**On the relations of technology to agriculture / by George Wilson.**

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# RELATIONS OF TECHNOLOGY

TO

# AGRICULTURE

BY

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(*Address to a Monthly Meeting of the Highland and Agricultural Society, January* 16, 1856.)

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I SHALL take for granted in what I have to bring before you, that the Members of this Society, which has taken so zealous an interest in the establishment of an Industrial Museum here, and has farther shown its good-will by the gift to it of a valuable series of specimens, need no minute information concerning its origin, or that of the Chair of Technology, which goes with its Directorship. It is one of those institutions which had become necessary by the altered condition of the world, and the felt wants of all the intelligent sections of the community. Yet such an altered condition required to be clearly realised, and such wants to find a voice, before any steps could be taken to satisfy either the perception of a great social change, or the sense that it demanded from us an effort uncalled for before.

Setting aside altogether political causes of social alteration, which are beyond the pale of discussion here, the steam-ship, the railway, and the electric telegraph, have revealed to us the unsuspected progress which the other great nations of the earth have been making in the industrial, as well as in the other arts; and whilst those great producers of mutation have opened to us the whole civilised world, they have also let in the whole civilised world upon us.

A perception of the risk we run of being left behind in the honourable rivalry of races, an honest admiration of the superior

skill in certain arts which belongs to other peoples, and the deep conviction that the qualities of heart and intellect which have given us our place among the nations, are still, by God's favour, possessed by us, have led to the foundation of the Industrial Museum of Scotland, as one means of enabling us to learn what we need to know, and to teach what we wish to be known. No public body has done more to bring about this than the Highland and Agricultural Society, and no members of that Society have contributed more to this result than its former President, the Duke of Buccleuch, and its present able and energetic Secretary.

It is, accordingly, with the full assurance that I shall not address indifferent or unwilling listeners, that I avail myself of the opportunity now afforded me to explain, as Director of the Industrial Museum, in what way Technology may be expected to benefit agriculture.

I am met at the outset by the strangeness of the term *Technology*, which has not yet found its way to the hearty appreciation and sympathy of all. This is not to be wondered at. A living language is continually receiving additions of words, but by a process so gradual, that the advent of single terms is scarcely matter of observation among the public at large. Constant repetition will accustom us to any word, especially if it occur incidentally in the exposition of some matter in itself of engrossing interest, and be left to find its way to general reception without criticism, whether in the way of commendation or disparagement.

Witness the readiness with which all ranks of the community have learned the names of places, persons, and things connected with the Russian war, so that every one has on his lips Sebastopol, Balaklava, Kertch, Renkioi, Cronstadt, Helsingfors, Gortschakoff, Todleben, Pelissier, Della Marmora, Redan, Malakhoff, and the like. Witness also the complacency with which such terms as daguerréotype, photograph, calotype, gutta-percha, hydropathy, phrenology, have been received into our language. We have already forgotten how unwelcome, when first heard, most of those words were to us, and how unconsciously we have made them part and parcel of our language. In truth, we have learned them, as we learned our mother-tongue in childhood, by continually hearing and continually repeating them, as words for which there existed no substitutes, and whose full sound and full meaning could be acquired only by degrees.

A solitary, strange word, however, especially one which we are not compelled by necessity to employ, cannot thrust itself at once into acceptance with the community. "Technology" must wait patiently; and till the reality which it represents is more fully brought before the public, the title of that reality cannot be matter of interest. I will only, therefore, say of the word, that for many

years it has been employed on the Continent, and more recently in Great Britain and America, to signify "The Science of the Useful Arts." No more euphonious or familiar term has been suggested as equivalent in meaning; it would be difficult to find one; and into its derivation from certain Greek roots I will not enter. Its present meaning is in conformity with its derivation, but is not the only meaning which it might bear. This, however, need not concern us.

No member of this Society, I imagine, would refer an intelligent foreigner, unacquainted with Greek or Latin, to the derivation of the word *Museum* as likely to assist him in apprehending what is the object of the Society's Museum.

The dictionary, if consulted, would explain that Museum meant "the temple or haunt of the Muses;" or a "school presided over by the Æsthetical Goddesses;" or, since the days of Ptolemy Philadelphus, B. C. 280, "an institution for the promotion of learning and the support of learned men."

