THE SCIENCE OF DRAWING IN ART

MOORE

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INTRODUCTION.

DRAWING is studied not only by the professional artist, the amateur, and the draughtsman as the foundation of all their work, it is also studied for its educational value. No one has more fully expressed its all-round importance than Michael Angelo, who says: "The science of drawing or of outline is the essence of painting and of all the fine arts, and the root of all the sciences. He who can raise himself to the point of mastering it possesses a great treasure. The power of drawing is so great that the artist can express whatever he wishes if he knows how to draw; thereto neither gold, silver, nor precious stones are needful, only a pen or a pencil . . . so much so that I sometimes think there is only one art amongst men, that of drawing, from which all other human arts proceed, or of which they form a part." [1]

In regard to the value of drawing as a factor in mental discipline, modern teachers agree more and more fully with Herbert Spencer that "the spreading recognition of drawing as an element of education is one among many signs of the more rational views on mental cultivation now beginning to prevail." [2] But in spite of all this willingness to do homage to the subject, to acknowledge its widespread value, and to promote the best methods of teaching, much confusion of thought exists with regard to its exact nature and place.

So widespread is this that as matters now stand it is commonly necessary to ask: What do you mean by drawing? or what does its teaching imply for you? and what do you understand to be its relation to art?

[1] See Biography of Michael Angelo by Charles Blanc.

[2] Herbert Spencer, "Education."

The need of generally accepted answers to these questions was shown on the largest scale at the art-educational congresses, held in Chicago in connection with the Columbian Exposition, and which brought together teachers and others interested in the subject from every part of the world.

Throughout the proceedings of the various sessions, no one could fail to be struck by the diversity of opinion and uncertainty of expression on these primary points.

Let us then seek such definitions and conceptions as will help us from the start.

Drawing is primarily the art of recording what is seen by every healthy eye. It is a matter of sight, knowledge and execution, dealing with facts of form and appearance. It is the basis of all graphic art, one and indivisible, the same for all.[1] Its teaching should imply all that helps us correctly to see and render form and appearance.

Right here let us note a vital distinction between what may be called the science and practice of drawing and that which is properly speaking Art.

Art involves intellectual creation, and, in its highest manifestation, is the very breath of life which genius alone has the power to breathe into its productions. It also implies the suggestion of action, movement, and sentiment, added to the literal record of form. Drawing is simple and exact, Art is complex and elastic. Drawing rests on a few easily understood facts, Art involves many elements, not the least important of which are identified with the individuality of the artist.

It is an axiom that "The artist of every type is born, not made." On the other hand it is not so generally understood that every one of ordinary endowments can learn to draw; that all possess some amount of capacity in this direction which may be turned to good account by study and practice.

The aim of this manual is twofold, first, to separate distinctly in the study of graphic art all that is certain and definite, and that can be profitably studied by every one of average faculties, from the more intangible matters of Art proper; second, to lead up to this science of drawing by the study of its underlying principles, founded on an

[1] See Lecoq de Boisbaudran, "L'enseignement des Beaux Arts."

elementary knowledge of the laws of sight. To promote these ends, certain aids and means are suggested, so simple that no fairly intelligent person can fail to understand them, and so practical that they are within the reach of every one determined to learn to draw.

It is generally admitted that those who can learn to see *perspectively* can learn to draw, but this is only half the truth, for it can be tangibly proved that, except in cases of diseased eye-sight, every one does see perspectively. The thing needed is the power of realizing what we see and of so recording it as to convey a right impression to others.

These reflections, strengthened by much study of Leonardo da Vinci's works, and others of like tendency, led to the bringing together of many facts and principles in a related grouping and sequence of theory, proof, and practice.

In connection with theoretical study the value of the series of simple mechanical aids named philographs had been demonstrated. These embody and further develop certain of Leonardo's suggestions in regard to optical and perspective demonstration, and for practical assistance in training the eye.

These instruments had already attracted much notice and appreciation among artists and teachers in Paris and in London, when an official invitation was received to send models of them to the Chicago exposition.

The models were exhibited and a diploma and medal subsequently awarded in the educational section. At the same time the principles of study herein set forth were also made known so far as could be by the reading of short papers and by demonstrations. These brought the hearty individual endorsement of very many artists and teachers, including the Directors of both the Chicago and the St. Louis Art Institutes.

A like interest has been expressed in other cities, and especially by a number of the foremost artists and professors in New York. Recognizing the value of encouragement from such competent judges, and in the conviction that its contents will prove useful to all concerned, this little volume is offered to the public.

I. THE SCIENCE OF DRAWING.

1. "The highest Art of every kind is based on science; without science there can be neither perfect production nor full appreciation . . . innate faculty cannot dispense with the aid of organized knowledge — only when genius is married to science will the highest results be obtained." [1]

In the face of these words, which are not merely authoritative but are amply supported by fact, surely the fear expressed by some amateurs, lest the admission of scientific principles into the study of drawing endanger Art, can have no serious weight! It is well known that gifted artists, even including the great Eugène Delacroix himself, have labored under extreme disadvantage all through their art career for want of sufficient grounding in this very science of drawing.

