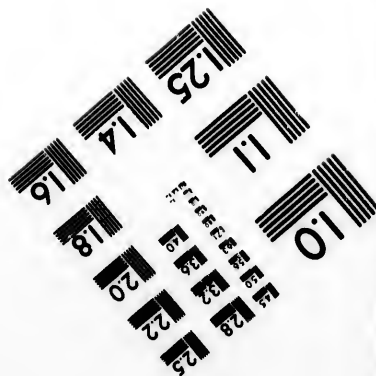
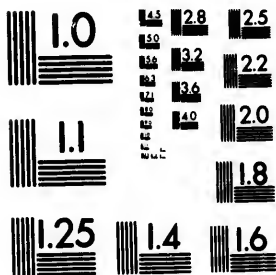


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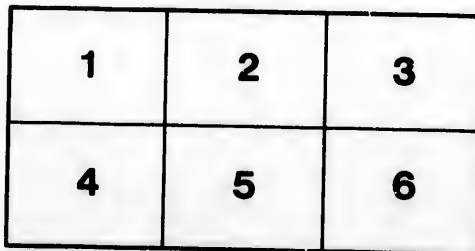
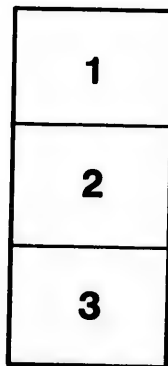
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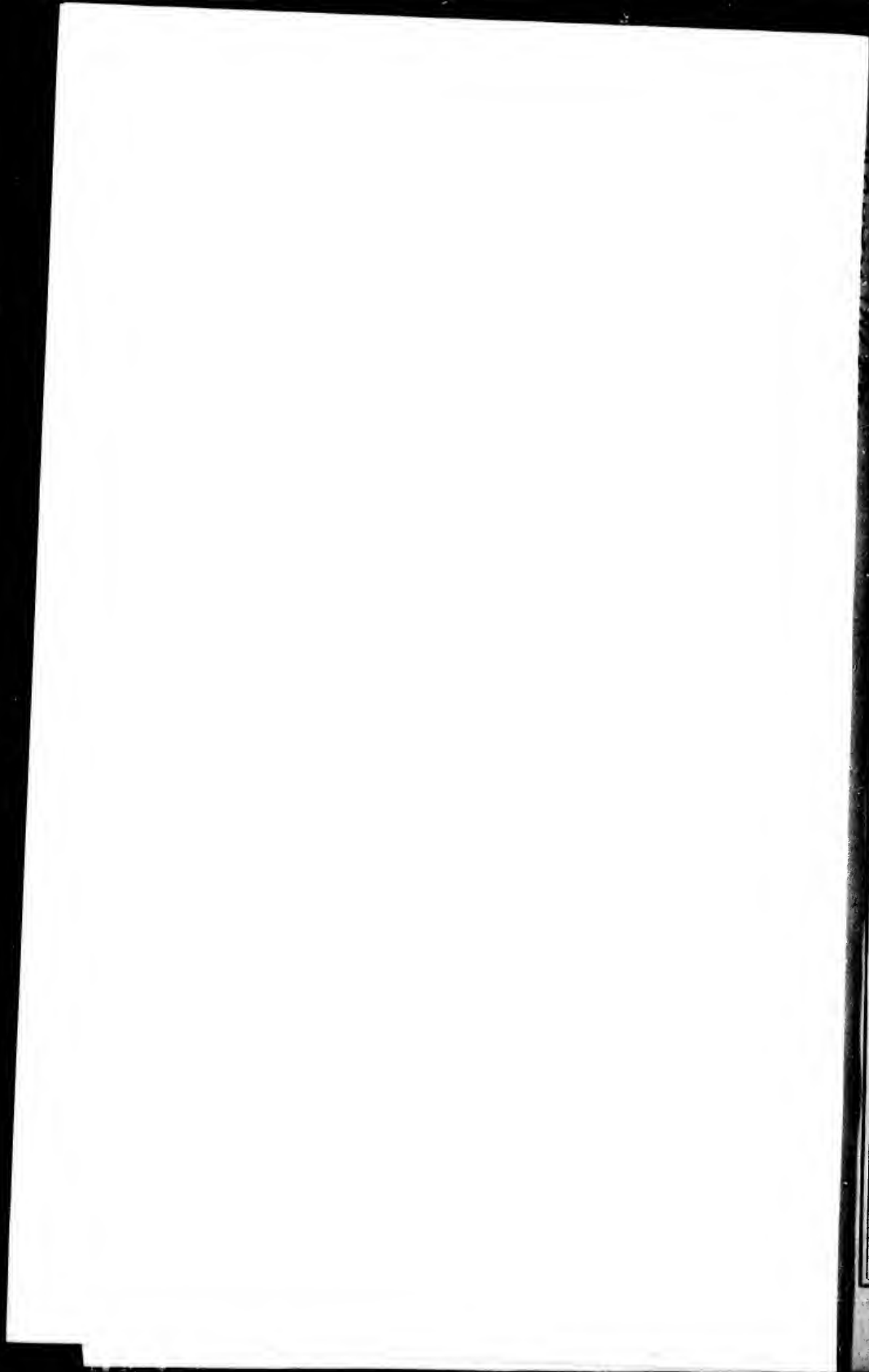
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THE ART

OBSERVING.