Now, far be it from me to say that the Muses never haunt the Highland and Agricultural Society's Museum; or that the æsthetical goddesses are not interested in its welfare; or that it has not promoted learning, or helped to support learned men; but these are not exactly the ends which it deliberately aims at securing; and our foreigner would not be much assisted in appreciating the treasures of the Museum by a knowledge of the etymology of its name. Neither probably should we be by studying the derivation of "Technology."

Let us take the word "Technology," then, without further criticism. Understood as signifying the "*Science of the Useful Arts*," it of course includes not one, but many sciences, and complaint has been made that it is thus inexplicit. But all inexplicitness separable from the subject will be removed, if it be kept in view that the Professorship of Technology and the Directorship of the Industrial Museum go together.

The duty of the one office is to collect, arrange, and preserve the objects, products, and instruments of industrial art: the duty of the other office is systematically to expound these within the walls of the University. This, however, let it be observed, is simply a University arrangement, like that which conjoins the offices of Professor of Natural History and Keeper of the Natural History Museum, and those of Professor of Botany and Keeper of the Botanic Garden, and does not exhaust the duties of the Professor of Technology.

And here it may prevent misunderstanding if I explain that, whilst the Industrial Museum is associated with the University, it is distinct from it, and included in the department of Science and Art of the Board of Trade, under whose instructions I act as Direc-

tor of the Museum. With a view to prevent the needless multiplication of similar collections, and to secure economy in the expenditure of public money, and not less to secure for the Museum the important assistance which the Professors of the University can give to an institution more or less connected with all the sciences, it was deemed desirable to associate it with that academic body.

By this arrangement, also, the Natural History Museum has been transferred to the possession of the Board of Trade, and becomes in consequence open to the public. When the new buildings are erected, it is intended to arrange the Natural History objects and the Industrial collections together, or in close proximity; so that, for example, the geological relations on the one hand, and the economical relations on the other, of coal, limestone, sandstone, ironstone, and the like, may be studied by those to whom the purely scientific or the purely industrial aspect of these minerals is alone interesting; whilst the many who desire to make themselves familiar with both aspects, will find the means of doing so under the same roof, and guided by a system of arrangement which contemplates their twofold study.

The object of the Industrial Museum will thus be, to gather together all that pertains to useful art; and I will now attempt to show how Technology, the science of useful art, will benefit agriculture. This may perhaps be done better by an indirect than a direct, exposition.

Agriculture, in the wide sense in which this society encourages it, occupies the front rank among the useful arts. We believe this in peace; but we only perhaps, fully, realise it in war, when we see cities which have defied fire and sword, open their gates at the summons of famine. The definite aim of scientific agriculture I understand to be the production, season after season, from a given area of land, of the largest amount of vegetable and animal food, within the shortest period of time. Before, however, Time can be shortened, Space diminished, and Food increased, the aid of many sciences and of many arts must be called in; and the skill which only experience can give, must guide the agriculturist in availing himself of their assistance. Such experience I assume him to possess in the fullest; and I shall not discuss the purely scientific applications of astronomy, geology, mineralogy, botany, zoology, natural philosophy, meteorology, and chemistry, to agriculture. A knowledge of the laws determining the seasons, the tides, the winds, the rains, the temperature of air, of land, of water—the conversion by natural processes of certain rocks into fertile soils, and of others into barren ones—the extinction or excessive development of useless or destructive plants and animals, and the converse prevalence of disease among those which are harmless and useful—and much else—would, according to the judgment of all intelligent men, be of the

greatest service to the farmer. But it does not fall within the scope of an Industrial Museum to furnish illustrations of natural laws, however important, which we cannot press into our service and make the foundation of useful arts, except in so far as approved and practically available forms of such instruments as the thermometer, barometer, rain-gauge, and the like, may form part of the collection of instruments.

The great object, however, of the Industrial Museum will be to illustrate the application of science to the determination of the qualities of existing raw or initial materials, to the discovery or production of new ones, and to the derivation from familiar and from novel substances, of bodies serviceable in the arts.

