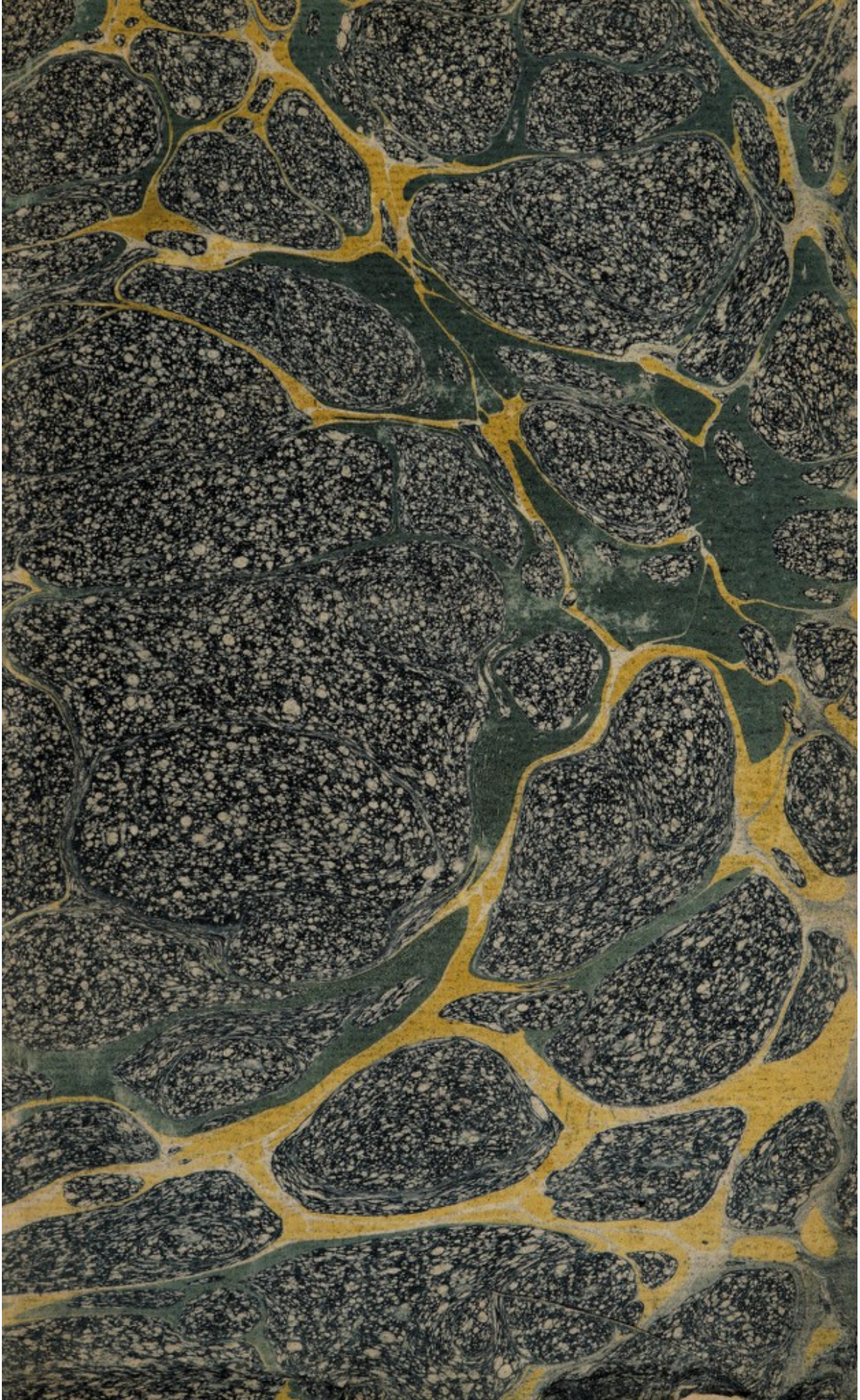
An introductory lecture to a course of chemistry : read at the Laboratory in Oxford, on February 7, 1797 / [Robert Bourne].



AN

INTRODUCTORY LECTURE

TO A

COURSE OF CHEMISTRY:

READ AT THE

LABORATORY IN OXFORD,

ON FEBRUARY 7, 1797,

BY

ROBERT BOURNE, M.D.

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ONE OF THE PHYSICIANS TO THE RADCLIFFE INFIRMARY,
LATE FELLOW OF WORCESTER COLLEGE,
AND FELLOW OF THE COLLEGE OF PHYSICIANS IN LONDON.

OXFORD:

Sold by Messrs. FLETCHER and Co. and J. COOKE;
And Messrs. RIVINGTON, St. Paul's Church Yard, London.

M.DCC.XCVII.

IMPRIMATUR,

SCROPE BERDMORE,

COLL. MERT.
Mart. 2, 1797.

VICE-CAN. OXON.

TO

THE REVEREND THE VICE-CHANCELLOR,

THE HEADS OF HOUSES,

AND

THE MEMBERS

OF THE

UNIVERSITY OF OXFORD IN GENERAL,

THIS LECTURE

IS VERY RESPECTFULLY AND GRATEFULLY

INSCRIBED,

BY THEIR MOST OBEDIENT SERVANT,

ROBERT BOURNE.

GENTLEMEN,

BEFORE I proceed to the ſcientific diſcuſſion of the ſubject of my Lectures, I think it right to employ one evening in offering ſome obſervations on the Utility of Chemiſtry, and in ſubjoining a few words on the object at which the Lectures will principally aim.

