, and dilute sulphuric acid, without being able to efface the writing. Relative to the remarks made by Mr. Stephens, as to the probability of the neutral chromate of potash destroying the paper in the course of time, he believed that if it was used in the concentrated form necessary for marking linen it might have that effect, but the very weak solution he found it necessary to employ if he desired many copies of a document, and which was also used in the same dilute state for the preparation of the indelible writing paper, had rather a contrary effect, and the largest houses in the stationery trade agreed with him in believing that the paper was much improved in durability by the process of preparation, and the copies he had by him, though done on much thinner copying paper than usual, showed no tendency to decay, and would bear rough handling better than many on stouter paper which was unprepared. He had not been able to give the time he wished to the peculiarly important part of this invention, viz., the great facility with which any person might take twenty or thirty copies of a written document in a short time. For the purposes of rapidly transmitting police intelligence it was most valuable, as any policeman who happened to be in the station when the information arrived, could strike off 17 or 20 copies in ten minutes ready for circulation to other stations. Railway and Steam Navigation Companies acknowledged it would be of great service to them, for it not only enabled them to copy the printing, ruling, and writing of their large way-bills, invoices, etc., but the "memorandum notes," frequently sent from station to station, might not only be copied previously to being issued, but, having been endorsed with a short reply, both question and answer could be copied, and even a third copy might be taken when this came back to the station from which it was orignally sent, the intervals of time, however great, between the taking of these copies making no difference. Bankers and merchants, also, were adopting it with great success, for the taking of many copies of advice letters, foreign invoices, &c., and as this might be done by any ordinary office boy, a great pecuniary saving was effected.

The paper was illustrated by specimens exhibited by Messrs. Underwood and Burt, the patentees of the process, showing copies of large printed and ruled Railway Invoices, Steam Navigation Companies' Manifest Sheets, Forms of Letters, and other documents; besides some 40 or 50 clean copies taken from their different writing inks, as well as specimens of writing on prepared paper, in which the characters had been attempted to be obliterated by oxalic acid, dilute sulphuric acid, and chloride of lime, none of them having been rendered illegible.

The Secretary announced that the next meeting would be held on Wednesday, the 13th January, 1858, when a paper by Mr. J. Bailey Denton, "On the Advantage of a Daily Register of the Rain-fall throughout the United Kingdom, and the best means of obtaining it," would be read.

THE FOOD GRAINS OF INDIA.

By Dr. J. H. Gilbert.

As the Chairman directed the discussion on the recent admirable paper of Dr. Watson, in the first instance, to the questions more particularly affecting India herself, and there seemed to be no opportunity for discussing the subject in its chemical and dietetic aspects after he had himself spoken upon them, perhaps it may be well to make one or two observations in this form.

But, first, a word or two on the question of the import of Indian grains and pulses into this country. It seemed to be generally admitted that the ravages of the weevil in Indian wheat proved a very great obstacle to its extensive import, though, from the examination, in the Rothamsted laboratory, of some Indian wheat sent to this country, as well as from the information obtained by Dr. Watson on that head, it would appear probable that, if uninjured, these wheats would be extremely valuable in admixture, when, as too frequently is the case, large quantities of our own home-produced grains are badly matured, or got in in bad condition. Wheats which serve this purpose, are, however, generally open to the objection mentioned—that of being very difficult to grind with our stones; otherwise, from their composition, we should expect them to fetch much better relative prices than they generally do. Dr. Watson properly observed that the samples of Indian wheat examined contained less water than the average of our home-grown grain. But this is the case with most imported wheats: for they are generally ripened in hotter summers than our own; nor could they be transported, were they not, either naturally or by special management, rendered drier than the average of our own.

Several of the speakers seemed to think that some of the Indian pulses might, with advantage, be cultivated in this country; and the trial would certainly be very desirable. As to their importation, it was suggested by one speaker that our farmers might possibly look upon their introduction with some jealousy. Whatever might be the feeling as to the importation of greatly increased amounts of wheat, I think there would be anything but a tendency to jealous feeling, at a considerable importation of these highly nitrogenous pulses. On the contrary, in these times, when high farming is daily gaining grouud, and the supplies of artificial nitrogenous manures are so much below the demand, it would be a great boon to the farmer to have a cheap source of these highly nitrogenous seeds, by which he would directly increase his production of meat and manure, and indirectly that of grain also.

But it is in relation to the bearings of Dr. Watson's paper upon the "Chemistry of Food," and the practical application of dietetic principles, that I would chiefly call attention. No one can doubt that we owe an immensity to Baron Liebig for his admirable generalisations on the subjects of the chemistry of food, some dozen or fifteen years ago. Nor can it, on the other hand, be disputed, that, besides clearly defining the special offices of the nitrogenous and non-nitrogenous constituents of food respectively, he, in making allusion to the practical application of his principles, throughout assumed that the relative values of current food-stuffs would be measurable, more by the amount of their nitrogenous constituents than by the character and amount of their non-nitrogenous ones. Thus, even as late as 1851, he says:—

"The admirable experiments of Boussingault prove that the increase in the weight of the body in the fattening or feeding of stock (just as is the case with the supply of milk obtained from milch cows), is in proportion to the amount of plastic constituents in the daily supply of fodder." And, again, "It is found that animals require for their support less of any vegetable food in proportion as it is richer in these peculiar matters, and cannot be nourished by vegetables in which these matters are absent."

So far, indeed, throughout his writings on the subject, has it been the pervading idea that in our food the nitrogenous constituents were most likely to be found defective, that almost every subsequent writer and investigator has assumed this to be his view; nor, indeed, at the time he first wrote, was there experimental evidence at command to decide the question one way or the other. Our highest authorities, both in this country and abroad, especially those connected with agricultural chemistry, have for the most part, at any rate until recently, adopted the same view; and most of the tables of the composition of different articles of food have been assumed to indicate relative value according to relative amount of nitrogenous compounds. Sometimes, indeed, the writer has had an obvious misgiving, seeing that theory and experience were not in accord; but this has been accounted for generally to the disparagement of adopted practices. Those, however, who have been aided by careful observation, and especially those who, looking at the subject from a physiological and medical point of view, have weighed their experience with the light thus thrown upon it, have seen reason to call in question the validity of the prevailing opinions. It is, indeed, a particular satisfaction to see so marked a qualification of the notions referred to, in the papers by Drs. Letheby and Watson respectively, which have been read before the Society of Arts during the present year.