(A FRAGMENT.)

1777.



TRANSLATED

BY

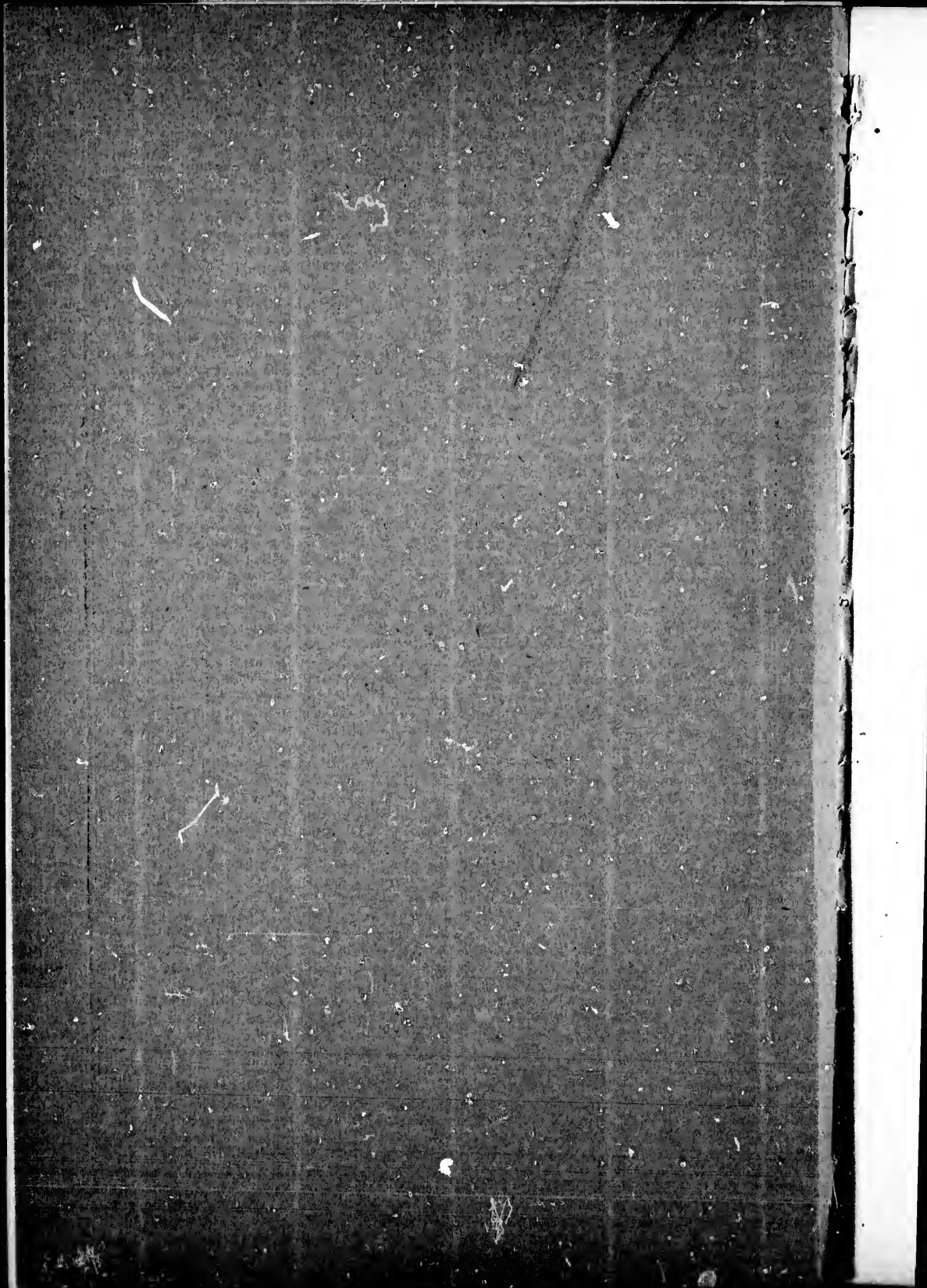
ALEXANDER KIRKWOOD.



TORONTO:

WARWICK BROS' & RUTTER.

1800



*THE ART*

OF

*OBSERVING.*

(A FRAGMENT.)

*1777.*

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TRANSLATED  
BY  
*ALEXANDER KIRKWOOD.*

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TORONTO:  
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1900



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THE ART OF OBSERVING.  
(A FRAGMENT.)

BY BENJAMIN CARRARD.

1777.

Vita Brevis, ars vero longa,  
Et occasio magni momenti,  
Aphorism, Hip.