Undoubtedly this lack of science, or of organized knowledge, is sufficient to explain the present chaotic, experimental condition of several of the modern *Schools* of Painting. Their adepts are not wanting in sentiment, or in love of nature, but, failing the science and hence the power necessary to express what they feel, they have recourse to numerous eccentricities, the outcome of which cannot but be incomplete because it is not based on knowledge.

2. Any one who realizes what a boundless ocean is the subject of Art, must be astonished to see how many mariners embark upon it, under cloudy skies and without chart or compass.

The true compass is not far to seek, for it can be no other than the human eye, by which and for which all purely graphic Art exists; but, unlike the compass, the eye requires not only to be understood but to be trained. The experiences of former voyagers, the labors of those who have studied the laws of sight scientifically, and the record of those who have applied them in the great Art works of all times, must serve as a chart to guide us in our individual efforts.

3. As before indicated, the methods of work proposed here are based upon a study of the eye and its functions. This implies a general familiarity, not only with the structure of the eye and the

[1] Herbert Spencer, "Education."

principles upon which it works, but, still more, with the illusions to which it is subject, certain of which illusions constitute the groundwork of perspective. To this end we must study the eye not as oculists, not as scientists, but as artists, that is, in its intimate relation to the human intelligence.

It should hardly seem necessary to insist on this need, where the eye is of such evident importance as it is here, and yet, of the thousands of young people who study Art as a profession or of the school-teachers counted by tens of thousands of whom a knowledge of drawing is now generally required, how many possess definite knowledge of these things, or could satisfactorily explain what they do or what they teach, in its connection with human vision?

They learn anatomy, geometry, linear perspective, and kindred subjects, but few realize how entirely these branches of science, in their relation to graphic art, are subservient to the laws of sight and must be so studied by whoever would gain familiarity with the facts and principles on which every-day Art work is based, or be properly equipped for teaching. It is possible to study all these subjects without getting hold of the essential principles of the Science of Drawing.

4. What then is the science of drawing? In the words of Leonardo da Vinci: "The young student must before all learn perspective."[1] Now perspective is literally what appears to the eye, and to study perspective is to study the *science of appearances.*

Drawing, that is, pictorial drawing, deals with apparent, not real form. Apparent (or perspective) form as it must be dealt with by the artist is intimately connected with many branches of science, geometry, optics, statics, dynamics, anatomy. It also depends upon the expression of human passion and sentiment. All this the same great Florentine master pointed out in detail more than three centuries ago.

The real need is that the science of appearances as a whole be simply formulated and brought within the reach of every drawing student, for the study and the faithful, intelligent record of these *appearances* constitute the *science of drawing.*

[1] "Trattato della Pittura," cap. I. For general use see translation by J. F. Rigaud, Bell & Co., London.

5. This seems to have been overlooked by promoters of modern scientific methods, and so, amid the constant and rapid progress observable in every other branch of knowledge, the study of the science of drawing, taken in the broad and general sense, has remained stationary where it was centuries ago. Everything has been done to analyze, locate, explain all that concerns color, light, sound, language, music, but little or nothing, except in one of its branches, to forward the better understanding of apparent or perspective form.

6. Whence comes this neglect of what for the artist constitutes the basis of right seeing?

It is doubtless chiefly owing to the incomplete idea of perspective now generally adopted, and in part to the slipshod notions that exist among the majority of even cultured people, according to whom science, instead of being the supporter and ally of Art, is rather its antagonist.

The common acceptation of the term perspective and the usual modes of teaching the subject tell plainly of this incomplete notion and suggest investigation of certain points that have remained so far strangely obscure.

7. In works on the subject it is stated that the whole of Perspective, the science of graphic appearances, is included under the terms linear and aërial perspective — linear being that branch which regards "the positions, magnitudes and forms of the objects delineated," aërial perspective that which "considers also the variations of light, shade and color."[1]

With aërial perspective we have nothing to do here; but limiting our attention to the first named branch, we find that linear perspective, taken in the broad sense of all that can be represented by help of lines, itself comprises two distinct branches, requiring to be studied in different ways and by different means. The great and very general mistake lies in not recognizing the separate existence of these subdivisions.

8. Both of them deal with solid forms seen in space, but the first treats of those regular or geometrical solids and spaces that can be accurately represented according to certain well-formulated

[1] *Century Dictionary.*

rules, and by means of straight lines, regular curves, and determined distances; the second deals with irregular forms, such as fruits, flowers, drapery, and with organic or living forms, plants, animals, and above all the human figure. These cannot be satisfactorily represented by geometrical lines or by any of the mathematical processes. The only term commonly used here is "foreshortening" and it is unquestionably insufficient. This branch is better called *organic perspective*, and we will henceforth adopt that term.

9. Although linear perspective has theoretically such a wide meaning, the term as commonly used seems to refer solely to the treatment of regular forms by the received mathematical processes. In this exclusive sense we will for convenience's sake continue to employ it.

10. The science of linear perspective, best illustrated by architectural drawing, seems to have reached the highest possible development, and in some sense undue importance has been given it, but the science of irregular and organic perspective, though really much more important to the artist, and more difficult because so much more intangible, has never been, properly speaking, recognized as forming a separate part of perspective nor, consequently, studied as such.