Thus, to make apparent the benefits which Technology may confer upon agriculture, let us begin with the *Buildings on a Farm*, including the farm-house, cottages, offices, stables, byres, and out-houses; taking along with them, garden-walls, and all other erections involving mason-work. We will suppose a large tract of land newly brought into cultivation, and that a farm-steading is about, for the first time, to be erected upon it. A multitude of questions at once arise, which it is not the province of the agriculturist of any class to answer. Shall the walls of the several buildings be of stone, or brick, or partly of both? In so far as they are of stone, shall granite, or whinstone, or sandstone, or limestone be preferred? Supposing all of those equally attainable, what considerations should determine a choice of one of them, rather than of another? How far do they differ in hardness, compactness, durability, permeability to moisture, tendency to stain, or discolour, and indifference in general to the action of rain, wind, and weather, and to what extent are some of them more quickly, cheaply, and neatly quarried, chiselled, carved, and polished than others? Whether, if the choice be between two kinds of rock only, is granite preferable to whinstone, or sandstone to limestone, as a building-material? If the choice be restricted to sandstones, will it make any difference whether the rock selected belong to the old red sandstone, the new red, or the sandstone of the coal formation? If but one of those sandstones be accessible, how far will the presence of clay, lime, magnesia, iron and coaly matter, affect the building-value of one bed of rock, as compared with another from the same or a similar quarry? If we must choose among limestones, should we prefer the dark or the light coloured, the shelly, the earthy, or the crystalline; those which are purely calcareous, or the magnesian limestones?

Those questions might be greatly multiplied, but this is needless. The problems referred to are some among the many which all must encounter who select building-materials, and as yet we can but imperfectly solve most of them. Now, one object of the

Industrial Museum will be to collect specimens of all the building-stones of Great Britain, and, as far as shall prove possible, of the world. One object of the Analytical Laboratory attached to that Museum will be the analysis of such stones, with a view to discover how good and bad building qualities stand related to the presence or absence of certain ingredients; and one important duty of the Professor of Technology will be to make the results of such researches known by lecture, exposition, and publication to the entire community.

Again, having selected a building-stone, we propose to build; but difficulties arise regarding the mortar. What kind of lime is best for making mortar? what kind of sand? and in what proportion is it best to mix them? Is it true that walls cemented by mortar containing sea-sand are always wet, and that if we wish dry walls we should select pit sand, whatever its quality or cost may be? This last problem is still a vexed one, and it is only one among many, the solution of which will demand the examination of a large collection of old wall mortars, and many experiments on the properties of sand, lime, concrete, plaster, and cement. Suppose such questions provisionally settled, we find similar ones to encounter in reference to the external roofing of our walls. Shall we take slabs of stone, or wooden shingles, or slates, or tiles, or thatch, or galvanised iron, or lead, or zinc, or felt, or glass? There are special good qualities in each of these, and an Industrial Museum, by exhibiting systematically-arranged specimens of all, would furnish one important means of enabling agriculturists throughout the country to choose intelligently among them.

Again, there must be much wood-work, brick-work, and metal-work in our farm-buildings. In so far as the Agricultural and Botanical relations of timber-trees are objects of illustration in the Museum of this Society, and of the Botanic Garden, it will not be necessary to include them in any other collection within the walls of the city. There are economical relations of wood, however, of importance to the agriculturist, with the illustration or exposition of which neither the Highland Society nor the Professor of Botany charge themselves: these would fall within the scope of the Industrial Museum and the Professor of Technology. Such, for example, are the mechanical bending of trees or large boughs into shapes suitable for the knees of ships, or the girders of roofs and bridges, now practised on the large scale; the rapid drying of wood by the action of air or super-heated (*i.e.* highly heated *dry*) steam; its impregnation with chemical substances so as to season it; or to give it a colour resembling that of more costly and more highly prized woods; or to confer upon it greater hardness and solidity; or by their antiseptic and poisonous character to remove its liability to suffer from wet-rot, dry-rot, and the invasion of fungi and in-

sects. The derivatives of wood, also, such as bark for tanning, charcoal, tar, resin, turpentine, wood-vinegar, wood-spirit, and wood-ashes, which are all of them important as affecting the market-value of timber, would, as contents of an Industrial Museum, be indirectly of interest to the agriculturist.

Leaving wood, however, which we were looking at only in its immediate application to building purposes, without further notice, I may pass without lengthened reference over brick-work and metal-work. It would be vain to attempt showing in a brief address the interest which the agriculturist has in Fictile and Metal manufactures. Bricks for the partition-walls and garden-walls, tiles for the floors, pipes for the drains, cans for the chimneys, must all be chosen, and cannot be chosen wisely, unless opportunity is afforded for examining samples made from different clays, at different works or potteries, and fired and glazed in different ways. Of these an Industrial Museum should contain a full series, including the clays, and other materials employed in their manufacture, and in addition, of course (though that is foreign to the question of building-materials), all the long series of objects for household use or ornament which are included under earthen-ware, stoneware, porcelain, and china.