The experience of Mr. Lawes and myself, during a dozen years of laborious experimenting on the feeding of animals, has been to show that, as our staple food-stuffs go, both the amount of food consumed, and the amount of increase produced, have a much closer relation to the amount of non-nitrogenous constituents than to that of the nitrogenous ones.

The analysis of numerous half-carcasses of butchers' meat has shown us, that several such contained a larger proportion of respiratory or fat-yielding material in relation to nitrogenous or plastic compounds, than even bread. The results of this investigation will, however, shortly be published in full.

From the fact last mentioned, it will not be surprising that the average of the 86 dietaries calculated by us, as quoted by Dr. Watson (many of which contained liberal proportions of animal food), should have shown a proportion of gross non-nitrogenous constituents to nitrogenous ones, almost as high as in bread. And it may be mentioned that, provided about one-eighth of the total non-nitrogenous substance be supposed to be fatty matter, then the relation of the respiratory or fat-yielding to plastic or flesh-forming constituents, would be fully as high in the average of these 86 dietaries as in bread. The difference in the respiratory capacities of fat and the starch series of compounds was more than once called attention to by Dr. Watson, as affecting the relative value of the assimilable non-nitrogenous constituents of food.

That the existence of a certain amount of *fatty matter*, in some form or other, and particularly when duly blended with other matters, as in meat, constitutes the characteristic of a high class of dietary, much more than does a high relation of plastic to respiratory matter, there can be little doubt.

If instinct, and market price as influenced by it, are to be accounted as of any value in showing what are the natural calls of the system, and that our current articles of food are not valuable according to the amounts of the nitrogenous or plastic constituents they yield, the following facts will illustrate it sufficiently strikingly. At the present time we can purchase one pound of nitrogenous or plastic matter—

	s.	d.
In wheaten flour or bread for about	1	6
In beans and peas	0	4
In butchers' meat	5	0

It is, then, something else than their relative amounts of nitrogenous compounds which determines the relative values of our current foods in meeting the wants of the system. It is obvious that we could, at a very small cost, increase the per-centage of nitrogen in our bread, if that were all that were needed to make it a first-class food. But, supposing neither the plastic nor respiratory class of constituents deficient in actual *amount*, it is not, even then, immaterial in what form they are presented to the system. Drs. Letheby and Watson have insisted upon the necessity of keeping in view, not only ultimate chemical composition, but the condition and variety in which the constituents are presented. Nor is their any doubt that in the replacement of a certain amount of starch (and its congeners) by fat, there is generally something more, as regards the health and vigour of the body, than the mere substitution of chemical equivalents of respiratory and fat-yielding material.

In conclusion, referring to the Chairman's illustration, it may be remarked, that no one, so far as I am aware, has ever attributed to Baron Liebig the folly of recommending the repair of the material structure of an engine, when it was proved that fuel and steam were all that it required to keep it in vigorous working. There is, however, no doubt, that after showing with what materials the machine itself must be kept in order—what must be used as fuel—and that that which would serve only for the latter purpose could obviously not serve for the former—Baron Liebig, by the whole tenor of his argument on the application to practice of these principles, tacitly assumed that the repair of the machine would require a more assiduous attention than the supply of fuel.

Home Correspondence.

THE SMOKE QUESTION.

SIR,—In the recent discussion on Mr. Pellatt's paper, Mr. Greaves, after giving us the results of his most valuable large-scale experiments, arrived at the somewhat melancholy conclusion that the avoidance of giving off smoke costs 7s. a ton on the fuel used. In November, 1853, you published in the *Journal* a letter giving the results of our experience of mechanical self-feeding smoke-burning grates. A longer experience, with an increased number of furnaces, confirms the results thus given. We have never made a hobby of any particular smoke-burning contrivance, but the large quantity of steam required in our works has made the study of cheapness and efficiency of fuel an important one.

I will now give our present experience at Battersea works, and there only, as though we use similar apparatus at our other works, near Birkenhead and at Vauxhall, yet as Battersea factory is the principal one, using the largest quantity of fuel, and having the most perfect appliances for measuring the water evaporated, the results arrived at there are the most reliable ones.

At Battersea works, then, our consumption of small coal is two hundred tons weekly, at a cost varying from 9s. to 12s. per ton—take an average of 10s. 6d. Not having the advantage of shelter, they are more or less wet. With these we evaporate 6·7 lbs. of water per lb. of coal, as taken from the heap, and burn all smoke. We have some Cornish boilers, but prefer bi-tubular boilers, 5 feet 6 inches diameter, with the fire underneath, the furnaces being Hazeldine's or Juckes' furnaces 24 feet consuming 10·5 lbs. of small coal per foot per hour.

The coke employed by Mr. Greaves, at his average of 20s. 7½d., evaporates 100 gallons of water at a cost of 12·25d.

The small coal employed by us evaporates 100 gallons of water at a cost of 8·4d., and gives off *no* smoke.

I am, &c., GEO. F. WILSON.

Price's Patent Candle Company (limited),
Belmont, Vauxhall, London, S., December 6, 1857.

COAL AND COKE.