To observe, is in general to be attentive to everything that strikes the senses, whether interior or exterior, so as to acquire just and proper ideas to lead to the different ends in view. The internal senses inform us of what passes in our minds. The external senses lead us to the knowledge of the objects that exist outside of us and come within the sphere of their action, as our own bodies, so to speak, the celestial bodies, the atmosphere and the meteors formed therein, the entire globe of the earth, the seas, the rivers, the minerals, and particularly among these, men, the societies they form, and what they do in them.

We will always suppose there is no imperfect organic conformation in the observer, and that he is certain in his examination, if the testimony of the senses he uses accords with that of his other senses, or with that of other persons respecting the same object.

The art of observing contributes largely to bring to perfection all the arts which imply taste, the sense of the beautiful, and a just discernment of everything that can agreeably affect mankind. It is, in fact, the contemplation of nature that furnishes the first idea of beauty. She exhibits, more or less, in different individuals an impartial variety, uniformity, and proportion which constitute the charm of beauty; and although the physical beauty perceived about every grand genius that has appeared in all races, has given birth to excellent models that seem to be sufficient to lead the mind to the idea of the beautiful, without hereafter having recourse to the observation of nature, nevertheless, genius will always be victorious in reuniting the two roads, the masterpieces of art and nature, to bring forth works of genius. By profound and reflex observations it learns to get together harmoniously, both the fine strokes that are seized, and those which might have escaped. Having thus become the severe judge, it will be incessantly stimulated to retouch its labors to carry them to a still higher point of perfection. But to expose what has been said in broad daylight, we will enter into some details.

By filling the soul with exact observations of the beauties of nature, the poet and orator bring together a rich fund of just and true ideas, grand pictures, pleasing and touching images which, without presenting exaggerated proportions to injure precision, please the mind so strongly brought to seize resemblances, make their march quicker and more rapid, unite solidity with gracefulness, and paint with a passion that communicates itself to others, the warmth with which they are animated. For what one sensibly feels is in like manner expressed, and this facility of expression is still more increased by the attention which the art of observing bestows upon the great models, to form different kinds of style, make them simple, elegant, touching, strong or nervous as circumstances and the end in view demand.

The varied spectacle of the play of human passion offers, moreover, powerful springs to eloquence to insinuate itself agreeably in the minds of men. By interesting their passions in favor of what she desires to exact from them, she moves and leads them at her will, beguiles them, so to speak, by presenting an object to their view, which by attracting them, at the same time lures them to her side.

This study of the allurements of the passions—of hearken to my song—is none the less suitable to direct the skilful musician in mastering the genius of his audience, captivating them and inspiring them with harmonious sounds, adapted to the peculiar modulations of each passion, such movements as he may judge proper to produce all the marvels told of ancient music, which the moderns appear incapable either to equal or surpass.

The painter and sculptor may likewise find new resources in the opera of nature to improve their art, without being servile copyists of their predecessors. Stimulated by the grandeur, the variety and magnificence they discover, it rests with them to warm with new fire, and distinguish themselves like men of skill by touches that equally interest by their truth and novelty. Choosing to ally with judgment the scattered perfections of Nature, they may even elevate their minds to ideal conceptions of a Nature more beautiful than that now beheld.

Lastly Architecture, although less invited to imitate Nature, but to shelter us from the wind and rain, does not cease, when observing her, to teach us to distribute her ornaments symmetrically; to avoid a fantastic and confused variety; and to give to her works by columns of just proportions and dimensions, that appearance of strength and solidity so well brought together in mass which characterises the Creator's works; and holds a just and agreeable medium between what is too light, or too elaborate.

Yet, notwithstanding the force of the reasons I have advanced, it has been said over again, that the fine arts degenerate under the empire of philosophy, that the spirit of analysis and exact observation are hurtful to the powers of imagina-

tion ; put the muses with their graceful ways to flight, or cast them into disorder and confusion. It has even been maintained, that the age in which we live, which is distinguished more than others by a spirit of research, was a striking proof of the assertion. But this disorder, when it exists, is but the sequel of a false philosophical spirit, traces of which appear more or less in all ages, and which prevents taste, and deforms all natural philosophy. As, in this science, it brings forth chimeras only, by desiring incessantly to produce new principles without consulting nature, so in works of art by dint of presenting to the reader adroitly rendered thoughts, or seeking to make them appear more ingenious than they really are, corrupt taste, discard the natural, and give to bombast and quibbling the false glitter and affectation of language.

This was generally remarked at the beginning of the last century, where the freedom of hypothesis, which had caused so much delusion in natural research, still dominated, and had such perceptible influence upon the fine arts, as to cause the study of those grand models of antiquity to be disregarded, which by directing the eminent writers of the seventeenth century, had preserved them from the wanderings of a too presumptuous philosophy. In like manner, the illustrious Agnesseau, when deploring the decadence of the eloquence of the bar towards the beginning of the eighteenth century, saw with sorrow rash men, full of confidence in themselves, despising the study of the grand masters and the beauties of nature, surrendering themselves to the flights of an unruly imagination, and becoming open-mouthed declaimers. Rollin, who was a good judge in these matters, even thought he saw the moment when the unhealthy savor of brilliant imaginations, and a species of pungency to cover it up, would cause the total ruin of eloquence. Then Architecture, Sculpture and Painting would share the same fate from the same causes, become fantastical and degenerate, from aspiring to open out new roads without subjection to Nature's laws.