On metal-work similar remarks may be made. What an interest all agriculture has in the single metal Iron! Without it, how low would be the condition of British farming! Yet, in employing iron, as a substitute for wood and stone, the agriculturist must be dependent for information, in reference to its strength, safety, durability, and cheapness, on others than members of his own profession.

To finish the skeleton of our imaginary farm-building, we must consider the mode in which it shall be lighted by day, and this cannot be wisely done without a knowledge of the properties of Glass, so that the opportunity of inspecting a large series of specimens of this substance, and of learning the relative value of different kinds of it, cannot but be serviceable to every house-builder.

It thus appears that those five things alone, stone, wood, clay, metal, and glass, would, in their building relations, suffice to give the agriculturist a practical interest in an Industrial Museum and in Technological disquisitions on its contents; but if we add under clay and glass his great employment of vessels made of both, and under metals all his metallic machines and implements, from the steam-engine to the weeding-hook, it would be difficult to exaggerate the service which a full Industrial Museum and a befitting exposition of its contents would render him.

Our farm-house being completed, it will be necessary to conduct water into it. There may be choice between very soft water, like that which gathers in our Highland lochs, or water of curable hardness, like that of the English chalk districts, and some of our well-

waters, or water incurably hard, like that containing dissolved gypsum, which the deep wells of our own city and of other localities supply. The agriculturist has a direct interest in the quality of the water supplied to himself and his household, and all questions referring to that I assume to be disposed of by his Medical Attendant. He has a direct interest also in the quality of the water supplied to his cattle, and to that the veterinary surgeon will look. If both are at fault, he can fall back upon the chemical analyst, and, if a member of the Highland and Agricultural Society, may avail himself of the services of its very accomplished chemist, Professor Thomas Anderson.

Supposing the choice of water (where there is a choice) determined, we have still to settle how it shall be conveyed and stored. Should the water-pipes be of lead, or iron, or zinked iron, or tin, or gutta-percha, or glass, or porcelain, or of some other material? Are the cisterns or tanks best made of wood, or stone, or iron, or zinked iron? and how may both pipes and cisterns be prevented from the corroding action of waters of one class, and the encrusting action of waters of another? These are not fanciful difficulties. One of our large cities is still doubtful as to the propriety of bringing in a corroding soft water through lead pipes; and another contemplates the abandonment of iron pipes, because they are filled up by water of the same character; whilst galvanised or zinked iron is undergoing trial throughout the country and on shipboard, as a safe substitute for lead, alike for pipes and tanks or cisterns. Now a series of long-used water-pipes and cisterns, exhibiting the action of soft, transiently hard, and permanently hard waters, would largely assist all interested in those matters. A collection of such objects is being made for the Industrial Museum.

The water-question disposed of, there arises the not less important question of Fuel, and with it the inquiry, How shall the farm-house and its appendages be heated and ventilated? Where there is a choice, should wood be preferred, and what kind of wood; or charcoal, and from what source; or peat, and what kind of peat; or coal, and which of the multitude of widely differing varieties of that mineral; or artificial fuel? and what are the considerations which should guide us in selecting fuel for the parlour fire, the food-boiler fire, and the furnace of the steam-engine? It should largely contribute to the practical disposal of those questions, that an extensive collection of the fuels of the world, systematically arranged with reference to their geographical and geological position, their chemical constitution, their heating and lighting power, and their economical value, could at all times be examined in the Industrial Museum, side by side with grates, stoves, and furnaces, or models and drawings of these illustrating the most approved methods of burning fuel, and of preventing or consuming smoke.

Closely allied to the question of artificial heating is that of artificial lighting. How shall the farmer most cheaply and effectively turn night into day? Will candles serve best, and, if so, what kind of candles? or oil, and what kind of oil? or will it be better to erect a gas-work on the farm, and depend mainly on gas for illumination? or is it the case that the electric light is the best and cheapest of all lights?