In ſpeaking on the Utility of Chemiſtry, I ſhall not ~~make too free an uſe of~~ the licence, frequently aſſumed by public Readers, of delivering a panegyric on the art or ſcience which they profeſs to teach, to the diſparagement of other, equally, or perhaps more important branches of knowledge. But to aſſert the juſt claim of Chemiſtry to notice is commendable in any lover of the ſcience; it is a duty which a perſon, ſituated as I am, owes to thoſe who favour him with their attendance. Our earneſtneſs in the purſuit of any ſtudy is, in general, proportionate to the plea-

ſure or advantage which we expect to reſult from its cultivation. Where there is the proſpect of recompence in one way or other, we can engage in literary or ſcientific labours with ardour; where there is no ſuch proſpect, the mind is ſeldom active in its exertions. A Lecturer, therefore, is ~~acting a proper part~~ towards his Hearers, when he ſtates to them the fair pretenſions that the art or ſcience, which it is his province to explain, has to their regard; let him convince them that it is deſerving of their attention, and then they will probably be attentive, unleſs he himſelf is deficient either in induſtry or capacity.

It was, on many accounts, unfortunate for Chemiſtry that its early cultivators, ſince the revival of Learning, directed the knowledge, which they had of its principles, to the ſolution of one or both of the following problems, *viz.* the tranſmutation of the baſer metals into Gold, and the diſcovery of a medicine which ſhould prevent or remedy all the diſorders of the human frame. A few centuries ago, almoſt every Chemiſt was an Alchemiſt.

chemiſt. Experience ſhewed that, notwithſtanding the boaſts of Alchemy, each of the above problems remained unſolved : with regard to the former, it was obſerved, that Gold did not become more abundant, and that Alchemiſts ſunk into poverty inſtead of riſing to opulence ; with regard to the latter, it was ſeen, that men continued the ſame frail mortals as before, and that diſeaſe and death made no diſtinction between Alchemiſts and the reſt of mankind. We feel ourſelves entitled to expect ſomething from thoſe who profeſs much, and who voluntarily engage in great undertakings ; hence the honeſt Alchemiſt, who did not pretend to have made the diſcovery he aimed at, rendered his purſuit an object of ridicule ; while the unprincipled Alchemiſt, who falſely pretended to have made this diſcovery, rendered it an object of reproach. The number of Alchemiſts of the latter deſcription was ſo conſiderable, as to cauſe Alchemy to be defined by a great Chemiſt *, " *Ars ſine arte, cujus principium men-*

* Lemery.

tiri, medium laborare, et finis mendicare," and this ſatirical definition was juſtified, both by the conduct and the fortune of Alchemiſts, in too many inſtances.

In the times to which I allude, it is no wonder that the diſcredit, incurred by Alchemy, was transferred to Chemiſtry, as theſe two purſuits appeared to be almoſt inſeparably connected. The world was not enough enlightened by philoſophical knowledge, and the province of Chemiſtry was not ſufficiently ~~de-~~ ~~fined~~, to cauſe a diſtinction to be made between the proper application and the abuſe of this art; I ſay *art*, becauſe, in thoſe times, Chemiſtry was conſidered more as an art than a ſcience. The prejudice thus raiſed againſt Chemiſtry was very general, and the ſtudy of it, of courſe, held out but few allurements. The Chemiſt was looked upon as a ſolitary, ſooty, myſterious kind of being, who, by the aid of fire and of ſome other agents, produced changes in ſubſtances, more in the manner of a Magician than of a real Philoſopher. His ſtudies were regarded as confined, and incapable

pable of any connexion with the uſeful or elegant arts.

The firſt reſpect, in which the Utility of Chemiſtry appears to have been acknowledged, was in its application to Medicine. As ſome compenſation for the diſcredit which the Alchemiſt brought upon Chemiſtry, he diſcovered, in the various proceſſes to which he ſubjected Metals in order to arrive at their tranſmutation or at the Univerſal Medicine, ſome valuable remedies. Theſe were introduced into practice by the boldneſs of BASIL VALENTINE in the fifteenth, and of the famous PARACELSUS and ſome other zealous chemical Phyſicians in the ſixteenth century. At firſt, it is true, their introduction was ſtrongly oppoſed by the majority of Phyſicians, who were advocates for a rigid adherence to the tenets of GALEN, and who conſidered theſe new chemical remedies as violent and dangerous. Thus, in 1566, by a decree of the Faculty of Phyſicians at Paris, backed by an *Arret* of the Parliament, Antimony was condemned as a poiſon, and all uſe of it, either crude or however prepared, was pro-

hibited; and, in 1609, a Phyſician of the name of BESNIER, tranſgreſſing this decree, was excluded the Faculty. But if theſe remedies were unreaſonably decried by the one party, they were as unreaſonably extolled by the other. The chemical Phyſicians laviſhed upon them the moſt unbounded panegyric; they were Panaceas; they were to relieve men from all the infirmities of their nature, and to extend the term of their years to patriarchal longevity. BASIL VALENTINE gave to the book, which he wrote in favour of the medicinal uſe of Antimony, the high ſounding title "*Currus triumphalis Antimonii*;" and, from ſuch a title, you may reaſonably conjecture in what ſort of ſpirit it was written. However, truth at laſt was diſcovered, and was found to lie between the two extremes of panegyric and of cenſure. The chemical metallic preparations appeared, on the one hand, to be leſs efficacious in the cure of diſeaſes; and on the other, to be leſs dangerous than they had been repreſented; but, upon the whole, to be extremely valuable acquiſitions to Medicine. They were probably ſooner admitted

mitted to be ſuch than they otherwiſe would have been, on account of the acknowledged efficacy of Quickſilver and its chemical preparations, in the cure of the venereal diſeaſe; a diſeaſe which, in the ſixteenth century, made great ravages in Europe, and which was found, in one of its forms, to yield to no other remedy. The uſe of theſe new chemical medicines, in the cure of diſeaſes, having been once eſtabliſhed, Chemiſtry naturally became a branch of the ſtudies of the Phyſician. It was expedient that he ſhould know the manner of compoſing the metallic preparations, on which a great part of his reliance was to be placed.