Sir,—It is a singular fact that, in the recent discussion on this subject, one or two points of primary importance were sadly lost sight of by all the speakers who addressed the meeting. It appeared to be taken for granted, when different kinds of fuel are to be experimented upon, that no change is required in the form, arrangement, and dimensions of the furnace, fire-grate, ashpit, or flues, that is to say, that the calorific powers of bituminous coal, coke, anthracite, wood, charcoal, or resinous matters, can all be effectually tested in the same furnace. A manifest absurdity. Coke producing a concentrated heat, with little flame and no smoke, must require a very different furnace for perfect combustion to that adapted for the use of bituminous coal, which gives out a diffused heat, with large flame, accompanied with abundance of smoke or gaseous products, and in carrying out experiments upon the evolution of heat from various species of fuel, the perfect adaptation of the furnace to each kind is indispensable, if reliable comparative results are to be obtained.

Again, the effect of differently formed ashpits upon the performance of a furnace is also totally ignored, while one half of the cause of our smoke-vomiting chimneys may be safely assigned to the very faulty construction of the ashpit, ever true to its name, as it is never more than a mere hole or pit, for the ashes to fall into. None of the innumerable inventions for the prevention of smoke ever included the slightest improvement in the ashpit.

Generally, engineers and contractors are required by their employers to confine the boilers to the smallest possible dimensions, and to put them in some out of the way hole or cellar, where, of course, the ashpit, the real *lungs* of the furnace, becomes contracted to a small hole sunk in the ground, with barely room to shovel out the ashes. The expedient often resorted to by millowners, of keeping the ashpit full of water, points to the evil; it is true that it saves the fire bars, but at a great loss of caloric by useless evaporation.

Insufficient boiler room, and a faulty ashpit, are the causes of half the smoke nuisance through a double action. The fires must be forced, and the extra draught required in consequence can only get to the underside of the fire bars in a very oblique direction, and through apertures ridiculously small and confined.

The first step towards true economy and the prevention of the smoke nuisance is to have abundance of boiler space, and the second will be a total reform in the setting of boilers, that is to say, the furnace must be so placed as to be over a large culvert open at both ends, if possible, and so constructed as to have four or five feet of perpendicular shaft, the full size of the furnace grate, immediately under the fire bars.

Of course, all furnaces confined within the boiler flue, with a diminutive fire space and nothing of an ashpit, must be condemned as extravagantly wasteful, and inveterate smokers, in spite of all the patent inventions and devices that may be adopted at the fire bridge or in the flues.

In the well-known "Prize Essay" on this subject, by Mr. Charles Wye Williams, there is scarcely an allusion to the subject of ashpits, and none whatever to the possibility of half the mischief being caused by their very faulty construction.

Mr. Williams acknowledges, however, that the Cornish system of firing is essentially the most economical in the evolution of heat from a given quantity of fuel in a given time; yet that gentleman still insists on the necessity for building and setting our furnaces and boilers on faulty and erroneous principles, and then curing the evils produced by means of costly patent inventions which seldom, however, meet with much success. Singularly enough, Mr. Williams goes on to state that the excellence of the Cornish system is "at the expense of time, space, and first cost of boilers."

The first item, "expense of time," is incomprehensible, for all boilers must, of necessity, furnish a given quantity of steam, at a given pressure, and in a given time.

The second, "expense of space," is absurd, because, if a man chooses to set up a 40-horse engine and boilers in a cellar, perhaps, 8 feet by 10 feet, he must abide by the consequences. It is true, that "space" costs rent in crowded towns and cities, but that is no reason why the inhabitants should be poisoned with the smoke or gaseous product ejected from the chimney shaft.

The last item, "expense of first cost of boilers," is surely a real source of economy, because boilers that do not require forcing or hard firing, will last out, perhaps, ten times those that require such treatment.

The effects upon combustion, by differently formed ashpits, may be readily tested by any person who possesses a common portable air furnace, by attaching to the body below the fire bars a sheet iron counter-funnel of the same size, five, ten, or fifteen feet long, terminating with a bell mouth, and carried perpendicularly downwards, if possible. He will soon perceive the enormous increase in the evolution of heat from such an addition.—I am, &c.

HENRY W. REVELEY.

Poole, Dec. 5, 1857.

COAL AND COKE.

Sir,—I am sorry I was not sooner aware of the reading of Mr. Pellatt's paper "On the Comparative Heating Properties of Coal and Coke," as I could then have furnished the particulars of the following experiments, which I have since obtained, and which to some extent would have confirmed his views.

The experiments were made on the boilers of a pair of engines used in forcing water for working some extensive hydraulic machinery, the constant pressure upon which was equal to a column of water 1,500 feet high. The coal was Newcastle Wylam, such as is commonly used in London for steam purposes, and the coke that which is supplied by the London gas works. The former cost 19s. per ton, and the coke 10s. per chaldron, which, reckoning the chaldron at 12 cwt., would be equal to 16s. 8d. per ton. The experiments occupied four weeks, and were of equal duration, namely, 90 hours each. The first experiment was on

Coal:

Time of working, 90 hours; number of strokes, by counter, 239,027; coal used, 14 tons. 9 cwt. 2 qrs. = 32,424lb, at 19s. per ton, = £13 15s. = 3,300d. = ·1017d. per lb.

Work done=1787 tons=4,002,889lb raised 1,500 feet=6,004,320,000lb raised 1 foot=185,180lb=raised 1 foot by 1lb of coal, at a cost of ·1017*d*.

Coke:

Time of working, 90 hours; number of strokes, by counter, 184,484; coke used, 12 tons. 14 cwt.=28,448lb, at 16s. 8d. per ton=£10 11s. 8d.=2,540d.=·0892d. per lb.

Work done=1,379·77 tons=3,090,684lb raised 1,500 feet =4,636,026,000lb raised 1 foot=163,000lb raised 1 foot by 1lb of coke, at a cost of ·0,892*d*.

Hence, the proportions between the weight raised and fuel used, are—for .... Coal, 185,180 to 1
Coke, 163,000 to 1.

And 163,000 is to 185,180 as 100 is to 113, so that, irrespective of cost, it appears that coal is 13 per cent. more efficient than coke, or one ton of coal would be equal to 22·6 cwt. of of coke. Again, 163,000 is to 185,180 as ·0892d. is to ·1013d., from which it appears that the *cost* of doing a given amount of work by coal or coke, weight for weight, would be as nearly as possible equal, the difference being only ·0004d.