Nevertheless, apparent form is evidently as much a matter of perspective fact in one branch as in the other, in the rendering of a foreshortened arm, for example, as in that of a cube or a cylinder. The intelligent practical study of perspective must be so widened as to include all perspective science.

11. The study of organic form has, as a rule, been treated in one of two ways: either as admitting no perspective accuracy whatever, or as capable of being treated by precisely the same methods and processes as geometrical forms. Evidently both these views of the matter are faulty.

Ordinary perspective processes do not greatly help here *owing to the extreme irregularity of the forms rendered*, and the result is that the difficulties of foreshortening are apt to be ignored — slurred over in the light and shade or general effect — or only partly surmounted by dint of very long and laborious application. To change this some means other than geometrical are required. Where

mathematical proof cannot materially help, optical proof, and above all analysis of underlying principles, can. These must then be sought out and definite means of demonstrating them must be found and adopted.

12. The first step here consists in proving to ourselves conclusively what we really see. For this we must have some means of realizing and of recording the eye's actual perception of forms; for although every normal eye sees perspectively, the normal untrained brain does not realize what that eye perceives, and consequently cannot guide the hand to make true record of it.[1] The only means of attaining this double end, of demonstrating and of recording, is by *transparency*. This was first suggested by Leonardo in his Treatise on Painting, in which also the science underlying art is largely dealt with.

13. It is not asserted here that drawing can be made easy, but it is claimed that by the proper classification of well-known facts and principles, supplemented by the judicious use of practical means of demonstration and of eye training, the difficulties of the subject may be lessened and the study placed on a more definite and intelligent basis.

II. THEORY OF THE TRANSPARENT PLANE.

1. We have to do here with general principles and with the immediate means both of demonstrating them and of putting them into practice. The student must be guided to a knowledge of the principles which underlie both nature and Art and must understand the optical and physical facts that govern our sight and form the foundation of all perspective. It is also of great importance that he be shown how to prove all this for himself.

[1] Let us take an elementary example; every person, however untrained, sees that any given octavo volume is longer than it is broad, and just as certainly if that volume be laid on a table about a foot below the height of his eye, he *sees* it with perspectively reversed proportions, but the chances are 1000 to one that he does not fully realize the extent of that apparent alteration, as would be shown if he tried to draw it. This is what he must be made to do if he is ever to sketch the simplest object correctly.

2. Leonardo da Vinci was the great advocate in Art study of self-reliance, of investigation into the nature and reason of things and also of the use of any kind of help available in training the eye, the mind, and the hand to the right representation of what has been intelligently seen. His words: "Before all, the young student should learn perspective," are the key to his theory of drawing study, for, as used by him, perspective evidently related as much to organic and living forms as to geometrical or regular forms, and in fact to so many other things that it seems to cover the whole science of *Right Seeing* so far as it concerns the artist.[1]

This is evidently founded rather on optics than on mathematics, and therefore requires before all a thorough practical training of the eye. Certainly it is more important, both to the artist and to the student, to learn to see forms perspectively than to learn to apply the usual mathematical means of drawing them to order.

3. Drawing, as we are to deal with it here, implies the representation on a plane or flat surface of solid forms, planes, and intervening spaces as they are seen in nature, and that by help of such simple mediums as pen, pencil, chalk, or charcoal.

This includes all that is often called indiscriminately perspective drawing, drawing from nature, drawing from the round, and pictorial perspective. It is the basis of the artist's most ambitious work no less than of the young child's first effort to sketch a simple object from nature; both have to translate on to a flat surface solid forms, planes, and spaces having height, width, and depth.

No amount of handling or of literal measuring will help here. "Form Study," as it is generally taught in the schools, taken by itself, increases rather than lessens the difficulties of drawing; of a work, that is, which consists largely in recording optical illusions. The one deals with the real, measurable, tangible forms, with their actual dimensions and proportions, the other with the infinitely variable perspective appearances of those forms.

[1] If Leonardo had but pointed out the elementary division of the subject into two distinct branches, no doubt very much subsequent confusion would have been avoided. As it was, his followers, determined to study out the matter to the utmost, took up only that part of it which admits of *geometrical* certainty, failing to develop what is *optically* sure in the other parts.

4. Now the point is to train the eye to recognize perspective form just as the brain, the ear, and the tongue are trained to recognize and to render foreign words or musical notes. This can be done from a sure and certain starting-point through means that enable the student to judge and test his work, just as the singer is aided by the tuning fork or the sculptor by the compass of thickness or callipers.

As the sculptor needs means of measuring the actual proportions of each part of the model, so the drawing student needs something enabling him to measure and record the apparent proportions and dimensions of *his* model when translated on to a plane surface, giving on the flat what the callipers give in space.

5. Leonardo recognized this need. "Take," says he, in the quaint wording of the original, "a piece of glass the size of half a sheet of royal paper, fix it firmly before thine eyes, that is, between thine eyes and the thing of which thou wouldst make a portrait, place thyself so that the eye may be distant two-thirds of a cubit from the said glass, fix the head with an instrument in such a way that thou canst not move it at all. Further, close and cover thee one eye and, with brush or pencil, mark on the glass what is visible from there, then trace on clear paper from the glass, transfer on to good paper and paint if thou wilt, making good use then of aërial perspective." ("Trattato della Pittura," § 126.)