Thus was Chemiſtry, in ſome meaſure, reſcued from obloquy, and allowed to be an uſeful auxiliary to one important art. It was long, however, before it aſſumed its title to the character of extenſive utility, and before it was conſidered as any thing more than a branch of Medicine. The connexion, even between Metallurgy and Chemiſtry, was not immediately perceived and acknowledged. At firſt ſight, this may appear ſomewhat ſur-

priſing, as Chemiſts, in order to realize their golden dreams, had employed ſo much of their time in torturing metals in every poſſible manner. Such, however, was the caſe. GEORGIUS AGRICOLA, a German Phyſician, who, after the death of PARACELSUS and about the middle of the ſixteenth century, publiſhed a treatiſe on Metallurgy, which may, even at the preſent time, be read with pleaſure, in his Dedication introduces the ſubject of Chemiſtry, but by no means to its advantage. He conſiders Chemiſtry and Metallurgy as diſtinct arts, or, indeed, ſcarcely allows Chemiſtry to be any art at all; and diſmiſſes it as a purſuit unconnected with the ſubject on which he is treating. This he does, although, in the body of his work, truth obliges him to acknowledge, in one inſtance *, the aſſiſtance of Chemiſtry to Metallurgy.

Chemiſtry, then, proceeded by ſlow degrees in proving its connexion with moſt of the uſeful arts, and in elevating itſelf to the

* P. 194. Edit. Baſil. fol. 1561.

rank

rank of a diſtinct branch of Natural Philoſophy. For this, in addition to what has been ſaid of the diſcredit which the early Chemiſts brought upon their ſtudies, other ſufficient reaſons may be aſſigned. Till within the laſt hundred and fifty years, the ſtudy of Chemiſtry was merely empirical. It had, indeed, from time to time, been enriched with many facts, but the facts had not been arranged and combined. Of courſe it was deficient in thoſe deduced general principles, which conſtitute ſcience, and by the application of which alone to the arts, their ultimate dependence upon Chemiſtry could be proved. Again, Manufacturers were poſſeſſed of much leſs general knowledge than they are at preſent, and carried on their arts by certain proceſſes, for the adoption of which they could often give no better reaſon than that their fathers before them had uſed the ſame. A ſtrongly marked line was drawn between the Artizan and the Philoſopher. But when Chemiſtry put on the form of a ſyſtem, and when its principles became better aſcertained, it began to be conſidered in the light of a ſci-

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ence as well as of an art; and opportunity was afforded of proving, that many of the uſeful arts, which had been long practiſed and brought to conſiderable perfection without its aid, depended ultimately upon the principles which it had deduced. At the ſame time, the Manufacturer became more the man of ſcience, and the man of ſcience became better acquainted with Manufactures. Under theſe circumſtances, the connexion between Chemiſtry and the uſeful arts began to be generally perceived, and, in the preſent improved ſtate of this ſcience, it is univerſally agreed by thoſe who are capable of forming a proper judgment, that the ſucceſsful practice of many of the moſt important of theſe arts depends, entirely, on the proper application of chemical principles. I will only mention Metallurgy, the art of Dying, of Enamelling, of making Gunpowder, Earthen Ware, Porcelain, and Glaſs.

To one of theſe arts, that of making Gunpowder, Chemiſtry has a particular claim. Gunpowder is a chemical invention. But with reſpect to the other arts here mentioned,

and

and to the uſeful arts in general, it would be going too far to contend, as ſome over-zealous Chemiſts have done, that they were the fruits of chemical reſearch. Their origin, like that of the Nile, is obſcure; it is, however, reaſonable to ſuppoſe that, if man was not ſupernaturally aſſiſted in the diſcovery of them, they were the offspring of neceſſity, joined to accidental obſervation, rather than of ſcientific enquiry. Hiſtory tells us that this was the caſe with the art of making Glaſs: that ſome ſailors, who were dreſſing victuals at the mouth of the river *Belus* on the ſhore of *Paleſtine*, for want of ſtones having employed lumps of the ſaline ſubſtance, with which their ſhip was laden, to ſupport their kettle, obſerved the ſand and this ſaline ſubſtance run together into vitrified maſſes by the effect of heat; and that the genius and penetration of the *Sidonians* ſoon improved upon this rude diſcovery, and carried the art to ſuch perfection as to derive, from the excluſive trade which they had in it, immenſe riches. A lump of clay, accidentally thrown into a fire, might have been obſerved to harden

whilſt

whilſt it retained its ſhape; and on this ſimple obſervation, ſucceeded by gradual improvements, might have been founded the art of making Earthen Ware, and Porcelain. It is poſſible, alſo, that the firſt idea of the ſmelting of metals might have been borrowed from what was ſeen to take place, when a foreſt was conſumed by fire; as ſuperficial veins of ore might, by this means, have paſſed to the metallic ſtate *.

It is right, therefore, to conſider Chemiſtry, not as the Parent, but as the Nurſe of the uſeful arts. Numerous and great are the advantages, which they have already derived from the aid afforded by this ſcience. Many of the tedious proceſſes in Manufactures have been ſhortened, many of the complex ones ſimplified, many of the expenſive ones made cheap, and many of the hazardous ones made

* *Quicquid id eſt, quâcunque e cauſâ flammeus ardor*
Horribili ſonitu ſylvas exederat altis
A radicibus, et terram percoxerat igni,
Manabat venis ferventibus in loca terræ
Concava conveniens Argenti rivus et Auri
Æris item et Plumbi, &c. Lucret. Lib. v. l. 1251, &c.

ſafe.

ſafe. Chemiſtry lends the ſame aſſiſtance to the arts with which it is connected, as the Mathematics do to thoſe which depend on their principles. A man may be well verſed in practical mechanics without being a good Mathematician; but he will, probably, be better verſed if he is one: he may be a good Manufacturer if he does not underſtand Chemiſtry; but he will, probably, be a better if he does. Neither the mere philoſophical Chemiſt, nor the mere workman, will be likely to make great improvements in Manufactures: it is when the Philoſopher adds the knowledge of the practice to the theory, or the Manufacturer the knowledge of the theory to the practice, that theſe improvements are to be expected. By the happy union of theſe two kinds of knowledge, the late MR. WEDGWOOD brought the art of Pottery to ſo unrivalled a degree of perfection; and it may reaſonably be hoped that, by a ſimilar union of theſe two kinds of knowledge in other men, other arts may be equally improved.