Hence we may conclude that with coal at 19s., and coke at 16s. 8d. per ton, whether with regard to economy or efficiency, the results of using either will be as nearly as possible equal, the superior efficiency of the coal being compensated by the lower prices of the coke.

There is, however, a fallacy in thus reasoning, inasmuch as coal, by its conversion into coke, loses about 40 per cent. of its weight; it is therefore quite clear that this loss, added to the cost of manufacture, must necessarily render it more expensive than coal, unless, as in the experiments under consideration, its manufacture has not been a special and primary object.

It is probably owing to this that there exists so much difference of opinion on the subject, which led one of the speakers to represent his experiments as leading to the conclusion that—in the performances of a given amount of work—the cost when done by coals was 16s., and by coke 37s. 6d., the latter being, no doubt, locomotive coke.—I am, &c., JOHN LEONARD.

Mortimer-road, St. John's-wood, Dec. 7, 1857.

ON THE BURNING OF COKE AND THE SMOKE NUISANCE.

Sir,—In reference to the recent discussion at our Society on the "Substitution of Coke for Coal as a remedy for the Smoke Nuisance," I was sorry to find that the commercial view of the case absorbed almost the entire attention of the meeting.

I should have been more gratified if the hygienic side of the question had also been given; and it is in the hope of eliciting opinions on this view of the case that I now write these few lines.

Admitting that, in round numbers, there are *five million tons* of coal consumed in London, then we have, as the result, 5,000,000 × 40 = 200,000,000 cubic feet of coal × 10,000 = 2,000,000,000,000 cubic feet of carbonic acid gas produced; if all this coal be converted into invisible fumes, and as *one* part of carbonic acid gas added to 1,000 parts of our atmosphere is sufficient to render that atmosphere injurious to health, we thus obtain the last figures, multiplied by one thousand, viz., 2,000,000,000,000,000 cubic feet of our atmosphere contaminated by the total combustion of *five million tons of coal*.

In other figures, more within comprehension, we have thus contaminated 13,560 square miles of air and one mile in depth, or about 117 miles square and one mile in depth. This is for the entire year, and if we divide by 365 days we have about six miles square and one mile deep of our London atmosphere daily contaminated, viz., a space equal to about the entire area of London if we exclude the suburbs.

As I have long taken a deep interest in the question of the abolition of the smoke nuisance, I shall feel much gratified if any one can prove that the law of the diffusibility of the gases is sufficient so to neutralise the above amount of carbonic acid gas as to render our London atmosphere wholesome under the above circumstances. I am, &c.,
GEO. WYLD, M.D.

6, Great Cumberland-street.

STEAM CULTIVATION.

Sir,—That part of Mr. Sidney's paper, read to the Society of Arts on the 9th inst., touching upon the application of steam to the tillage of the soil, appears to throw a damper upon its application to light lands, which, he says, are done at so little cost with horses that there appears but little chance for steam. Upon this point he and I differ. I believe it will be found that, within a very short time, there will be but few good light-land farmers who will not have and use a steam-cultivator of his own. Am I not supported in this view by Mr. Mechi, whom you report to have said that every farmer with 300 acres ought to have a steam threshing machine. Then, to have that, they must have got a steam engine; then, when it is not used in threshing, grinding, chaff cutting, &c., why should it not be used in tilling the soil when required, when nothing but a windlass, &c., and a few implements, comparatively costless, are required to start it. Here I will give a practical proof that steam can beat horses in cost on light land. It so happens that I have no light land on my farm, but that I had the good fortune to be invited, by the Royal Bucks Agricultural Society, to work my steam plough at their meeting, held at Newport Pagnell, in September last, and that they provided for its working a light gravelly soil wheat stubble field, on the farm of Mr. Rogers, of Lathbury, in which five men, with a boy to fetch water, and an eight-horse engine, ploughed, with my three coulter plough, five acres and a-half, eight inches deep, in five hours and forty minutes. The actual cost, including wear and tear, of this kind of work on my heavy land is 6s. 8d. per acre. All the filth was brought to the surface without being cut to bits. Mr. Rogers informed me that the clearing it off by hand, with forks, was comparatively costless, after which he put it in ridges with a ridging plough and two horses, and it is now like a perfect garden. Now I challenge any light-land farmer in England to produce the like result in the ordinary way at double the cost it has been to bring it to that beautiful state; I again say, why should not the engine that Mr. Mechi says every 300 acre farmer should have, be employed, when not otherwise required, in producing such results. The case above is not a solitary one. Lord Hatherton worked a set of my tackle on his estate at Teddesly, which is moderately light-working land, the whole of last summer. His lordship stated, at an agricultural meeting held at Stafford, in September last, that it had effected a saving of forty per cent. to him.

I am, &c.,
WILLIAM SMITH.

Woolston, Dec. 12, 1857.

Proceedings of Institutions.

Bucks and Berks.—The annual meeting of the Lecturers' Association was held at the Town-hall, Windsor, on Thursday evening, Oct. 12. The chair was occupied by the Hon. and Very Rev. the Dean of Windsor. The attendance was tolerably numerous, and among those present were the Revds. Lord Wriothesley Russell, H. J. Ellison, T. H. Tooke, E. Hale, C. K. Paul, Ellis, C. D. Goldie, Flint, Haviland, T. Carter, Hodson, S. Major, Cotton, J. S. Blunt, Gore, H. Hawtrey, S. Neville, A.