But since sound philosophy has called back sense to observe Nature and tower to higher thoughts and truer principles, the fine arts have gained much, and originated works that are worthy of the best days of Athens and Rome. The Ontology of the Arts has been created, and has refined the taste of artists, in developing ideas of nature till then in a state of confusion among the generality of men, by teaching them to discern true beauty, beauty unadorned, independent of the prejudices and caprices of fashion, which charms us in the works of Nature and produces sublimity in the Arts. This same spirit of research and observation has successfully extended itself even to grammar. It has opened up the whole order of relation between thought and language. In attaching itself to the proper genius of language, it has discovered principles where it was thought there existed only whimsy or caprice ; made us feel on what the harmony of a discourse depends ; gave clear and sure rules on all the parts composing it ; aided in adroitly catching the subtle and delicate shades that distinguish synonyms :

placed limits to an excessive timidity which impoverishes speech ; taught us to reunite energetically those terms expressing new ideas, and enrich language with new words, according as they make perfect and extend the taste for the arts and sciences.

Indeed we still see too many writers tormented with a rage for wit, swerving from nature, affecting an ambiguous, tangled, enigmatic style, torturing their minds as if to conceal great judgment within them, but, after vain efforts to penetrate their secrets, leave them void and destitute of instruction ; or substitute frigidly analysed opinions for those grand flashes which warm, transport and pierce the soul. But happily for the honor of our century, and the philosophic spirit which characterises it, all those affected writers, who in seeking after the wonderful and the extraordinary, neglect the language of nature, the fittest to persuade, are recognized for what they are worth. The standard of merit is fixed by the most eminent authors. Our century has seen observers of every kind ; naturalists, physicians, sublime and eloquent philosophers, adorned with the most brilliant literary attainments, made to serve as models to the centuries to come. D'Agnesseau, that grand master of the art of oratory, observed that the eloquence of the bar, whose decline he had first announced, rose again with new splendor. If to satisfy, to move and convince the mind, we must reason with force, and present ideas which are in accord with nature : if to speak to the heart, a profound knowledge of the passions is necessary ; it follows that the spell of eloquence depends upon the art with which we study nature, and man in particular.

Oh ! you who depict with so much force of truth and approbation the marvels which the universe everywhere displays to our eyes ; you who by unfolding to the world with so much energy and precision the virtues of the heroes and benefactors of the human race, have given grand and weighty examples to the lessons of wisdom ; you, who in vindicating the right of the oppressed, in confounding the usurper, in protecting the widow and the orphan, in making harmless the blows that fanaticism meditated against the innocent, have restored and sustained the honor of the bar ; inform us how you stamp upon your thoughts that character of grandeur which elevates the mind ; whence comes that vigorous, bold and rapid touch that warms and carries away the soul ? Is it not from the powerful influences of genius, from profound and philosophic meditations upon nature, from all the springs that stir the human heart, the morals, the laws, and the great subjects you are called upon to discuss, that you owe the grand, noble and picturesque manner that distinguishes your sublime discourses.

Far from spoiling eloquence, the spirit of research and observation, in the present century has sustained, made perfect and even created many kinds, in banishing pompous discourses, insipid and trivial formularies, and making them interesting, whether by instructive reflection, or by a noble and nervous style. It

is this which, in the tributes of praise that literary societies pay to the memory of the great men they have lost, has made eloquence truthfully describe the ideas, the views, the fine peculiar flashes which characterize the genius of the writer and elegantly conceal, by luminous and profound reflections, the aversion attached to panegyric.

The philosophic and observing mind is not, therefore, the enemy of the Graces. If it weighs, if it appraises everything, it is not for the purpose of putting fetters on talents, but only to prevent the rambles of impetuous genius. If it restrains the fiery sallies of imagination, it also knows to speak its own language when necessary, to diffuse without pride, and wisely, the adornments indispensable to the sciences, that they may be understood, relished and revered.

Have we not also seen in this century many celebrated writers who, when introducing the most abstract, the dryest, and most difficult matters in a facile and agreeable manner, had the exquisite art of making them accessible to ordinary comprehension. By means of this philosophic smile, the profound memoirs of the Academy of Sciences launched out among them, and dispersed the darkness that reigned upon the subjects to which their studies were applied.