If what I have juſt ſtated be true, if there be this intimate connexion between Chemiſtry

miſtry and our Manufactures, the general importance of chemical knowledge to the inhabitants of this Country will not be called in queſtion. For in our Manufactures and our conſequent Commerce we juſtly pride ourſelves; we juſtly look towards them, as the principal ſupport of our national Greatneſs. It is chiefly by their aid, that, at the preſent momentous period, we are enabled to raiſe and to maintain ſuch numerous forces for the defence of Religion, of Property, and of Order.

Perhaps there never was a time at which any ſcience, that was likely to contribute to improvements in our Manufactures, was ſo much entitled to our attention, on their account, as the preſent. I do not ſpeak merely with reference to the ability, which our Manufactures give, of ſupporting the unavoidable burdens of the war in which we are now engaged, but with reference alſo to the great advantages, which, by a ſpirited attention to them at this criſis, this Country may ſecure to itſelf over other nations. A few years ago, *France* took the lead in Chemiſtry. The

French

French Chemiſts overturned old theories, eſtabliſhed new ones, and altered the face of the ſcience. They did not ſtop here; they were beginning to apply chemical principles, with ſucceſs, to ſeveral Manufactures, and might perhaps ſoon have rivalled us in ſome of thoſe, in which our ſuperiority was before confeſſed. The French Manufactures are now overwhelmed by the dreadful political ſtorms which have prevailed in that afflicted kingdom, and the Manufactures in Holland have ſuffered from the ſame cauſe. On theſe grounds, the Manufacturers of this Iſland have the greateſt inducement to call in every aid to the improvement of their arts: in the nature of things they muſt, for ſome time, have a large demand for the articles which they prepare; and, if they can bring their proceſſes to a high degree of perfection, it may be very long before a competition can be inſtituted by any other Country. Circumſtances are very favourable to their efforts: luckily for them, they can carry on their experiments without moleſtation; the ſmelter is not forced from his furnace, nor the potter from his lathe, by civil diſſenſions, and

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the theatre of the war which we wage with our foreign enemies is, and, whatever they may deſperately attempt, we truſt will continue to be, remote; our Commerce, moreover, is flouriſhing and protected. The Britiſh Manufacturer is aſſiſted by preſent advantages, as well as incited by the moſt encouraging future proſpects.

Agriculture, the other great ſource of our national proſperity, has alſo an intimate connexion with the ſcience, the Utility of which I am endeavouring to ſhew. Chemiſtry has aſcertained the number and nature of the different earths which enter into the compoſition of ſoils, and has laid down eaſy rules by which they may be diſtinguiſhed from one another, and the proportion of each be accurately known. Hence there is every reaſon to ſuppoſe, that it may be reſorted to, as a much ſurer method of determining the quality of ſoils, than the eye or the taſte of a Land-ſurveyor: for the baſis of every ſoil is an admixture of theſe earths in certain proportions. The preſence of vegetable ſubſtances in a ſoil is, we know, neceſſary to fertility;

fertility ; but Chemiſtry detects theſe, likewiſe, and proportions them with accuracy. I am aware that the goodneſs of a ſoil, and its fitneſs for one or another ſort of culture, muſt depend upon other circumſtances, as well as upon the proportion of the component parts of the ſoil itſelf. Its ſituation as high or low, its expoſure to ſun and wind, the ſubjacent ſtrata, and more particulars muſt be taken into the account. But theſe muſt be taken, equally, into the account, in either mode of judging of the quality of ſoils; and, with reſpect to the nature of the ſubjacent ſtrata, that can be beſt determined by chemical means.

The general operation of Manures, and the peculiar fitneſs of this or that manure for this or that particular ſoil, are not ſo well underſtood as might be wiſhed. Some light has been thrown, and much more may be, on this important part of Huſbandry, by aſcertaining the quality of ſoils, in the manner above alluded to, with philoſophical exactneſs. From the prevalence of one conſtituent part of a ſoil, and the ſmall proportion of another, we might, in many inſtances, judge, *a priori*, what kind of manure

was beſt ſuited to the ſoil under conſideration; or, at all events, when the beſt manure had been determined by experience, the fact might be made extenſively uſeful to the preſent, and to future generations, becauſe the exact nature of the ſoil could be ſtated, with unerring preciſion. Thus agriculture, with the aid which Chemiſtry is ready to lend it, may, in future times, be conducted upon ſure ſcientific principles.

We may look forward to theſe improvements, with the greater confidence, becauſe Chemiſtry has made conſiderable progreſs in aſcertaining the nature of Vegetation itſelf. It appears to have gone a good way towards diſcovering how far the different ſubſtances, contained in a ſoil, are the direct food of plants, and how far they are favourable to Vegetation, merely by affording a proper bed for the reception, and tranſmiſſion, of the nutritive particles. Theſe diſcoveries it has been enabled to make, principally, by the recently acquired knowledge of the different aeriform ſubſtances; ſubſtances, which are found to act a much greater part, than could formerly

have

have been imagined, on the great theatre of Nature.

The Farmer and the Chemiſt have, generally, been looked upon as characters ſo remote from each other, that what I have ſaid may be thought by thoſe, who have not given their attention to the ſubject on which I am ſpeaking, to be mere theory. But when they ſhall have acquired chemical knowledge, ſufficient to enable them to comprehend the writers on this ſubject, they will find the connexion, between Chemiſtry and Agriculture, fully eſtabliſhed. The theory is not unſupported by practice. This may be ſeen, by comparing the chemical with the practical authors on Agriculture ; by comparing, for inſtance, the obſervations of LORD DUNDONALD, and MR. KIRWAN, with thoſe of MR. YOUNG.