Douglas, W. C. Bromhead, J. A. Miller, T. H. Stevens, Esq., Captain Wilson, Messrs. Clode, Phillips, Menzies, Brown, of Slough, &c. From the report read it appeared that, "There are now in union with the Association six Institutes (Windsor, Staines, Slough, Beaconsfield, Amersham, and Chesham), eleven Reading-rooms and Libraries (Burnham, Maidenhead, Colnbrook, Eton, Chalvey, Cumberland Lodge, Taplow, Bier Lane, Clewer Lane, Windsor Working Men's Association, and Woburn), and four school or class-rooms (Bracknell, Clewer-road, Shaw Farm, and Windsor Night Schools). In the course of the past season upwards of sixty lectures have been delivered by members of the Association at the various Institutes, &c., in union. The circulating libraries of the Association, nine in number, and containing about 500 volumes, are in constant use. Six of these (the Prince's Library) were presented last year to the Association by his Royal Highness the Prince Consort. The Committee, considering the encouragement of classes, both in Institutes and Reading-rooms, to be the most effectual mode of carrying out the aims of the Association, and hoping also to obtain practical results from the lectures and libraries, offered the following prizes, which were distributed to the successful competitors at this meeting:—1. A gratuity of £2 to the Institute or Reading-room with the greatest number of pupils for classes (in proportion to the number of members) during the season of 1856 and 1857; awarded to his Royal Highness the Prince Consort's Reading-room, Shaw Farm. 2. A gratuity of £2 to the Class whose members during the same time have been most regular in their attendance; awarded to Cranbourne. 3. A present of books to the value of £1, to the pupil who has attended his class with the greatest regularity; awarded to John Chitty, Colnbrook. In addition to these, prizes were awarded to the most proficient candidates in the examination held at the Windsor Institute, of all members of Institutes, &c., in union with the Association. The candidates, nine in number, were separated into two divisions, according to the subjects in which they elected to be examined. The examination was conducted by W. Johnson, Esq., M.A., the Rev. W. Wayte, M.A., R. Maltby, Esq., M.A., T. H. Stevens, Esq., and Rev. E. Hale, M.A. The subjects of examination were arithmetic, geography of the British Isles, history of Henry VII. and Henry the VIII., writing from dictation, English grammar, and composition." After the adoption of the report, and the distribution of the prizes, the meeting proceeded to the discussion of the following subjects:—1. Night schools for lads and adults. The best mode of conducting them. The best mode of giving help from the Association. 2. Lectures in their relation to the class-room and the library. The Rev. H. J. Ellison opened the discussion on the first subject, in a few observations, in the course of which he observed that the various educational efforts made in this country could as yet only be regarded as a series of experiments. Among these the system of night schools occupied an important position. They were the offspring of necessity, consequent upon the early age at which children were removed from school. The rev. gentleman dwelt upon the necessity of making the night school a place of discipline, and in time the pupil would become convinced that this strictness was conducive to his own advantage. The Vicar then gave various reasons in support of his opinion that it was expedient to keep separate rooms for the instruction of adults and lads. He afforded illustrations of the disinclination often exhibited by the former to mix with the latter. The degree of discipline rendered necessary in the case of youth would be inappropriate in dealing with adults. Reference was made to cases in which ladies might, under certain circumstances, render much assistance in this work. It was highly important that the system of education should be such as to convince those taught that it was calculated to supply the deficiency which they felt. It ought not to be of a character to induce them to despise manual labour, but calculated to make them better workmen, as well as better men. The great advantages derivable from securing the co-operation of the employers of labour was also dwelt upon, and the Vicar concluded by pointing out how, by a judicious system of rewards, associations of this kind could materially contribute to the success of night schools. The Rev. C. D. Goldie expressed his concurrence in the general principles laid down by Mr. Ellison, but he adverted to the difficulties experienced in practically carrying them out in all localities. The Rev. C. K. Paul dwelt upon the difficulty of maintaining a constant interest in these schools. He had often observed this interest flag after the first year, and it was necessary to resort to extraordinary means to resuscitate it. The Rev. E. Hale, the honorary secretary, offered a few remarks on the best mode of rendering aid to night schools by means of this Association, and remarked that the committee would be glad to receive any suggestions from those interested in the subject. The Rev. H. J. Ellison then read a sketch which he had drawn up of prizes to be given by this Association. It included various rewards for good conduct, regularity of attendance, as well as for proficiency in various branches of education. After various suggestions had been made by Captain Wilson, Mr. Hale, Mr. Goldie, and other gentlemen, Mr. Ellison summed up the discussion, offering various suggestions as to the best mode of obviating the difficulties which had been alluded to with respect to the maintenance of discipline, securing efficient teachers, and keeping up interest in the school. The meeting then proceeded to the discussion of the second subject appointed for the evening—"Lectures in their relation to the class room and the library." This subject was opened by the Rev. T. H. Tooke, who endeavoured to solve the question whether the lectures delivered by this Association had, on the whole, answered the purpose intended. He arrived at the conclusion that they had, if a proper view were taken of the object of lectures. In his opinion they ought not to be considered as primary or principal means of instruction. Their chief use was that of exciting a further interest in the subject discussed, so that the knowledge acquired by means of the lecture might be further perfected in the class room, and by means of the library, After some lectures it had been found that the books in the library treating of the subject or subjects embraced in the lecture were in great demand. This he looked upon as a natural and proper effect of lectures. The rev. gentleman dwelt at some length on the importance of rendering lectures simple, intelligible, and of selecting subjects calculated to promote education and to elevate the classes for whose advantage this Association had been formed. The Rev. E. Hale offered some remarks on the advantage arising from inducing pupils to prepare abstracts of lectures. He also dwelt on the difficulty of securing courses of lectures, so as to concentrate attention on one subject until it had been, to a certain extent, mastered. He thought that when the lectures were weekly varied it had a tendency to induce more miscellaneous reading. In noticing the books successively taken out of the library by members of institutions it was not often found that a systematic course of study was pursued. The Rev. C. D. Goldie thought that the lectures would be more interesting if they were simple. Many competent gentlemen shrank from offering their services as lecturers because they imagined that something extraordinary was required of them. Mr. Brown, speaking from his experience of the Slough Institution, was of opinion that variety in lectures secured larger attendances. The Rev. J. H. Ellison was disposed to adopt a view unfavourable to variety. The great question was whether these lectures were intended for amusement or instruction. If the lecture was intended to create an interest in the subject, to inculcate knowledge, and to diffuse more than a smattering acquaintance with the subjects treated, he was decidedly of opinion that courses of lectures ought to be encouraged