If poetry seems to-day less fruitful than formerly, it is because the strength of many kinds has been exhausted, for, to produce sparkle and brilliancy, besides the charms of harmony and the happy choice of expression, we require thoughts more than ever equally interesting from their solidity, novelty and nobleness of soul. According as the spirit of observation and research progresses in a nation, she demands more and more in this regard, makes the course more difficult to run, to captivate esteem and compel applause. Nevertheless our century may, in many respects be proud of having produced great poets who will ever be acknowledged by the purest taste and severest reason. We venture here to attest the immortal works of the *Henriade*, which holds such a distinguished place among the most brilliant efforts of poetry, or those other philosophic poets who penetrated with the beauties of nature present such animated pictures, that by an almost irresistible illusion their readers believe themselves transported to the midst of the scenes themselves.

Behold how the art of observing contributes to bring to perfection all the fine arts. It remains for us to speak of its influence on the progress of the Mechanic Arts, which notwithstanding the unjust disregard for a long time manifested towards them have since been vindicated as necessary to the well-being of society, since they teach to make subservient to her uses the productions and agencies of Nature.

II. The knowledge which the art of observing brings to bear upon the structure of bodies, the tenacity of their parts, their resistance to fracture; the polish, more or less bright, of which they are susceptible; their degrees of malleability, of ductility, of weight and transparency, the regularity of their parts and

facility of being wrought, or being divided in one way rather than another, should teach to what arts, that demand some one of these qualities, the different bodies may be successfully applied. The properties or dispositions concealed in bodies are laid open only by profound experiment or subtle procedure, their composition or decomposition for medicine, the arts and uses of life, an infinity of different substances, combinations and resources, the knowledge of which cannot be too highly estimated. We know for example that chemical analysis applied in separating heterogeneous metallic substances which mask themselves from view, furnishes us with the means of purifying them and appreciating their richness with precision. Natural objects do not always present themselves to us in a form fit for use. We must first prepare, combine, torment them, so to speak, in a thousand ways, and submit them to different operations. It frequently happens we succeed in producing the desired effect by means which at first sight appear very unlikely to lead to it, and even contrary to well known facts. Also we must not doubt that new experiments may spread greater light on those preparations which best respond to the first trials of art. When we see what certain combinations succeed in one case, they may be applied to others in the attempt to overcome the opposing difficulties, and endeavor if possible to arrive at the same results. We will find an example of this in the labors of chemists who strive to procure stability for a greater number of colors in dyeing. They labor to penetrate the cloth or stuff with a middle salt, which, being insoluble in cold water, and indestructible by the action of air and light, serves as a proper mordant to hold fast the coloring atoms in the pores of the material without changing color. What increases the difficulty of this work, is, that in using a certain mordant it often happens that the same dye gives beautiful and fast colors to some fabrics, whilst it gives very disagreeable and fading colors to fabrics of a different kind. Chemists must then seek to find whence comes this difference. They often discover it and succeed in communicating the same color to refractory fabrics as to those with which they succeeded best. The same cochineal bath which communicated the most beautiful scarlet to a piece of cloth gave to silk only a disagreeable color of the lees of wine, so little tenacious and permanent as not to resist a single washing in water. Those artists who strive less to open new roads by their observations than to follow old ways were stopped as if by an invincible obstacle. The research of a chemist as able as Macquer were required to show that a solution of tin in aqua regia could serve to give to silk the brilliant red of cochineal.

In studying the natural history of one's country by observations, experiments, and various combinations of objects that present themselves, we often succeed in putting to good use many substances formerly slighted and overlooked, and may dispense with bringing them from abroad, because we already possess them and can substitute them as equivalents. The more we observe, the more

we have reason to be convinced that men are generally slaves to a singular prejudice which persuades them that everything beautiful and peculiar in nature should rather be discovered in distant regions. Naturalists themselves, who may seem to be less subject to preoccupations of this nature, have sometimes given way to this fatal prejudice. They have been known to devote their labors to the examination of substances brought at great expense from abroad, and often impaired by transit, whilst objects that present themselves to their sight are lost to view, and which, besides the advantages of possessing properties worthy of observation are within call, and have undergone no change before examination. We also feel how much this unjust prejudice against the production of one's country injures the commerce and industry of a nation, and makes her tributary to others. Naturalists who are as enlightened as they are good citizens have discovered stones at home as beautiful and worthy of workmanship as those from other lands

The researches of Reaumur have proved not only that turquoise is petrified fossil bone, colored by a metallic solution that fire has caused to extend, but besides that there were turquoise mines in France that did not yield neither in size nor beauty to those found in Persia. Guettard found that the preference given to Egyptian granite over that which France produced was based on prejudice and the slight examination that had been made of the latter. He even considered that those of Mount Dauphin surpassed in beauty those of Egypt. This able naturalist also showed that France possessed those spotted pebbles, stained with different colors, which make such pretty work, and were considered peculiar in England. And lastly, he showed that France possessed the material of which China boasted, and made such excellent porcelain.

It is painful to think that more active research has not been made with a view to extract many colors from our plants and insects which are now obtained from foreign plants and insects, or at least to naturalize those plants and insects in our climate. If in searching whether other materials can be added to or substituted for those first employed in the Arts, it might happen that the results obtained would not be equally beautiful. But although of inferior degree they may be usefully employed in many cases which do not demand perfection in workmanship, or saving in expenditure. Experiments of this kind may often place us in a position to benefit from what at first sight would seem to be an injury. Thus an able observer once proposed that caterpillars, who destroy our trees, would make amends to some extent if the thread they spun was used in manufacture of paper.