At all times, Agriculture ought to be a favourite object of the care of an enlightened Nation. As the dawn of civilization commences when the plough and the ſpade begin to come into uſe, ſo ſhould advances in refinement be attended with proportionate

advances in Huſbandry. In ſome points of compariſon, Huſbandry claims the preference to Manufactures. While the latter ebb and flow, like the ſea which carries their products, the former, like a noble river, keeps a direct and ſteady courſe, and varies but little from the ſame level: the latter are often ſeen to corrupt the mind, and enfeeble the body; the former diſpoſes to temperance and ſerenity, and produces a manly race of ſubjects, inured to toil, and capable of bearing every viciſſitude of weather. To dwell no longer on this compariſon, I proceed to ſay, that the obſervation which I made when ſpeaking of Manufactures, that they, and any ſcience which was likely to contribute to their improvement, never more demanded our attention than at preſent, will apply equally well to Agriculture, although from a different and more urgent principle. We are, at this time, ſtimulated to agricultural improvements, not ſo much with the proſpect of enriching ourſelves by adminiſtering to the wants of other Nations, as of producing a ſufficient

ſupply

ſupply of proviſions for the uſe of our own. It is not long, ſince we were under the alarm of an impending ſcarcity. The regulations, the example, and the ſalutary recommendations of the Legiſlature, together with the bleſſing of an abundant harveſt, have now quieted our apprehenſions. But we ſhall ſtudy our beſt intereſts, in endeavouring, by an attention to huſbandry, to prevent a recurrence of the ſame diſtreſſing fears; in ſtriving to make our own Granaries certain reſources; in not putting the wiſdom of Parliament to the teſt, whoſe beſt contrived plans, on ſuch emergencies, may be diſconcerted by the oppoſition of winds and waves, or by the vigilance of an enemy; in not tempting Providence, by depending, for our ſubſiſtence, on the uncertain amount of any ſucceeding year's produce. There is nothing viſionary in ſuch an object. Whatever may be the comparative ſtate of Agriculture in this and other kingdoms, no intelligent perſons deny, that, with us, it has not yet reached its higheſt pitch of excellence; that, in many diſtricts, the mode of practice is evi-

dently defective, and, in the moſt improved, room is ſtill left for the ſuggeſtions of experience and ingenuity. Notwithſtanding its importance, this does not ſeem to have kept pace, in its improvements, with other practical arts. The true cauſe is perhaps to be ſought in ſome natural difficulties, which attend experiments in Huſbandry. Experiments, relating to other arts, may be performed in a ſhort time; the experimenter may be an eye-witneſs of the proceſſes in every ſtage; and may exclude every agent that can make the concluſion doubtful: while experiments in Huſbandry require the revolution of ſeaſons; preclude minute ocular obſervation, becauſe Vegetation is an obſcure proceſs; and are influenced by the anomalies of the weather, which may lead to an uncertain reſult. However, be the difficulties what they may, the ſucceſs, which has of late years attended enquiries into our rural economy, may be adduced as a proof, that they are not inſurmountable; and the application of chemical principles will, it may be truſted, greatly facilitate our exertions. Let me add to what

I have

I have already ſaid, of the claim which Agriculture has to our attention from the particular circumſtances of the preſent period, that the encloſure of common and waſte lands is in agitation; and, if ſuch plan take place, of what vaſt conſequence is it, that the principles of Agriculture ſhould be well and generally underſtood, in order to turn the great variety of freſh ſoils, which would thus be ſubjected to culture, to the beſt account?

I cannot quit this head of my Lecture without remarking, that to thoſe, who entertain ſentiments ſimilar to what have been juſt expreſſed, it muſt be a matter of ſolid ſatisfaction to be able to look up to a late noble inſtitution, in this country, the BOARD OF AGRICULTURE; an inſtitution, which derived its origin from pure public ſpirit, and the promoters of which muſt eventually meet with an adequate reward, the conſciouſneſs of having contributed to public proſperity.

Poſſibly, what I have hitherto ſaid may be allowed; and, yet, the Utility of the ſtudy of Chemiſtry to the Members of an Univerſity may be

 queſtioned.

queſtioned. For it may be urged, that what I have ſaid amounts to no more, than that the knowledge of Chemiſtry is uſeful to the Phyſician, the Manufacturer and Farmer. To this obſervation it might be replied, that, although the Phyſician has the opportunity of informing himſelf in every department of ſcience, the Farmer has not; neither has the Manufacturer, notwithſtanding that the avenues to ſcience are more open to him than they were, ſo often as might be wiſhed. The time, allotted to the education of the Farmer and Manufacturer, is, for the moſt part, but ſhort; they are placed, at an early age, in the lines of buſineſs which they are to purſue; and from this time they are employed in acquiring manual dexterity, or in learning the common routine of their buſineſſes, rather than in informing themſelves of the ſcientific principles, upon which they are carried on. From this cauſe it has happened, that improvements in Manufactures and Agriculture have been ſo frequently made by philoſophical men; by men, more remotely intereſted than the Manufacturer or Farmer in the improvements which

they

they ſuggeſted, and directing their attention to theſe ſubjects from patriotiſm and the love of ſcience.

I might, therefore, recommend the ſtudy of Chemiſtry to academical Gentlemen, upon this general conſideration, that it is on our Univerſities and Public Seminaries, that improvements in Manufactures and Agriculture ultimately depend; that in the former are ſituated thoſe fountains of ſcience, whence the ſtreams, by which the latter are watered and nouriſhed, are ſupplied. Conſiderations of this ſort may, however, be looked upon as too abſtract and remote; and I will, therefore, endeavour to point out, in what particular reſpects the ſtudy of Chemiſtry may be uſeful to the different deſcriptions of Gentlemen, who reſort to the Univerſity as a place of education; to Gentlemen of fortune, to Students in Divinity, in Phyſic, or in Law.