Proceeding in this way the object or landscape to be drawn is seen through this transparent or glass plane as through a window, and its every line and part can be observed and recorded, exactly as they appear. The perspective outlines and proportions of the subject can then be obtained by tracing over its real outlines, seen through the glass, as they might be traced on a window, or as the outlines of a print are traced over on a child's transparent slate. The accuracy of the picture would depend chiefly on the proper placing and maintaining of the plane between the eye and the model.

6. A general survey of the eye and the normal conditions of sight shows that by careful use of the transparent plane all the main facts and the elementary theory of perspective can be clearly, rapidly, and tangibly demonstrated in such a way that the simplest cannot fail to understand and assimilate them. The nature of the picture

plane and the horizontal line, the apparent vanishing of horizontal planes and lines to the horizon, their upward or downward inclination, all that concerns the visual angle and rays of light, can be demonstrated by transparency as by no other means. On the other hand the most difficult foreshortenings of the figure are accurately recorded.

7. The old saying, "Seeing is believing," was never better exemplified. Both sight and touch work together here. You can measure between finger and thumb the proportionate perspective lengths of different parts or objects. In this way tangible proof is obtained of the most illusive things, the ever-varying appearances of forms in space; for, by simply tracing them on the glass you record their actual perspective projection.

Can anything help as practically as this in gaining that mental grasp of perspective, the very key to the knowledge of form, so difficult to acquire? Can photography render similar service? Can the camera lucida or the camera obscura? No! For neither photography nor any other really artificial means can take the place of this actual record of nature; none of them makes the student see with his own eyes and understand with his own mind or become to the same extent conscious of what he sees.

As to photography it cannot be accounted correct because it does not represent exactly what the natural eye sees. A very little study of human sight as compared with it makes plain the difference between the eye and the lens. (See chapter IX.)

III. PRINCIPLES OF STUDY.

1. In the words of M. Marcel as quoted by Herbert Spencer: "Education amongst us consists *too much in telling, not enough in training;* what the learner discovers by mental exertion is better known than what is told him"—and in those of Horace Mann: "The individual, independent activity of the pupil is of much greater importance than the busy officiousness of many who assume the office of educators."

To attain such independent activity the student's attention is called to the three following principles:—

REPETITION,
SELF-CRITICISM,
GRAPHIC ANALYSIS.

Repetition brings into play that enormous power for good or harm known as force of habit. Self-criticism is rendered possible to the student by so separating his work from himself, that he can judge and criticise it with as much independence and severity as if it were done by another. Analysis implies the habit of comparing, describing, expressing in words what we observe as to characteristic movement, form, color, or effect, before we attempt to draw, sometimes when we have no opportunity at all of drawing.

The first two, repetition and self-criticism, have to do with the act of recording form; the last deals solely with the intellectual effort of observation. The advantage of recognizing it as a separate factor is considerable, for we are naturally too much inclined to think of drawing as a matter of sight and of handiwork only, whereas the very simplest graphic production is more or less the result of a triple effort of eye, brain, and hand.

Well directed repetition should be turned to account in the study of form as it has already been in various systems of language and music study. Teachers of these latter subjects seem to have fully realized the value of easy but frequent repetition of certain acts as even more effective than great mental effort, in leading to knowledge and cultivating memory. Although such effort is, at times, indispensable, the brain tension it requires calls for constant interruption. In practice the aim should be judiciously to combine the two.

2. It has been well said, that every branch of knowledge becomes a science when it is possible easily to repeat the facts of which it is composed. This applies very directly in the present case: Learn by repetition to see and draw a form correctly and intelligently, even the simplest geometrical solid, and you will not only know it for all time, but you will hold the key to the perspective representation of all forms composed of the same elementary planes and curves.

Again, learn in the same way to see aright the perspective of any single organic form, understand and realize with your mind's

eye its varying contours and the principles of its foreshortening, and you can apply your knowledge to the more difficult complications of figure-drawing.

Make your pupil see and draw forms correctly by any means available; he will soon be able to see and to draw them unassisted. Give him, by easy gradation, the understanding of what he does, and he will surprise you by his power of applying it in more advanced work, by his intelligent possession of what he has acquired.

3. Repetition has chiefly to do with the elementary training of eye, brain, and hand, the outcome of which is a desire for betterment, and this leads to self-criticism.

Any person, other than yourself, coming before your drawing, is likely to see in it mistakes that you have failed to notice. This comes from either of several causes. It may be simply a question of freshness of vision — your eye and brain are fatigued and have lost grip; in this case your critic may be greatly your inferior in such matters, and his criticism yet deserve attention. In another case you may have done the best you can, have worked up to your own knowledge and need to be shown further; here the critic can only help you if he be wiser.

But oftenest it is because every one sees better and further than he can do. Your critic need spend no effort on what has cost you much labor. He does not even take much into account the work done, but sees ahead to what is further wanting and gives judgment accordingly; sometimes surprisingly good judgment.

Thus the mere casual observer may possess an enormous advantage over the really interested person, the conscientious student. Are there no ways and means by which this advantage may be shared by him? There are, but it is first necessary to fully recognize the need of them.

4. Freshness of vision can be obtained by allowing enough time to elapse before criticising one's own work. Palma Giovane tells of Titian that it was his practice at an early stage of any work to turn his canvas to the wall, keeping it out of sight sometimes for months, in order to judge of it with fresh impression.