How many more advantages may we not reap from the rules which the art of observing affords for the discovery of the secret operations of nature, and means of making them favorable to vegetation, or preventing the changes which they have a tendency to produce in objects most interesting to mankind. I will



not repeat here what has already been said respecting the assistance it renders to medicine and agriculture, but I will not silently overlook the advantages derived from it every day in bringing the veterinary art to perfection.

This important art, formerly abandoned to the basest hands, is to-day cultivated by well-informed observers, who, after numerous dissections of animals that had died of epidemic diseases, laid the basis of a science founded upon incontestible experiments, and taught numerous students the rules derived from them for the healing of animals, and the preservation of the farmer from overwhelming losses.

Domestic animals, always better observed in everything that relates to their natural condition, their constitution and animal economy, will thus produce fine and pleasing aspects for the perfection of the species and making them more useful to man. D'Aubenton, having made researches upon the mechanism of rumination to which certain species of animals are subject, had occasion to observe the influence this operation had upon their temperament; deduced very judicious rules on the manner of treating them to save them from diseases and imperfections. These observations particularly convinced him how pernicious the custom was that prevailed in many countries of keeping sheep in warm stables. He comprehended that this artificial heat caused, by an abundant perspiration, the loss of a portion of the serosity which was necessary to the animal for the purpose of rumination: whence he concluded that the animal economy was thus perturbed by bad digestion resulting in disease to the sheep, and defective wool. For the purpose of putting this reasoning to the test of experience, he kept a little flock in the open air night and day, without any cover, even for the rack. They were exposed to very cold and violent winds, to continual rain, to many days of foggy weather, and to frost and snow. They suffered every kind of atmospheric temperature, and nevertheless they were always more healthy and more vigorous than others kept in stables. Sheep exposed to the open air gave birth to lambs that stood the test of hard frost the first days of their life, and were, nevertheless, perceptibly more vigorous than those kept in stables, and their mothers suffered no harm.

The study of domestic animals by well-informed natural philosophers may also lead to special methods of facilitating their breeding and multiplication, and supplying their wants. We know that the celebrated Reaumur, when studying the degree of heat necessary for hatching eggs and raising young birds, discovered the method of substituting the action of artificial heat for incubation, an art, indeed, known to the Egyptians and Chinese, but which they could not practice with the same facility and the same precision which a graduated thermometer now furnished, whose perfection is solely due to the labors of the natural philosopher.

The operations of nature exactly followed and well understood can frequently furnish excellent models to the mechanician, and lead to the discovery of useful

machines, or the improvement of those he already possesses. It was the structure of the eye that suggested to the celebrated Euler the happy idea of forming object glasses of two different refractory materials to cause the aberration of light to disappear in dioptric glasses, for, observing that the eye was not incommoded with the iris, he conceived that the Author of Nature had composed the eye of different refractory materials, as if with the design of connecting by this means the aberration of the rays, which a single medium necessarily introduced.

The perfect imitation of Nature's procedure thus guides the arts to perfection. It is nevertheless true, that before reaching the top of the hill the necessary knowledge and executive power over her secret operations frequently fail. But we should always, when it is possible, strive to imitate her, if not very closely, at least at a distance. The more we attentively consider the agencies she employs and the mode of operation, the more we find the means of so doing, ably assisting our designs.

A first observation is a notice to wait the result, until some idea of an intention or discovery is formed although still coarse and clumsy. But more profound observations of its nature and the properties of the agency brought into play upon the susceptible force; upon the obstacles which oppose its action: upon the circumstances by which its aptitude to produce an effect may be increased; upon the manner of using it with the greatest advantage and the least incumbrance: soon bring an imperfect machine or discovery to perfection when a general view of its use and purpose has been grasped. This is the history of the generality of mechanical inventions. A superficial observation preconceived the mariner's compass, which for a long time was rudely constructed. But natural philosophers, by handling the loadstone in a thousand ways, by penetrating more and more into its mysteries, by investigating the best methods of increasing its directive force and applying it to the magnetic needle, have brought this instrument, so necessary to navigation, to perfection; have given it force to direct it to the magnetic pole, and made it extremely mobile on its pivot without causing it to lose the property of settling itself promptly towards the point the loadstone directs.