Of Gentlemen of fortune, who do not intend to follow any profeſſion, it may be obſerved, that many of them will, at ſome future time, be members of one of the Britiſh Houſes of Parliament. In this capacity, they will

will often be called upon to decide on queſtions, highly intereſting to our Manufactures and Commerce. A tax upon this or that manufactured article, or this or that material employed in Manufactures; a duty or a bounty upon certain goods, exported, or imported; a commercial treaty: topics, ſuch as theſe, are frequently diſcuſſed in the Britiſh Senate. The knowledge of Chemiſtry may, if directed to this object, have given them an inſight into our Manufactures; from an acquaintance with our Manufactures, it is but another ſtep to have become acquainted with Commerce; and thus they will have proceeded ſyſtematically, inſtead of adopting looſe and changeable ideas on ſuch important ſubjects. Some of thoſe Gentlemen of fortune, who do not enter into public life, may have a fondneſs for Agriculture. If they have, an opportunity is afforded them of trying, at leaſt, how far Agriculture may be improved by an application of the principles, which Chemiſtry has taught them. Should they fail to improve it, they will experience ſome ſatisfaction in the idea of having been rationally employed, and will probably have ſpent no more money, than

might

might otherwiſe have been required for the gratification of leſs patriotic purſuits: ſhould they improve the ſtate of our Agriculture, they will, ſooner or later, feel the advantage in the increaſe of their rentals, and will deſerve to be ranked among the greateſt benefactors to their Country. It may be, that, inſtead of a taſte for Agriculture, they have a taſte for Natural Hiſtory. With regard to two branches of Natural Hiſtory, *viz.* Zoology and Botany, Chemiſtry may not appear, at firſt ſight, to have any immediate connexion with them. It has not, in the confined view which is often taken of theſe ſciences, and which makes the Zoologiſt and the Botaniſt, mere nomenclators. But the accompliſhed Zoologiſt does not confine himſelf to the claſſification of animals, nor does the accompliſhed Botaniſt to the claſſification of plants. The former enquires into the anatomical ſtructure of animals, and into the nature and chemical properties of the animal ſolids and fluids; the latter enquires into the anatomy of plants, knows their chemical analyſis, and muſt bring Chemiſtry to his aid, in order to underſtand

what

what is known concerning the vegetative proceſs. To the ſucceſsful ſtudy of Mineralogy a knowledge of Chemiſtry is abſolutely eſſential : minerals are claſſed according to their chemical properties, and they muſt frequently undergo a nice chemical examination, (ſo indeciſive are their external qualities) before they can be referred, with certainty, to any particular claſs.

The property of ſome Gentlemen of fortune conſiſts, in part, of metallic mines. To theſe it is impoſſible to pay too minute an attention : in the large way in which they are often worked, great profit or great loſs may depend, upon what, when applied to ſmall quantities of the metals, appears a trifling difference, in the price for which they can be procured from the ore, or for which, on account of their quality, they can be ſold. The difference of a ſingle halfpenny *per* pound may make or may mar a fortune. In circumſtances like theſe, a Gentleman would ſurely wiſh to know the principles upon which mines are worked, and not to reſt entirely on his opinion of the ſkill and integrity

grity of others, where he has ſo much at ſtake. This knowledge he muſt gain from the ſcience, which I am endeavouring to recommend; the working of metallic mines being, excluſive of the mechanical contrivances, conducted entirely upon chemical principles.

To thoſe Gentlemen, who are intended for the Church, I might only ſay, that Chemiſtry is now eſteemed one of the liberal branches of knowledge; ſo great has ever been the general character of the Engliſh Clergy, for information in every department of learning and ſcience. But at the ſame time that the ſtudent, of this claſs, gratifies his thirſt after extenſive information, by yielding to the allurements of chemical ſtudies, he will find that they may be turned to account. A few of the Clergy are Members of the upper Houſe of Parliament; it ~~falls to the lot~~ of many to live in the country, where they are often neceſſitated to engage in the concerns of Huſbandry, even in their own defence; and, in ſuch inſtances, they would have to lament

their

their want of the knowledge of the principles of Agriculture. If they are not neceſſitated to engage in ſuch concerns, they may wiſh to fill up their leiſure hours in cultivating ſome branch of Natural Hiſtory. I muſt be permitted to make a further remark, the force of which may be felt by ſome Students in Divinity, and this is, that the honourable charge of the inſtruction of youth falls, in general, to the lot of the Clergy, and that it is incumbent upon ſuch, as engage in this employ, to be acquainted with the branch of Natural Philoſophy of which I am ſpeaking. It is daily becoming more and more popular, and they ſhould be able to communicate ſome general idea of it, at leaſt, to thoſe, who rely upon them for the foundation of their literary and ſcientific acquirements.

After what I have already ſaid of the connexion between Chemiſtry and Medicine, it will readily be allowed, that the knowledge of Chemiſtry is neceſſary to the Student in Phyſic. The Phyſician, who is ignorant of Chemiſtry, cannot be well ſkilled in his profeſſion;

feſſion; and, indeed, cuſtom now makes Chemiſtry one of the initiatory parts of the education of medical Students. Yet there is reaſon for ſuppoſing, that medical Students, in general, are not ſufficiently aware of its importance; and we ſometimes hear it ſaid, both of Chemiſtry and Anatomy, that ſuch a perſon knows enough of the one, or of the other, for a Phyſician; as though a Phyſician was to content himſelf with a general acquaintance with theſe neceſſary aſſiſtants to his art, and to leave the more particular acquaintance with them to the mere Chemiſt, and the Surgeon. The importance of Anatomy to the Phyſician, it is not my province to ſhew; but of Chemiſtry I muſt obſerve, that the Phyſician ſhould not reſt ſatisfied with a general knowledge of it. If he does not drink deep, he may almoſt as well not taſte of this ſpring of ſcience. In the firſt place, it will greatly aſſiſt him in his phyſiological enquiries: the Phyſician ſhould be able, in proſecuting this part of his ſtudies, to comprehend, and, if occaſion require, to make the chemical analyſis of the different ſolids and