But freshness of vision is not all. Useful self-criticism requires some knowledge and calls for some means of seeing and

judging the work from outside. It is at this point that the philograph comes into play to great advantage. It enables the student to get the necessary outside view. Through its use he can test his work by optical proof before carrying it on to completion.

It is hardly possible to exaggerate the value in drawing of constant, intelligent criticism, whether to the student who is naturally too apt to think well of his own work, or to the one who is diffident. The foundations can never be too sure. If they be faulty we cannot know it too soon. On the other hand, a want of certainty as to actual fact will often make a conscientious worker spoil what is good and individual in his drawing by going back to make sure of his groundwork.

5. Analysis comes in to supplement all this. Analyze, compare, describe, mentally and even verbally, for your own better knowledge of it, what you intend to describe with the pencil. The effort required for this is a great help in training the observation and strengthening the memory, and, together with careful, accurate study of form, is the groundwork of memory drawing.

But analysis is not to be taken here in the purely scientific sense adopted by some art critics. We are studying the science of appearances in connection with art, and we must analyze form with that in view, not by pulling things to pieces to see how they are made, but by comparing appearances, by understanding their interdependence, their relation to each other, their synthesis. For example, the general characteristic tendencies and proportions of a whole profile, the few chief or *axial* directions of a figure in movement, not only the form of each feature or limb, must above all be studied and remembered.

This mental reduction of forms to their simplest elements, not piece-meal, but as an organic whole, belongs to every branch and kind of drawing, and it is of especial importance in portrait study. It will be referred to at every stage of work in the following pages, and further suggestions of its application will be given in the practice exercises.

IV. OF THE EYE AND THE SIGHT.

NOTE. — Although the study of the eye does not form an immediate part of the study of drawing, familiarity with its structure and workings will considerably help the drawing student, enabling him to avoid many a stumbling-block. It is also important in view of judiciously using such material means as are correct and helpful, and avoiding such as are misleading, or even harmful to the eye. For this no very detailed study is required, rather such general notions as are embodied in the following paragraphs.

1. We have already seen that drawing is the representation of forms as they appear to the eye. What we have to do first is to realize those appearances.

How do we see? How much do we see? On what is human sight based? Wherein does it differ chiefly from its powerful, valuable, but defective counterpart, photography?

2. In the first place, how does light affect objects? How do they become visible to the human eye? Light is produced by a rapid succession of vibrations radiating from the light-giving source. When these "rays" of light encounter any solid object, they are in part absorbed by it, but in part also thrown back or reflected from it, as is plainly shown in the case of a plate of polished metal, or as happens at night when the moon, receiving light directly from the sun, throws it back to us on the earth.

It is owing to the constant vibration of rays (thus received and thrown back) that objects become visible to us, for certain of these rays penetrate into the eye, producing there an image of the object seen. Imagine a candle burning in an otherwise dark room, light is plainly seen to *radiate* from it in every direction. Now suppose that a sheet of cardboard, pierced by a small round hole, be held up between the candle and the wall: only a small portion of all the rays will pass through the hole, the rest being cut off by the cardboard screen. This represents what happens in the case of the eye. Fig. 1.

But the rays thus isolated might be greatly affected by causing them to pass through a lens or magnifying glass, and this would still better represent the eye, for precisely so do they pass through its crystalline lens.

3. Now, if rays run in every direction from every object around us, those that penetrate into our eye will come, not from one point alone as in the case of the single candle, but some from above, some from below, some from opposite us — these last running at right angles to the supposed cardboard screen. As each ray follows its own direction, upward, downward, or horizontally, they meet and cross and then spread again, forming what is commonly called a *sheaf of rays*. Fig. 2.

Only those rays that reach the eye concern us at present; therefore we speak of the sheaf of rays as if that alone existed, and sometimes, for convenience' sake, as though the rays proceeded from the eye instead of entering it, which simplifies explanations. This figure of a wheat-sheaf, though not absolutely accurate, is used in different languages to illustrate the grouping of rays of light, which speaks well for its general suggestiveness.

4. Now think of the sheaf of rays as passing through the hole in the screen, and of each ray as carrying with it the image of the single point it comes from; note where they touch the wall (see Fig. 2), and how their relative position is reversed, the one coming from *A* below touching the wall at *a* above, and *vice versa*. Thus it is that, as physiologists tell us, the image formed in the eye is always upside down, as it is seen to be on the ground-glass plate at the back of the photographic camera. In the case of the eye that image is, in some so far unexplained manner, so redressed as to give us the conception of its true position.

In the camera rays enter, cross, and abut, or "project themselves," on to the back wall or plate much as they do in the eye, — with certain differences, however, for the boundary wall at the back of the eye, instead of being flat, is concave, forming a large part of a hollow sphere. It is lined with a special membrane, called the retina, on which the rays of light produce the picture they bring with them, the image of what we are looking at.

5. The eye consists of a great many component parts, named and described in every manual of physiology. Only a few of these concern us here, namely, the iris and pupil, the crystalline lens, the retina, and the optic nerve.