Similarly, a first glance at the facility with which water evaporates when it is extended over a large surface with little depth, suggested graduated levels in brine pits to supplement in part the action of air with that of fire and thereby save too great consumption of wood. But the more extended observations of an enlightened philosopher on the mode by which Nature carries on evaporations have made the invention more advantageous. Given the same temperature of air, the quantity of water evaporated depends not only on the extent of surface over which the water is spread, but also upon the time it remains exposed to the action of the air, he conceived that the number of times the water was renewed might be diminished by means of pumps to procure a new

evaporation; since to produce the same quantity of evaporated water, it was only necessary to let the water glide along more slowly in the sheds, and by this simple artifice more work is got from the motive power to evaporate a greater quantity of water. The illustrious Haller has also improved these inventions, and has shewn of what resources the spirit of observation is capable; having recognized many inconveniences of the graduated levels, from his knowledge of the country and the seasons where the heat is sufficient he opened a new route and procured, when using solar evaporation only with the salt water, a more considerable quantity and at less expense, than could be obtained by the ordinary methods.

Profound and well considered observations are so much the more necessary to place one in a position to use Nature's agencies in the most advantageous manner, as it is sometimes difficult to accomplish one's designs by means which, after a superficial examination, appear rather to diminish their force, failing to have well considered and grasped all the circumstances which usually accompany the action of these agencies. How many people would not have viewed as a very improbable, and even absurd means of strengthening a piece of wood to saw it partly, and insert a foreign body! Nevertheless, this method appears very well conceived, if a person examines attentively what happens when a piece of wood is ready to break under his care. As a matter of fact what does happen then?

Towards the place where the rupture is likely to happen, some fibres contract on the concave surface. The extension fibres resist, whilst the contracted fibres give way. Those between the two kinds, being neither contracted nor extended, form a prop against which the extended fibres that resist fraction, press themselves, and the action of these last is greater as the prop is farther from them, and approaches nearer the concave part because the leverage under which they act is so much greater. This idea which well observed phenomena supplies being caught by a clever philosopher led him to understand that he must substitute an incompressible body in place of the contracted fibres in order to increase the strength of the wood, by placing at a distance from one another the prop and the fibres which occasioned the resistance. When he concluded that by sawing the wood in the thick part, provided the saw kerf was filled again with a hard substance, he could by this means increase the strength and stiffness of the piece, in such manner that the foreign body would brace up the entrance of the line of the saw more than the other end of the kerf. These considerations, when submitted to experiment were confirmed and furnished a more ingenious and efficacious means of increasing the strength of wood, than a slight attention at first sight would have deemed practicable.\*

Other similar examples which could easily be mentioned shew how much the progress that has been made in the art of observing the operations of Nature favors those of the mechanic.

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\* The practical utility of the observations in the above paragraph is not apparent at the first glance.

NOTE.—It is not generally known that trees, as the maple and elm, for example, have two growths, namely, a Spring and an August growth, in the same year.

This art should, still more, produce this effect, as the spirit of observation unceasingly calls from every side to redouble itself, and overleap the difficulties which the secrets of nature conceal from view, and always accompanied by an active curiosity that is not content with ordinary ideas, but seeking to satisfy itself by some novelty, must necessarily, by dint of exercise, fill the head with resources, and acquire great facility to fling forward towards some new prop from which the result had in view can be produced.

The art of observing doubtless finds great assistance in accomplishing its ends from the light of geometry. Nevertheless, this light frequently leads, in the arts, to pure chimeras. To be convinced of this, we have only to look at the errors of geometers in estimating and applying the agencies of Nature to machines, when they have not looked at them in all their aspects. For example, being persuaded that the waters of a running stream act on the flat boards of an undershot wheel solely by their shock, they have drawn deductions from the number and most advantageous arrangement of the boards, that a geometrician, DESPARCIEUX, a better observer than his fellow members, found contrary to experience, because they had neglected to consider that running water acted on the boards, not only by its shock, but also by its weight. In like manner it appears from experiments recently made by DE BORDA on the resistance that fluids oppose to the motion of solid bodies, that those who have worked on the construction of ships, or the direction of their movements by the power of the helm and the disposition of the sails, risked a good deal in making many useless calculations by not starting from well observed facts. Moreover, let us add that whatever difficulties the geometrician may encounter in estimating with precision the agencies he attempted to employ, he is always obliged to make allowance for many circumstances which he frequently cannot foresee, and which should largely modify the results according to the facts; as for example the quality of the materials that are used; certain circumstances that prevent a machine from speeding too much, or too little; the effect of air, of heat, of cold, of moisture, and the friction which varies according to the structure of the bodies, their cavities, the form of their prominent parts, their elasticity, their coherence or their degree of velocity, respecting which no general rule can be laid down. If, therefore, the art of observing does not succeed in discovering the restrictions which must be brought to bear in particular cases as consequences of imperfect geometrical investigation, we may be led astray by seductive calculations.

The spirit of observation thus frees us in the arts from a thousand frivolous expectations too hastily conceived. In discovering, by dint of handling objects in every way, the particular difficulties which oppose themselves to the production

of certain results it undertakes to bid defiance to arbitrary promises and exaggerations of many great talkers and little doers, who have no other end in view but the enrichment of themselves at the expense of a credulous public. The sound ideas of Chemistry to which the art of observing is indebted have, for example, drawn us away from the ruinous and fruitless researches of the alchemists, and directed the labors of true chemists towards objects within their reach, and from which the arts may expect more real advantage. Similarly, the considerations which observation on the friction of bodies have furnished, and on resisting mediums, have proved the impossibility of perpetual motion, and the uselessness of any propositions respecting it.