fluids

fluids of the human body. I would not be underſtood to argue, that the knowledge of the chemical compoſition of the human ſolids and fluids leads us directly, or neceſſarily, to the knowledge of the manner in which they are formed. We cannot account for Digeſtion, Sanguification, and moſt other animal proceſſes, upon thoſe principles which we can apply, with ſucceſs, to explain the changes which take place in inanimate matter; and the chemical Phyſicians, who, in the laſt century, looked upon the human body as a mere Laboratory, were, perhaps, guilty of nearly as great an error as the mechanical Phyſicians, who thought it a mere Machine, the animal functions of which could be explained upon the principles of the Carteſian Philoſophy. However, without a knowledge of the component parts of the different ſolids and fluids of the human body, the phyſiological enquirer will make but little progreſs; he, who wiſhes to inveſtigate obſcure cauſes, muſt lay the foundation of his reſearches in the knowledge of the effects. It would be doing injuſtice to Chemiſtry, to diſmiſs the ſubject of Phyſiology

logy without intimating, that one of the moſt important of the animal functions, Reſpiration, is, in part, a truly chemical proceſs, and that it cannot be comprehended by thoſe, who have not made ſome advances in chemical ſtudies.

Chemiſtry is as much an auxiliary to pathological, as to phyſiological enquiries. In conſidering the nature of diſeaſes, a ſhare of the Phyſician's attention will be directed to the chemical changes, which they produce on the human frame; and this enquiry preſuppoſes the knowledge of the chemical ſtate of the human ſolids and fluids, in a ſtate of health. I ſhould be ſorry to overvalue the Utility of Chemiſtry, while I profeſs to ſtate its juſt pretenſions only: and, therefore, as I have already remarked, that the chemical examination of the human ſolids and fluids, in a ſtate of health, does not directly, or neceſſarily, lead to the knowledge of the manner in which they are formed; ſo would I here obſerve, that this examination of the changes, wrought upon the ſolids and fluids by diſeaſe, does not directly, or neceſſarily, point out the method

of cure. Such an examination, however, muſt form an eſſential part of a correct pathology; and there are ſome inſtances, in which the cure of formidable diſeaſes is ſucceſsfully attempted by the direct application of the principles of Chemiſtry. Of this nature are thoſe, where acrimony is preſent in the ſtomach, whether it has been generated there, or whether acrimonious ſubſtances have been ſwallowed by miſtake, or for the purpoſes of ſuicide. The chemical examination of the ſtone of the bladder, a ſubſtance concerning the compoſition of which very erroneous notions had been before entertained, appears to have conducted us to the uſe of thoſe remedies, which have proved moſt ſafe and moſt ſerviceable in calculous diſorders; and the chemical difference obſerved in the blood, after drowning and other modes of ſuffocation, has enabled us to reject the uſeleſs, and to practiſe the moſt promiſing means of reſtoring thoſe, who have ſuffered from ſuch accidents.

An accurate knowledge of the Materia Medica, and of the various medicinal preparations, is one of the firſt requiſites in a Phy-

a Phyſician. To judge how far this knowledge is derived from Chemiſtry, we need only take up a *Pharmacopœia*. It will there be ſeen how large a part of the remedies, now in uſe, chemical ſubſtances form, and what a number of chemical proceſſes are directed for making them. From the days of PARACELSUS, the feeble remedies, propoſed by GALEN, have been giving way to the more powerful products of the Laboratory. "*Interea temporis Medicina . . . . . adjumenta . . . nec pauca nec parvi æſtimanda, tum aliorum induſtriæ et inventis accepta retulit, tum eorum, egregie et præter cæteros, qui nuperis abhinc annis in Chemiam altius ſubtiliuſque excolendam acriori ſtudio incubuerunt*," is the language of the claſſical preface to the late edition of the London *Pharmacopœia*, alluding to the ſtate of Medicine within the preceding fifty years. Phyſicians, it is true, do not themſelves prepare the Medicines which they uſe; but to know how they are prepared is the ſureſt way, by which a Phyſician can enable himſelf to diſtinguiſh them readily, and to form a proper eſtimate of their goodneſs: occaſionally,

too, he may wiſh to direct a chemical proceſs, at length, in his preſcriptions. Whether he may wiſh this or not, it may be juſtly affirmed, that if he be not thoroughly converſant with the chemical remedies which he employs, if he do not know the different degrees of affinity which ſubſiſt between the more ſimple chemical ſubſtances, he will commit great miſtakes in his ordinary manner of preſcribing. He may bring together compounds, which ſhall decompoſe each other, and produce new compounds, very different in their medicinal qualities. Thus, where he intended to give a mild medicine, he may give one that is rough; where he intended to give an active medicine, he may give one that is inert. In other caſes, he may bring together ſubſtances, which, from their want of chemical affinity, are either incapable of being made up in the form which he preſcribes, or which make a very inelegant and unpalatable compoſition; and the reſult of the whole is, that, in theſe errors through want of chemical ſkill, the health of his patients will ſuffer in many inſtances, his own profeſſional character in all.

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The practice of exhibiting factitious airs, as medicines, is, at preſent, to be conſidered as a matter of experiment, and therefore I do not enlarge on this topic. Should the credit of it ever be eſtabliſhed, the Phyſician would be called upon, more than ever, to cultivate chemical knowledge.

In ſpeaking of the Utility of chemical knowledge to the Phyſician, I am perſuaded I have ſaid no more than what juſtice required. Let it not, however, be imagined, that I deny their importance to his other aſſiſtant purſuits. The medical ſtudent muſt be attentive to the Hoſpital and to the Diſſecting Room, as well as to the Laboratory. It does not follow that the beſt Chemiſt will be the beſt Phyſician, although it may be ſafely aſſerted, that a man cannot be a good Phyſician without being a tolerable proficient in Chemiſtry.