To answer these questions will be one important duty of the Professor of Technology, and the Industrial Museum will afford large space for the objects supplying the means of answering such queries. A collection has been commenced, which, when completed, will enable the agriculturist to judge of the relative value of candles made in whole or in part from tallow, from African palm-butter, Ceylon cocoa-nut oil, Borneo vegetable tallow, Brazilian palm-wax, and Chinese insect-wax, from the paraffine derived from the bituminous shales of the Continent, from the coals of our own country, and the peats of Ireland. A similar collection is being made of the animal, vegetable, and mineral oils, and the inflammable liquids suitable for burning in lamps, and of the materials economically available for the production of illuminating gas. Along with these will be placed lamps, models or drawings of gas-works, the apparatus for the electric light, and galvanic batteries.

Such are a very few of the ways in whichTechnology can in one direction assist agriculture. I have selected them as illustrative, not as exhaustive, of the relation of the science of all the useful arts to the one pre-eminently useful art, Agriculture.

Nor need I enlarge upon the manufactures in which the agriculturist has a direct interest, as himself supplying the raw material for them. The consideration, for example, of the cultivated grains and roots leads directly to the manufacture of starch, sugar, alcohol, vinegar, and the arts of baking, brewing, and distilling. The cultivated grasses, along with flax, hemp, the cotton-plant, the trees yielding jute, and other textile fibres, involve the arts of spinning, weaving, bleaching, dyeing, calico-printing, and beyond these the arts of paper-making, letterpress-printing, engraving, lithography, and many more.

In connection with animals, putting aside their immediate use as food, and the value of the manures derived from them, we have the application of their skins in the manufacture of leather, parchment, vellum, glue, size, and gelatine; the application of their horns and hooves to the manufacture of combs, spoons, cups, and the like; the application of their bones to similar manufactures, and also in the production of hartshorn, ivory-black, and phosphorus; and the application of their blood and offal, when not otherwise employed, to the manufacture of prussiate of potash, prussian blue, and other dyes and pigments, and to the artificial

production of nitre. Having an eye also to the agriculture of the world, I refer, in as many words, to the important insect derivatives, honey, wax, silk, shell-lac, cochineal, and carmine, and to the arts to which they minister.

All the trades, arts, and manufactures referred to are based upon the cultivation of the soil. As the money-profit of agriculture must largely depend upon the value of the products which it directly or indirectly furnishes to the markets of the world, the farmer plainly has a deep interest in the uses to which his produce is put by the followers of other callings, and these uses he can nowhere so intelligently learn as in an Industrial Museum.

Farther, the cost of producing a cart of hay, a waggon-load of turnips, a sack of wheat, a Christmas turkey, a well-fed lamb, or a fat ox, varies of necessity with the cost of the materials required for its production. Now, these materials are in demand for the production of other commodities, and the agriculturist has an interest in knowing what these commodities and who their producers are. Let me illustrate this by an example or two.

The bones of animals have a high agricultural, and therefore a high commercial value. The farmer of Great Britain would be glad to have all the dead animal bones in the world at his disposal. But in the bone-market he must purchase against many competitors. The price of bones is raised against him by

*Firstly*, The ivory-turner, who converts them into spoons, brush-handles, buttons, and ornaments.

*Secondly*, The glue-maker, size-maker, or jelly-maker, who extracts their gelatine from them.

*Thirdly*, The sugar-refiner, who requires them for the ivory-black with which he bleaches his syrup.

*Fourthly*, The refiner of metals and assayer of gold and silver, who finds the powder of calcined bones superior to everything else as a material for his *cupels*, those peculiar cups and basins in which precious metals, and especially silver, are separated in the furnace from the common metals, such as lead and copper.

*Fifthly*, The manufacturer of porcelain, who has long ago discovered that calcined bones greatly improve the quality of china, so that in Staffordshire they find their way to the potter much more readily than to the farmer.

*Sixthly*, The lucifer-match maker, who employs bones to yield phosphorus, and whose manufacture, insignificant though it may appear to be, is sufficient, in England alone, to divert shiploads of bones from the farmer.

*Seventhly*, The pharmaceutical chemist, who prepares from bones, phosphoric acid, phosphate of soda, and the other phosphates used in medicine.

Here are seven competitors in bone-buying against the farmer. A great extension of any of their trades must raise the cost of

bones to all who employ them. The abandonment of the use of bones in favour of some other raw material by any of those trades, would lessen their cost to all the others. The discovery of a source of phosphates other than bones would equally lessen the competition for them. The farmer has thus an interest in watching the doings of the ivory-turner, glue-maker, sugar-refiner, metal-refiner, porcelain manufacturer, lucifer-match maker, and pharmaceutical chemist; and the systematically-arranged bone products of a Technological Museum, would largely furnish him with the means of observing the development of rival professions.