The iris is the colored portion of the eye, represented by the sheet of cardboard above mentioned; the pupil is an aperture in the iris,

like the hole in the card, serving to admit light into the eye, just as much light as is required at a given time, no more, for — thanks to the contractile nature of the iris — the pupil shrinks when the light is intense, so as to admit but little, and dilates when the light is faint and more of it is needed. Never, even at its greatest dilatation, however, does it entirely expose the crystalline lens behind it, nor give passage to the outer or marginal rays. This accounts in great part for the clearness of the images we see. Fig. 3.

6. The crystalline is a double-curved lens, of which the front or anterior surface is normally flatter than the posterior. When, however, — and this is a marvelous adaptation of nature, — a very near object has to be looked at, the front curve becomes momentarily more convex and protuberant than usual, whilst the back curve slightly flattens in sympathy with it. This is technically called the *process of accommodation*, and it is a very important factor in human sight, a point in which the eye necessarily differs from every kind of artificial seeing apparatus.

The impression of the image formed on the retina by the rays of light passing through the pupil and the crystalline lens is carried to the brain by the optic nerve; otherwise we should not be conscious of seeing anything.

These few elementary facts constitute what it is imperative for the student to know concerning the actual structure of the eye; the use of knowing them becomes more and more evident as we go on into practical work. Next to be considered are some important points connected with the working of the eye and the laws of sight.

7. Of focussing the Sight. — Although the human eye can bring any given object into focus through the power of accommodation, it cannot do so for more than one *plane* at a time. For example, suppose two similar objects placed directly in the line of your sight, the first, A, one yard away from your eye, the second, B, rather lower and only half a yard away, you must choose which of the two you will see distinctly, for although they are in the same straight line, if your attention be fixed on A that point alone will appear clear, whilst B looks foggy, and *vice versa*, B will be clear when A is foggy. This experiment is most striking when made with two lighted candles.

8. The natural eye only sees distinctly a very small space at a

time, and can only look with intensity at one point of that space. The space seen clearly at a single glance is called the *area of distinct vision;* the object actually looked at gives the focal point, that is, where the sight of the two eyes comes together.

Although we see distinctly only a very small space at a time, the constant movement of the eye on its axis leads us to believe otherwise; and in fact, our sight does practically cover a very large field, thanks to this easy and rapid change of direction, and to the large, semi-spherical, concave surface of the retina, not therefore by seeing all at one glance, but by the almost unconscious working around of the eye, like a telescope on a movable stand.

The eye, we learn, unless constrained to do so, never remains motionless more then a single second ; again, the limits of our perfectly distinct sight are vague, and we are apt to be deceived by this, to think that we see clearly what we really only perceive.

9. When we are looking at an object very near us, and the power of accommodation of the crystalline comes into play, it is as though the lens were bent on getting nearer the object, stretching forward "like a hand reached out to take hold of that object," as the French physiologist Béclard puts it. Hence a common French expression, "cela tire les yeux," it *draws* the eyes, and so tires them, is not merely a figure of speech, but a literal truth.

When we have been looking long and intently at a near object, a certain infinitesimal space of time is required for the eye to be able to perceive a distant one. When we look at objects at different distances from the eye, we are conscious of the effort made to re-focus our sight. This becomes almost painful when we look suddenly from distant to near objects, or from large ones to small.

10. On the other hand, when we have looked long at something close to us and then change to a more distant object, there is a feeling of relief, a cessation of strain, for then the eye is in the same condition as when in complete repose. This explains why it is fatiguing to the eye to look at pictures in which very wide-angle perspective is represented, especially when the picture is of very large size (see chapter on perspective).

Some of the present-day painters would do well to learn, consider, and act upon these elementary optical facts. They might thus avoid

numerous common errors; for example, they would be less apt to treat "values" as though the foreground and the background of their picture represented planes at equal distance from the spectator's eye; they would not so often be harmfully influenced by photography.

11. The eye sees things immense distances away, if they be sufficiently well lighted, but the converse of this does not apply in the same degree to very near objects. Each student must find out for himself the limit of his powers. "Accommodation" is said to cease for the normal eye at a distance of 22 centimeters (8 inches). Eyes of different kinds of animals bear a distinct relation to their nature and customs. Thus, in the case of a bird of prey, the crystalline is very flat, whereas that of a fish is almost spherical, and that of a bird accustomed to dive under water for its prey is rounder, more like the fish's. Human eyes show diversities of the same kind, though less marked. Those of short-sighted people are generally more protuberant than others'.

All these things find their application in drawing with regard to what is to be avoided as well as to what is to be done. Before entering upon this subject some facts have still to be mentioned concerning optical illusions.

V. OPTICAL ILLUSIONS IN GENERAL.

1. Besides knowing how his eye is constituted, how it works, and what are the necessary conditions of position and distance for properly seeing, the student needs to become familiar with the many illusions to which even the healthiest eye is subject. Some he must understand in order not to be deceived by them, others he should study in order to cultivate and record them, for in one sense, all perspective is founded on visual illusion.

To speak first of perspective illusion. It is the painter's chief aim to give to his canvas such an appearance of depth, distance, relief, movement, as shall make the spectator forget that it is flat, thus producing for him a considerable degree of optical illusion.