After observations by Mr. Sanders on the general results of the lectures held at the Eton Reading Room, and by Mr. Passmore on the success attending the labours of the Windsor Working Men's Association, the Rev. S. E. Major, Rev. A. Douglas, and Mr. Stevens, of Eton College, offered various suggestions bearing upon the topic under discussion. Mr. Tooke, who introduced the subject, having briefly summed up, the Dean expressed the pleasure he felt in presiding over the deliberations of the meeting. He also bore testimony to the interest manifested by his brethren the clergy in the success of this Association. He thought considerable advantages would result if Eton College were to grant certificates to pupils of schools in connexion with these institutions similar to the certificates granted by the universities to middle class schools. The chairman also alluded to the deep interest taken by his Royal Highness the Prince Consort in the welfare of the Bucks and Berks Lecturers' Association. After passing a vote of thanks to the Very Rev. the Dean the meeting separated.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. No.

Delivered during the Vacation, 1857.

274. Public Libraries—Return.
263. Court of Chancery, &c. (Ireland)—Abstract of Return.
295. East India (Education of the Sonthals)—Copy of a Letter.
240. Bath City Election Petition—Minutes of Evidence.
303. Copyright (Colonies)—Return.
318. Hampton Court and Kew Gardens—Return.
338. Cathedral and Collegiate Churches—Return.
298. Military Savings Banks—Account.
275. Army—Account of Receipt and Expenditure for the year 1856.
276. Ordnance—Account of Receipt and Expenditure for the year 1856.
290. Assessment of Sugar—Return.
309. Gold (Australia)—Return.
339. Chapters—Return.
271. Orders of Knighthood—Account.
299. Redundant List (Public Departments)—Return.
308. Guano—Copies or Extracts of Correspondence.
242. Bury St. Edmund's Election Petition—Minutes of Evidence.
282. Episcopal Patronage—Return.
297. National Education (Ireland)—Return.
302. Order of the Bath—Return.
322. East India (Singapore)—Return.
344. Court of Chancery (Ireland)—Correspondence.
323. County Courts (1st January to 30th September, 1856)—Return.
324. County Courts (1st October to 31st December, 1856—Return.
220. Bank Acts—Report and Evidence, Part I.
279. Public Monies—Report.
255. Drogheda Election Petition—Minutes of Evidence.
265. County Treasurers (Ireland)—Account.
287. Lambeth Election Petition—Minutes of Evidence.
316. Bury Union (Workhouse Cemetery)—Correspondence.
317. Property Tax and Population—Return.
341. Bombay (Titles of Land Commission)—Returns.
342. East India (Liberty of the Press)—Copy of a Despatch.
293. Dublin City Election Petition—Minutes of Evidence.
49 (4). Trade and Navigation—Accounts (31st August).
163 (1). Wareham Election—Index to Minutes of Evidence.
187 (1). Galway Town Election—Index to Minutes of Evidence.
280. Revenue (Ireland)—Accounts.
311. Marlborough Election Petition—Minutes of Evidence.
233. Metropolitan Drainage—Report.
234. Metropolitan Board of Works—Report.
288. Poor Law (Ireland)—Returns.
243 (1). Beverley Election—Index to Minutes of Evidence.
262. Harbours of Refuge—Report from Committee.
326. Australian Mail Service—Return.
328. Local Board of Health—Return.
343. Election Petitions—Alphabetical List.
151. Bleaching and Dyeing Works—First Report.
273. Friendly Societies—Report of the Registrar.
291. Spirits—Accounts.
336. Pensions, &c. (Ireland)—Return.
241. Rating of Mines—Report and Evidence.
286. Coalwhippers Act—Lords Report.
49 (5). Trade and Navigation Accounts (30th September).
77 (B). Poor Rates and Pauperism—Return.
307. Colonial Government—Return.
321. Sittings of the House—Return.
294. Sale of Poisons, &c. Bill—Lords Report.
300. Army, Navy, and Ordnance—Detailed Accounts.
313. Education—Return.
148. Woods, Forests, &c.—35th Report of the Commissioners.
269. Contracts (Public Departments)—Report and Evidence.
312. Weights and Measures—Return.
319. Bank of England, &c.—Account.
77 (A 2). Poor Rates and Pauperism—Return.
246 (1). Westminster Bridge—Plans.
314. Contested Elections (Poor Law)—Return.
252. Hop Duties—Report.
224 and 260. Hudson Bay Company—Reports.
270. County and District Surveyors, &c. (Ireland)—Report.
327. Oxford University—Copy of Ordinances.
340. Railways (Amount of Capital, &c.)—Returns.
220 (1). Bank Acts Report, Part 2—Appendix and Index.
330. Electors (England and Wales)—Abstract of Return.
345. Vestry Clerks (Metropolitan Parishes)—Abstract of Return.
49 (6). Trade and Navigation Accounts (31st October).
346. Public Petitions—Return.
211. Bleaching and Dyeing Works—Second Report.
Honduras—Treaty of Friendship, Commerce, and Navigation.
China (Naval Forces at Canton)—Further Paper.
India (Mutinies in the East Indies)—Further Papers.
Tariffs—Return.
Trade of various Countries and Places—Abstract of Reports.
Public General Acts—Cap. 36-85, and Table.

Delivered 4th December, 1857.

1. Bank of England—Correspondence.

Session, 1857.

256. Paupers—Return.
301. Omnibuses and Cabs (Metropolis)—Return.

Delivered 5th and 7th December, 1857.

1. Bill—Bank Issues Indemnity.
East India (Mutinies)—Further Papers.

Session, 1857.