Again, there are patents enrolled for distilling ammonia from guano, which at present are not turned to account because guano is too dear, but if its price fell, they would at once come into operation. The farmer has thus a direct interest in encouraging the production of ammonia from other substances than guano,—as, for example, from gas-liquor, which is of less value to the farmer than the manure in question, but which, nevertheless, as I think Dr Anderson has already pointed out to the Society, is at present in many quarters used by nobody, being literally thrown away from the smaller gas-works in the country.

Again, nitrate of soda is *comparatively* cheap, because from its tendency to absorb moisture, and its slower evolution of oxygen when melted, it cannot be used as a substitute for nitrate of potash in the manufacture of gunpowder; but it serves better than nitrate of potash for the preparation of nitric acid; and everything therefore that leads to the increased consumption of this acid, will raise the price of nitrate of soda for the farmer. Further, in a time of war like the present, when gunpowder is costly and in great demand, it is worth while to convert nitrate of soda into nitrate of potash; and a few weeks only have passed since an Order in Council put a stop to the exportation, as contraband of war, of certain apparently innocent potash-salts extracted from kelp, which Government had discovered were employed on the Continent to convert nitrate of soda into nitrate of potash for Russian gunpowder. Thus the cost of gunpowder and of nitric acid affects the value of one of the most highly-prized fertilisers in use among agriculturists.

Once more: it might seem, at first sight, as if the agriculturist had no very special interest in the price of sulphuric acid. But how does the case stand? Sulphuric acid is prepared from sulphur, and all our sulphur comes from Sicily. Political changes, or the fortunes of war, may any day cut us off, as they have done before, from Etna as a source of sulphur. In that case the farmer would immediately experience an increase in the cost of all the articles—and they are very numerous—in the manufacture of which sulphuric acid is employed. Thus, super-phosphate of lime, sulphate of ammonia, sulphate of soda, sulphate of magnesia, and all the other

sulphates used as fertilisers, except perhaps sulphate of lime, would at once rise in value. So would washing-soda and soap, and with them all bleached and dyed goods, for bleaching and dyeing would be more expensive. So would glass, vinegar, spirit of salt, ether, chloroform, and many less important but yet useful substances which require sulphuric acid for their production.

The evils I am referring to were partially experienced some twenty years ago, and led in part to the substitution of iron pyrites (the bi-sulphuret of iron) for sulphur as a source of sulphuric acid. A recurrence of these evils is apprehended, and I have very recently sent to an intelligent inhabitant of Iceland the results of an examination of its volcanic sulphur, which may yet come into competition with the sulphur from Sicily. It would not then be waste of time for an intelligent farmer to study in the Industrial Museum all the Technological relations of sulphur, for he has plainly an interest in its sources being multiplied, and its products or derivatives being cheapened.

On the direct relation of Technology to agriculture I will say no more; but allow me a few words on their indirect relation to each other. Hitherto I have spoken as if the sole question for consideration were, how the single farmer could be made a wealthier and more comfortable person; but I know that I should do the greatest injustice to the Society of which I have long been a member, if I addressed my fellow-members as actuated only, or even largely, by a selfish, utilitarian spirit. I know, on the other hand, that these and the other meetings of this Society are rallying-points for all those Scottish agriculturists who love their profession as a profession, who are actuated by a high *esprit de corps*, and who seek to improve not only their own farm, or their own parish, or their own shire, but the whole country, and through it the entire world.

The recent munificent free-will gift of the Agricultural Statistics of Scotland to all the competing nations of the globe, is proof sufficient of the generous spirit in which this Society encourages useful knowledge: but I recall also the project warmly entertained by this Society some years ago, and not yet, I presume, abandoned, of elevating the standard of education among the younger members of the agricultural profession, by giving its diploma as a certificate of merit to all who should pass creditably an examination, after some two years of study in such branches as Botany, Chemistry, Veterinary Science, Mechanical Science, and one year's work on a farm.

Without obtruding my opinion on the advisability of such a project being carried out, I refer to it now, because the same feeling which led to its entertainment, will lead to the encouragement of Technology and the Industrial Museum.