For this he must copy the apparent form of everything he intends to represent. Experience teaches us the real form of things, their distance from us, and all that; but nine times out of ten, owing to

their varied positions, their appearance is entirely different. For example, you know that the door before you is oblong or square, as the case may be, but open or close it a little and note the change in its appearance. It looks narrower or wider, according to your own position or point of view. Your eye alone, without experience, would mislead you as to the shape of that door, but, if you attempt to draw it, the chances are that your knowledge will interfere with your representing it as you see it.

2. Every one is more or less conscious of these alterations of appearance, but no one ever realizes how complete they are until he tries to draw them. They are of the greatest importance in our present subject, for, as cannot be too often repeated, drawing consists in representing things not as they are but as they appear.

It is the student's first task to learn to see consciously the apparent, or perspective, form of objects, as well as to know their real form.

3. In this connection a more detailed remark with regard to what is known as "form study" (now so largely and deservedly in vogue) will not be out of place. In spite of its unquestioned value in Kindergarten work and otherwise, this study of actual form does certainly increase the difficulty of realizing apparent form, and, in view of any serious study of drawing following after form study, it is absolutely necessary that the two should be linked together, and, from the first, even greater importance given to apparent than to real form. This does not seem to be generally understood.

4. The eye is subject to illusion with regard to form, size, distance, color, and values. Illusions of form are of two sorts, those concerning surface forms and those concerning solid forms "seen in space." The latter enter into the subject of Perspective, and will be dealt with in a separate chapter; the former, optical illusions on the flat, are important in their connection with perspective, but do not, in the usual sense, form a part of it. We shall notice some of these first, as being even more intimately connected than the others with the eye and with the first principles of sight.

Optical illusions on the flat are mostly due to contrast, whether of size, space, color, or value, but some depend on such common visual sensations as are specified below.

5. The only impressions which the retina is able to receive and to transmit to the brain immediately are those of volume, direction, color, light, and shade. These are, in the most literal sense, elementary; any further notions we possess are greatly modified by experience, as, for example, that of motion.

Any object passing rapidly across our field of sight causes a distinct sensation, chiefly owing to the fact that our eye naturally follows it (it causes a displacement of the axis of the cone of rays; see chap. VIII); but if the movement be right out from us, in the direction of our line of sight, we are only conscious of it because the moving object appears smaller as it gets further away, or larger as it approaches us. Thus at a great distance we are unable to discern whether a ship at sea be advancing or receding. The same is true of a person seen in the street.

Separate points give a seemingly uninterrupted line when one follows another before the optical sensation made by the first is past; example, a lighted match whirled around in the darkness produces a circle of light, rapid falling drops of rain produce an effect of continuation; so does a rocket shooting upwards (this illustrates exactly the phenomenon of the rays of light). In the same way images rapidly succeeding one another give an appearance of motion, as in the zoetrope, a favorite toy of some years ago, and the more recent kinetoscope, in which the figures shown have all the appearance of going through a series of actions.

On the other hand, things that are stationary appear to move. The landscape seems to run alongside the railway train.

6. We only appreciate facts of distance through experience. Thus a young child will try to take hold of objects far beyond his reach, and people fully trained and developed constantly misjudge of distance and size. This occurs even in quite familiar matters, under unusual atmospheric conditions, or if the object be too far off for its individuality to be perceptible, or again when no familiar form is at hand to serve for comparison.

This leads us to consider the importance of contrast, which is the immediate cause of so many of our visual illusions and of some of our knowledge. It is by virtue of contrast that two or more forms, colors, or values, placed close together, frequently cause alterations

in one another's appearance, sometimes effacing, sometimes accentuating characteristics. These things are dealt with at length by the celebrated French scientist, Chevreul, in his works on the Chemistry of Color, in which the close connection between contrast and the laws of complementary colors is strongly brought out.

7. For some typical examples in contrast as to size, value, form, direction of line, etc., see Plate II.

Straight lines traced upon a sphere will always appear slightly curved in opposite directions, as in Fig. 9. Other things being equal, what is white generally appears larger than what is black. In Fig. 10 the white centre appears larger than the black one. It trespasses or impinges on the dark ground, and its importance is increased by contrast. On the other hand, small white spots on a black ground appear gray or disappear altogether when seen from a short distance. The empty square appears smaller than the square *A*, *B*, *C*, *D*, subdivided into smaller squares (see Fig. 11).

In Fig. 12 the lines *aa*, *bb*, are exactly equal, but *bb* appears longer owing to its surroundings; its length seems to be carried on upwards and downwards by the short sloping lines, whereas those on *aa* make it appear shorter; the eye travels further in looking at *b* than in looking at *a*.

If we look successively at two figures of the same height, but of different width, the narrower will always strike us as being the longer. The mere direction of lines often deceives; of two lines equal in length, one vertical, one horizontal, the vertical appears the longer. In Fig. 16 the eye confuses the extremities with the field of vision at the expense of the extremities, that is, the interrupted line *aa* appears shorter than the firm line *Aa*.

The question of contrast is also directly connected with that of size or extent. This is seen chiefly with regard to contrast in colors and in values. When we look closely at the alternate black and white squares of a marble pavement, each square seems to intensify the other's value, and especially at their points of junction. But, move further away, look at the same pavement from a greater distance and surrounded by other objects; the blacks and whites lose much of their intensity, especially at those very points of contact, which now, instead of contrasting strongly, seem to mix and melt

together. The effect produced is the same for the eye as if the pavement were of exceedingly small squares. The visual angle would be the same in both cases (see perspective).