315. Seamen in Union Workhouses, &c.—Return.
337. Electors, &c. (Metropolis)—Return.

Delivered 8th December, 1857.

2. Public Income and Expenditure (Balance Sheet)—Account.
Spain (International Copyright)—Convention.

Delivered 9th December, 1857.

5. General Committee of Elections—Mr. Speaker's Warrant.
6. Police (Scotland)—Rules and Regulations.
East Indies (Mutinies)—Further Papers.

Session, 1857.

333. Parochial Elections—Abstract of Return.

Delivered 10th December, 1857.

3. Bill—Sir Henry Havelock's Annuity.

Delivered 12th December, 1857.

4. Bill—Oaths.
Agricultural Statistics (Ireland)—General Abstracts.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Dec.* 11, 1857.]

Dated 18th September, 1857.

2417. John May Munro, jun., of Bristol—An improved metal wheel-stock.

Dated 9th November, 1857.

2831. Alphonse René le Mire de Normandy, Judd-street, Brunswick-square—Improvements in the manufacture of soap.

Dated 13th November, 1857.

2836. William Devon, 4, Maryland-terrace, Stratford—An improved self-acting apparatus for flushing water-closets, and the means of connecting the same to water mains, part of which are applicable to the junction of gas or water pipes generally.
2859. George Sheppard, Fordingbridge, Hants—Improved machinery for cultivating land, or for cutting up and pulverizing the surface thereof.

Dated 16th November, 1857.

2872. Casimir Debax-Talabas, Castres, France—Improvements in lithographic printing presses.
2874. John Frederick Spencer, Brighton—Certain improvements in steam engines, and the apparatus connected therewith.
2876. Thomas Richardson, Newcastle-on-Tyne—An improvement in treating manganese ores.

Dated 17th November, 1857.

2878. William Gossage, Widnes, Lancashire—Improvements in the manufacture of certain kinds of soap.
2880. Daniel Foxwell, Manchester—The application of certain material for the backs of cards.
2882. George Tomlinson Bousfield, Loughborough-park, Brixton—Improvements in fire-arms, and in detonating compounds to be used therewith. (A communication).
2884. Richard Archibald Brooman, 166, Fleet-street—The manufacture upon circular frames of a fabric suitable for petticoats and other garments, and curtains and other articles of furniture, together with apparatus to be employed therein. (A communication).
2886. William Eardley Richardes, Bryn-Eithin, Aberystwith, South Wales—An improved war-weapon.

Dated 18th November, 1857.

2888. William Heward Bell, Pelton, Durham—Improvements in the permanent way of railways."

2890. Emile Alcan, Fore-street—An apparatus to be applied to looms for producing figured fabrics of all kinds. (A communication.)
2892. Andrew Frederick Germann, Frederick Gustavus Germann, and Joseph Germann—An improved propeller.
2894. Robert Clegg, Islington—Improvements in registering or indicating apparatus, applicable to the registration or indication of fares, the distances passed over by vehicles, the revolutions of machines or parts of machines, and other similar purposes.
2896. Philip Bettle, Messrs. Carley and Co., Ely-place—An improvement in the construction of watches.

Dated 19th November, 1857.

5897. William Smith, St. Paul's Corner, Norton, near Malton, Yorkshire—An apparatus for the purpose of protecting the turnip crop by destroying the turnip fly and other insects which are injurious to turnips and other plants.
2898. Charles Wye Williams, Liverpool—Improvements in steam engine boilers.
2900. Jean Baptiste Mirio, Paris—Improvements in the permanent way of railways. (A communication.)
2902. Reverend Theophilus Henry Hastings Kelk, Tonge, near Ashby de-la-Zouch—Improved metallic alloys.
2904. William Clay, Liverpool—Improvements in metal knees, employed in the construction of ships, buildings, railway or other waggons or carriages, or other analogous purposes.
2907. Reinhold Goedicke, 29, John-street, Bedford-row—The suspending of the lines of electric telegraphs in the air by means of gas balloons across water and land, or the atmospheric telegraph.
2908. David Melvin, Glasgow—Improvements in machinery or apparatus for manufacturing heddles or healds for weaving.
2910. John Edmund Burningham Curtis, St. James'-road, Croydon—Improvements in apparatus for filing papers and documents.
2912. Thomas Frederick Brabson, Birmingham, and George Hughes, Yardley, Worcester—Improvements in door springs.
2913. William James Cantelo, Camberwell—Improvements in the preparation and application of graves or cracklings for the purposes of animal food and manure.
2914. Benjamin Keightley, Lofthouse, Wakefield—An improved apparatus for indicating and registering the flow or supply of air to mines and other places requiring ventilation.

Dated 20th November, 1857.

2916. John Hinks and George Wells, Birmingham, and Joseph Letiere Petit, Aston, near Birmingham—An improvement or improvements in metallic pens.
2918. Henry Walker and James Beaumount, Sand Field House, Mirfield, Yorkshire, and Joseph Gothard, Huddersfield—Improvements in steam engines.
2919. Henry Page, Whitechapel-road—Improvements in the manufacture of sheet and crown glass.
2920. Pierre Alphonse Brussaut, Mont de Marsan, France—An improved anti-friction apparatus for shafts, axles, and other revolving surfaces.

Dated 21st November, 1857.

2922. William Archibald Cooper, Dungannon, Ireland—Improvements in the navigation of steam and other vessels.
2924. Napoleon Felix Boreiko de Chodzko, Paris—Improvements in furnaces for heating boilers.
2926. Samuel Hall, 19, King's Arms-yard, Moorgate street—An improvement in apparatus for igniting matches and other articles.
2928. James Wright, 19, Alfred-place, Newington Causeway—Improvements in the mode of treating madder for printing, dyeing, and distilling purposes, and also in the preparation and treatment of silk, cotton, and woollen cloth for printing and dyeing. (A communication.)

Dated 23rd November, 1857.