To thoſe, who are intended for the ſtudy of the Law, no kind of knowledge can be uſeleſs, ſo various are the queſtions upon which the Lawyer is obliged to ſpeak. As I

am addreſſing myſelf to a claſſical Audience, it may be preſumed, that few of them are unacquainted with CICERO's Dialogues *de Oratore*, a work, upon which that extraordinary man appears to have beſtowed the utmoſt care. With ſome exceptions on account of the greater preciſion and perfection of our laws, and on account of the different circumſtances attending the Roman Forum and the Engliſh Bar, the directions, which, in the perſon of CRASSUS, CICERO gives for forming a complete Orator, will apply for the moſt part to the Engliſh Lawyer. The ſame wide compaſs of knowledge is neceſſary to form the character of a perfect Engliſh Lawyer, as was to form the character of a perfect Roman Orator. It muſt be allowed, that many have been conſpicuous at the Engliſh Bar, who could boaſt of no attainments in literature or ſcience; natural abilities have done much of themſelves. But the ſame natural abilities, combined with extenſive information and erudition, would have done more; and it may reaſonably be ſuppoſed, that the aſpiring law-ſtudent of an Engliſh Univerſity aims at excellence; that

he

he is willing to avail himſelf of every collateral aid; that he is more inclined to adopt the enlarged views of CRASSUS, in the Dialogues before mentioned, than the confined notions of ANTONIUS; and, when a particular cauſe occurs, would wiſh to be able to draw from his own well-arranged ſtores of knowledge, inſtead of relying entirely on the looſe and confuſed ideas, which he can collect from others on the urgency of the moment. If the ſentiments of the law-ſtudent are thus liberal, he will probably not think Chemiſtry undeſerving of his regard. He will recollect, that, in a trading and commercial Nation, law queſtions frequently occur which require a knowledge of our Manufactures; and the proper way to attain this knowledge is to begin with the chemical principles, upon which Manufactures are conducted. Sometimes, in a diſpute about a Patent for inſtance, theſe very principles may be the ſubject of his Brief. Another incentive may be mentioned, which is, that the Lawyer, if he arrive at eminence, will become a Member of Parliament, and, in this capacity, he will derive the ſame advan-

tages

tages from an acquaintance with Chemiſtry, which I obſerved that Gentlemen of fortune would, if placed in that ſituation.

So much for the particular reſpects, in which a knowledge of Chemiſtry may be found uſeful to the different deſcriptions of Gentlemen of this Univerſity. There are ſome points of view, in which it is equally uſeful to every deſcription. It muſt be conceived that thoſe, who have had the advantage of a liberal education, who have viſited an Engliſh ATHENS, cannot but have imbibed ſomething of that laudable curioſity, which makes them deſirous of being able to account for thoſe remarkable appearances and proceſſes in the world about them, ſome of which are almoſt conſtantly preſent to their ſenſes, others of which more rarely occur, but arreſt attention by the grandeur that they exhibit, or the terror that they impreſs. The theory of moſt of theſe appearances and proceſſes is to be ſought for in Chemiſtry. Do we wiſh to know why metals ruſt? why fire burns?

why

why atmoſpheric air ſupports life? why the exhalation of paint and the fumes of charcoal are pernicious? why we ſee meteors in the heavens, or volcanic eruptions upon the earth? it is to Chemiſtry we muſt look for an explanation of theſe, among other Phænomena.

The above are all the obſervations, which I have to offer on the Utility of Chemiſtry. Much might be ſaid upon it as an engaging ſtudy, were this a topic on which I had propoſed to enlarge. As I have not, I muſt be ſatisfied with two general remarks. The firſt is, that chemical information is acquired in that manner, which is moſt gratifying to the vanity inherent in the human mind: "*ipſe ſibi tradit ſpectator*;" the Chemiſt appears to teach himſelf, as the knowledge, that he gains, is deduced from experiments, which he either ſees or makes. I may add, that theſe experiments, for the moſt part, are agreeable to the eye, and that ſome of them are ſtriking and beautiful. The ſecond remark is, that, in this ſtudy, alternate thought and ac-

tion relieve each other: at one time the mind is employed on theory, at another the hands are employed in practice; one day the Chemiſt is contriving experiments, the next he is making them.

What I have to ſay, reſpecting the object at which my Lectures will principally aim, will occupy only a ſmall portion of your time.

From the eſtimation in which chemical knowledge now begins to be held, my Claſs may poſſibly conſiſt of Gentlemen, who differ much with regard to their preſent chemical attainments. There may be ſome, who have already entered into the refinements of Chemiſtry, and to whom nothing, which I could ſay, would be entirely new: there may be others, who have laid the foundation of this ſtudy, and who wiſh to raiſe the ſuperſtructure; but the majority muſt conſiſt of thoſe, who have as yet made but little progreſs in it; of thoſe, who have hitherto moſtly directed their attention to claſſical learning,

ing, but are now deſirous of extending their views over the fields of ſcience. It is to Gentlemen of this laſt deſcription that I ſhall chiefly addreſs myſelf. I ſhall endeavour to deliver the elementary parts of Chemiſtry in as familiar a manner as poſſible; to avoid the minutiæ of chemical controverſy; in ſhort, to make the acceſs to the ſcience as eaſy as may be. This plan, whilſt it is beſt calculated for the greater part of my Audience, may not be altogether without it's uſe to thoſe who are already Chemiſts. The elements of a ſcience are to that ſcience, what Grammar is to Language: and if great Scholars have confeſſed, that they have read their Grammar over and over again with profit, the good Chemiſt may, perhaps, reap ſome advantage from an elementary Courſe of Lectures. He may condeſcend to be reminded, where he cannot be informed.

I wiſh to have it underſtood, that I ſhall not, becauſe I am a Phyſician, dwell too much upon pharmaceutical Chemiſtry. I do not, on the one hand, reſign the privilege of noticing

ticing the applications of Chemiſtry to Medicine ; neither ſhall I be ſo biaſſed by my profeſſion, on the other, as to give them a particular conſideration. I ſhall bear in mind that my Claſs does not conſiſt entirely, or even principally, of medical Students.

My object will be, Perſpicuity, and general Utility.

THE END.