Nevertheless, however useful it may be to know the limits of the arts, that is to say to determine the point that may not be passed, we should not be hasty in drawing such conclusions. The art of observing does not permit us to regard an invention as absolutely impossible unless such impossibility is made to appear by the best evidence, and repeated and incontestible experience. For it may happen that new observations furnish luminous and unexpected views to overcome an obstacle, which at first appeared insurmountable. So we are often too hasty in deciding upon the impossibility of certain instruments and machines.

Achromatic glasses and telescopes and the mirror of Archimedes accomplished by Buffon, are striking examples of this truth. In searching in every corner and the most secret recesses of nature we may procure unexpected treasures. The satellites of Jupiter discovered almost at the extremity of our solar system, at an immense distance from our globe: Parallax and the motions of the moon determined with the greatest exactitude; and a singular experiment of the pendulum that induced a precise measurement of the earth have given new and powerful aid to geography, and to navigation that manly art which enables us to surmount the difficulties that nature had put in the way of our travels, and to use the winds and waters to carry us into the most distant regions.

All observations, it is true, do not immediately lead to manifest utility. But everything is knit together in nature. It would be difficult to find there some discovery which by the efflux of time, new points of view, new facts, or comparison with some other discovery, cannot be made of greater use. In the first experiments upon electricity we were far from thinking that they would one day lead to the discovery of a method of preserving edifices from the terrible effects of thunder and lightning.\* But the identity, or extreme analogy of electric fluid and thunder having afterwards been demonstrated, it was not difficult to imagine, that it would be possible to succeed by raising the metallic points above the edifices which, communicating by similar conductors with the earth, would draw off, so to speak, the electric fire from the stormy clouds that approached the buildings, and disperse them silently without explosion.

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\* Witness now, the dynamo, the electric railway, and electric light.

Convex and concave glasses had been handled by men for three hundred years before they dreamed to use them in the construction of telescopes.

It was noticed for a long time that vapour rose from water, and shot out violently through little holes pierced in a closed vase that contained it, when exposed to heat, without thinking for a moment of drawing any advantage from it, but it was afterwards comprehended by observers that they could use the elastic force of a similar vapour obtained from a moderate fire to move the piston of a pump, and raise water.

Archimedes was doubtless the first who remarked that the weight of a body was less in water than in air, but being resolved to compare the loss which bodies of the same weight and different density sustained in the same fluid, he deduced a method of discovering in what proportion the parts of a mixture were, as gold and silver in an alloy. Why therefore not hope that the most sterile observations in our hands may bear fruit when wielded by our successors, and influence sooner or later the improvement of the arts, and the needs of life.

But after all, when some observations, as may be the case with some electric phenomena, have nothing to recommend them but their singularity, and do not lead to any material and perceptible utility, which is not even probable, they will always be precious in that they serve as an aliment to a very reasonable curiosity natural to men without which their attempts to cultivate the science and arts for many thousands of years would have been in vain, and which spurs them on to extend their boundaries unlike the Chinese, who for many centuries have made no new progress in them, because they think less of observing Nature than respecting the knowledge they have received from their ancestors.

Love of new discoveries! precious fruit of the spirit of observation, that extends itself more and more every day, it belongs to thee to give to the nation most accused of unsteadiness and frivolity, a character of stability, when we attempt to cultivate the sciences and the arts, to pry into nature, to spread before us for our use the motions of the stars, the earth, the seas, the minerals, the rivers in short the whole assemblage of bodies that compose this universe!

Compare the actual state of the arts that bring themselves into play in times of peace and times of war with what they were less than a century ago, it will be found that immense progress has been made, because at this epoch the spirit of observation has especially begun to take possession of all orders of citizens. But what demonstrates its powerful influence upon the perfection of the arts is the fact that it appeared a short time ago in the strangest places.

Since a northern potentate, sacrificing himself for his country with a desire to instruct his people, stepped down from the throne to travel as a philosophic observer amongst the most polished nations of Europe, and carried away to his dominions their taste and genius for knowledge, due to observation, to cultivate and adorn the mind; these fertile seeds were naturalized in those northern

countries, and pushed out deep roots. From that moment the impulse of genius made itself felt among men who not long before had emerged from barbarism. An ardent and consuming curiosity bestowed on them an industry which convinced them that lavish Nature only waited the assistance to pour out her abundance; find new routes for commerce, discover northern extremities of Asia, and the arms of the sea that separated the old from the new world, to survey their vast geographical and physical extent, and learn their advantages and their value.

Lastly, it is true to speak of the greatest advantage that the art of observing brings to the human mind by furnishing it with surpassing considerations of a better life, and giving us the most majestic ideas of our Creator to elevate our conceptions, banish all superstition, and lead us to solid and eternal felicity.

This should make the art precious to all men, who are alike called to march in the glorious career of honour and virtue

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