2930. Walter McFarlane, Glasgow—Improvements in moulding or manufacturing cast-iron pipes and other generally similar hollow articles.
2932. Charles Barlow, 89, Chancery-lane—Improvements in steam and air engines and furnaces therefor. (A communication.)
2934. David Hulett, 55 and 56, High Holborn—Improvements in cocks, taps, and valves, and in joints for pipes and tubes.

Dated 24th November, 1857.

2936. Thomas Coxon Wilkinson, Ashford, Kent—Improvements in pump valves.
2937. Joseph Schloss, 75, Cannon-street West—A so-called Diana lock or improved fastening.
2938. George Lowry, Salford—Certain improvements in machinery for heckling flax and other fibrous materials.
2939. William Searby, Newgate-street—An improved form of elastic spring, applicable to bedsteads, sofas, chairs, the padding and seats of carriages, and other similar purposes. (A communication.)
2940. Charles Sands, Felix-terrace, Liverpool-road—Improvements in stereoscopes.
2941. Augustus Frederick Butler, Ceylon—Improvements in machinery for pulping coffee.

Dated 25th November, 1857.

2943. Robert Willan, James Abbott, and Daniel Mills, Blackburn, Lancashire—Improvements in looms.
2945. Antoine and Jean Martin, Trieste—Improvements in cleaning, and in preventing the formation of deposits and incrustations in steam boilers.
2947. James Hogg, London—An improved safe or depository for cash, deeds, or other valuables.

Dated 26th November, 1857.

2949. William Thomas Manning, 20, Great George-street, Westminster—Improvements in the treatment of sewerage and in the apparatus employed therein.
2951. Charles Farrow, Great Tower-street—An improvement in fire-arms.
2953. Henry Woodward, Birmingham—A new or improved knife cleaner.
2955. James Higham and George David Bellamy, Plymouth—An improvement in the manufacture of soap.

Dated 27th November, 1857.

2957. Thomas Wheeler, Albion Works, Oxford—Improvements in machinery or apparatus for cutting turnips and other roots.
2959. William Elcock and Samuel Bentley, Wednesbury—Improvements in elbows used for joining wrought iron and other pipes or tubes, and in tools for manufacturing the said elbows.

Dated 28th November, 1857.

2961. Major Arthur Vandeleur, Royal Arsenal, Woolwich—Improvements in the construction of fire-places and passages for air of air furnaces, by which (without machinery) the intensity of the fire is increased, a saving of fuel effected, and the smoke consumed.
2963. Marc Antoine François Mennons, 39, Rue de l'Echiquier, Paris—An improved "tell-tale" clock or timekeeper. (A communication.)
2965. William Binns, Claremont-villa, Victoria-grove, Brompton—Certain improvements in the treatment and application of surcharged or superheated steam.
2967. William Massey, Newport, Salop—Improvements in guides or conductors to be applied to machinery or apparatus employed for winding or coiling chains, ropes, lines, thread, wire, or other similar articles.

Dated 30th November, 1857.

2969. Joseph Gardner and Richard Lee, and Henry George Pearce, Improvements for self-reefing sails.
2971. Henry Deacon, Woodend Chemical Works, Widnes Dock, near Warrington—Improvements in apparatus employed in the manufacture or production of caustic soda from liquors obtained in the manufacture of alkali, and applicable also to the manufacture or production of soap.
2973. John Palmer de la Fons, Carlton-hill, St. John's wood—Improvements in apparatus for retarding omnibuses and other carriages.
2975. Richard Archibald Brooman, 166, Fleet street—Improvements in casks and other vessels for containing liquids. (A communication.)
2977. Charles Goodyear, Leicester-square—Improvements in the manufacture of buoyant fabrics, which are applicable to the manufacture of garments, carpets, rugs, cushions, mattresses, bags, and various other useful articles.

INVENTION WITH COMPLETE SPECIFCATION FILED.

3023. Frederick Oldfield Ward, Cork-street, Burlington-gardens—Improvements in the manufacturing manure and obtaining accessory products. (Partly a communication.)—5th December, 1857.

WEEKLY LIST OF PATENTS SEALED.

December 11th.

1641. Josiah Latimer Clark.
1649. George Davies.
1657. George Lister.
1702. Thomas Lowell Ralph, and Thomas Lowell Ralph, jun.
1707. George Washington Charlwood.
1710. Stanislas Tranquille Modeste Sorel.
1719. William Edward Newton.
1761. Robert Mallet.
1840. Augustus Philibert Malard.
1857. Emanuel Ruegg.
2281. Joseph Gilbert.
2556. John Talbot Pitman.

December 15th.

1456. Edwin Travis and Joseph Louis Casartelli.
1668. Charles Vero and James Everitt.
1675. William Young.
1678. William Smith.
1687. William Barnard de Blaquiere.
1688. Richard Goulding.
1689. Philipp Kurten.
1708. Horace Hollister Day.
1712. Simon Pincoffs.
1722. William Wright.
1736. James Gascoigne Lynde.
1738. George W. La Baw.
1740. William Edward Newton.
1752. Daniel Evans.
1764. George Ireland.
1788. James Lamb Hancock.
1842. Thomas Moy.
1960. Thomas Ashton.
2242. Francis Preston.
2294. Thomas Gray and George Joseph Gladstone.
2344. William Geach.
2480. James Jackson.
2488. Thomas Crick and John Throne Crick.
2588. Jonathan Parker.
2614. Charles Coffey Alger.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

December 7th.

2604. William Grindley Craig.

December 8th.

2593. Edward Maniere.
2602. William James Harvey.
2630. Jas. Redgate, Jas. Thornton, and Edwin Ellis.

December 9th.

2632. Llewellyn William Evans and James McBryde.
2671. William Porter Dreaper.
2686. Richard Whytock and Thomas Preston.

December 12th.

2605. Isaac Dodds.
2610. Christian Henry Rd. Ebert and Lippman Jacob Levisohn.
2643. Luke Turner.
2692. William Bertram.
2697. Jabez Smith.