It cannot but be of service to a young man about to follow the profession of agriculture, to have the means of studying the sources,

the objects, the processes, and the products of all the other manufactures of the country. It cannot but sharpen and strengthen the very faculties which will be most needed in his own calling. It cannot but expand his mind and quicken his sympathies, to possess an intelligent appreciation of the learning, patience, perseverance, faith, courage, ingenuity, inventive skill, and manipulative dexterity which have made other professions great and famous, and which, transferred to his own profession, will make it greater and more famous than it is. And apart from this, are not such arts as photography and the electrotype; such devices as the electric telegraph, the electric light, and the time-ball; such machines as the railway locomotive, the screw-propeller, and the steam-hammer, besides a hundred others, worth the study of all who wish to realise what a wonderful worker, with all his defects, Man is?

For those reasons, and for many more which I do not particularise, I ask you, if you acknowledge any justice in what I have said, to look with favour on the Industrial Museum.

That Museum is budding into existence, and additions are daily made to it; but I have at my disposal, for its contents, no fit accommodation. There is room enough, no doubt, within the walls of the Trades Maiden Hospital, and under the roof of Argyle Square Chapel, but these are only suitable as receiving-houses, and the latter building must be taken down as soon as the erection of the new Museum is commenced; so that, unless its erection is to be very long delayed, it would be folly to fill the chapel with specimens. Little good can be done till proper galleries be provided. These are imperatively demanded by the present condition of all the museums in Edinburgh. Within the walls of the University, a very large number of important objects of natural history are, from sheer want of space to exhibit them, shut up from view in boxes. The Professor of Anatomy has almost ceased to expend money in adding to the splendid collection of Comparative Anatomy (most important in reference to geology) which he has accumulated. There exists at present no building in our city where either resident or stranger can practically acquaint himself with the geology and mineralogy of the country. The Museum at the Botanic Garden is already straitened for room, and this Society's Museum is in the same case.

It is, accordingly, with no selfish or restricted object in view that I urge the desirableness of encouraging the erection of the proposed new Museum. I have no reason to think that Government would grudge the sum, if aware of the pressing necessity for its expenditure. All the money that is required would not sensibly increase the year's estimates of the Commons, or tell upon the sufficiency of the military chest. We cannot, however, expect money to be granted unless we ask for it; and I have heard but two arguments against asking a grant.

The one is, that a war-time, with doubled income-tax, and the prices of all commodities raised, is not the period when grants of public money should be asked for peaceful undertakings which are not imperative.

Now, if the sum of money needed for the Museum would, by its diversion from our army and navy, appreciably lessen our power to fight effectually the just battle of our country, then it would be most culpable and cowardly to ask for it; but no well-informed person imagines that a grant of £10,000 or £20,000 a-year till the Museum be completed, would cripple our fleets and armies, or exhaust the resources of our Treasury. This argument, therefore, I put aside.

The other is, that the public mind is so occupied with the events of the war, that it is idle to expect the mass of the community to be interested in the prosperity of such an institution as an Industrial Museum. This conclusion I believe to be the very opposite of a true one. Just because we are at war, are we likely to excel in peaceful pursuits. The excitement occasioned by intense sympathy with our brethren in arms, and continually fostered by news from the battle-field, compels us to active thought and work; and the activity which cannot expend itself in bloody combat, is expended on peaceful labour.

A civilised people fighting of its own free-will for a cause which commends itself to its heart and conscience, will carry into all its acts, so far as it can, the courage, energy, sagacity, and devotion which are the pre-eminent virtues of the soldier and the sailor. It is as much in keeping with one great natural law, that the industrial arts of peace should flourish at home because the destructive arts of war flourish abroad, as it was in keeping with another great natural law, that the snowdrops and violets which last spring so quickly covered the fields of Alma and Balaklava, were richer in colour, and sweeter in fragrance, because their roots were watered with the precious blood of the slain. All history shows that a season of international conflict is a season of intellectual activity, and that, whatever be the evils of war, intellectual work of all kinds goes on well at such a time. Moreover, the close of a war, however successful, must be followed by a reaction of disappointment, and a season of political discontent. We should be prepared, when peace comes, not to ask for money, and to begin building a Museum, but to throw open a more or less fully equipped one, as a School of Instruction for those whose warlike occupations will then be gone, and a place where all may learn the arts of peace.