8. Effects of color (chromatic phenomena) produce similar illusions, and are subject to the same laws. When two wide bands or zones, one of blue, the other of yellow, are placed side by side, the blue appears more or less violet, the yellow of a slightly orange hue; but cut them up into very fine stripes, or make the two colors cross and subdivide each other, and a distinct impression of green will result. It might well be said here, in the words of the German philosopher, Kant, that "Quality is a mode of quantity."

Colors also have specific individual characteristics; for instance, a blue at the same distance from the eye as a red will appear to be much further away.

Practical examples of these facts are constantly met with in drawing from nature, and a knowledge of them may be turned to good account; thus, referring to preceding examples, a given form in your drawing may be really correct as to size, and yet convey an impression of being too large or too small, which impression can be altered by simplifying or by breaking up the values. Again, a figure draped with a view to producing a cross-wise, diagonal direction of line (Fig. 12), can be made to appear much taller and slimmer than otherwise.

An artist, for want of realizing the existence of these and similar visual illusions, sometimes makes his figure unnaturally tall, putting it out of proportion with its surroundings in order to obtain an effect of height and dignity that might be insured by judicious application of the means above suggested.

It is, of course, often possible to counteract one such misrepresentation by another, but the effect thus produced is unsatisfactory, whereas, with a competent knowledge of these things, the required effect can be obtained without recourse to any such complications.

9. Before going further let us realize shortly what are the chief lessons the drawing-student should gather from the study of the eye.

We learn that, apart from any idea of art or of drawing, it is largely owing to the natural and unconscious working of the brain that we see things in their proper relations. Countless facts of

everyday occurrence concerning distance, proportion, etc., are only realized by us through experience.

If our intelligence has so much to do with our seeing correctly and harmoniously in ordinary life, how much more important must be the connection between sight and mind for those who purpose to study art.

It is well for us to learn about the eye and its actual sight, both because we are very apt to make mistakes as to what we really see, and also in order to realize the differences between the natural and all artificial seeing apparatus, especially the photographic camera. We must, however, constantly bear in mind that the sense of sight alone is not enough. From the artist's point of view it is even very incomplete. The study of Graphic Art, with all it implies of understanding, choice, and selection, requires from the very first, distinct, conscious, brain work, and especially implies thorough training in observation, which will form the subject of our next division.

VI. WHAT TO LOOK FOR.

I. The Axial Principle — Proportion.

1. It soon becomes evident to the drawing-student that seeing alone, and even understanding what he sees, is not enough. Even for the truthful record of natural forms, observation, choice, elimination are required. Of the infinite amount that we see, what shall we specially take note of — observe? What shall we record, what omit, in order to give the living essentials of our model? What portion of the panorama before us will form a good subject for a sketch or for a finished painting, what point of view, what distance will best suit our figure-subject or portrait?

These things it will be said, are matters of study for the accomplished artist, and that is true, but it is no less true that they enter into the student's elementary productions.

If we can trace them back to their origin, and lay hold on some of their underlying elements, the earliest teachings may be based on them.

Seeing is not always observing, and even careful observation, when unguided, does not tell just what route to follow, what is essential in our subject, what must be looked out for and determined first, in order that what comes after may constitute an organized whole and not a mere indiscriminate mass.

In all drawing the student has to deal with essentials and with matters of choice. By essentials are meant things that it is his place simply to study and to record. It will be found that these owe their supreme importance to the fact that they proceed directly from the first visual impressions received by the normal eye.

First among essentials are direction and proportion. Let us see how they originate and what is their application in our work.

2. DIRECTION AND PROPORTION.— It was shown in Chap. V, No. 5, that the first perceptions of the retina are those which give notions of direction and of volume, quantity, or extent, whence results the idea of proportion. We shall now see why these two (direction and proportion) are the most important things to be observed. As already said, when an object passes rapidly before your eyes, you may not see what it is, but you will surely perceive the direction of its motion. Look at a boy running or a man carrying a burden: the general direction or inclination of the whole figure, apart from its actual motion, is what will strike you first, long before any details of form.

What is true for the figure, is true for everything else. Every time that motion, or action has to be expressed it is done mainly by one chief direction of figure or of form. Think of a galloping horse, a wind-blown tree. Lay hold of this direction and express it as best you can by a single line. That line will be the chief *axis* of your figure's action, and it is what you must think of first in sketching that figure.

But organic forms in action do not, as a rule, work as though they consisted of a single piece. The very fact that the figure as a whole is violently inclined in one direction, makes it necessary that something should counter-balance that inclination, thus a secondary axis, or counter-axis, will have to be found in order fully to express the elements of that figure's action or "movement." We call this obtaining the sense and counter-sense ("le sens et le contre-sens")

or the axis and counter-axis of a figure; and refer to the existence and importance of these axes as the axial principle.

3. Our very first perception of proportion comes through contrast. If a tall and a short man stand side by side, or if two sticks of unequal length be laid near one another on the floor, even the untrained eye is able at once to distinguish between them. If, however, you place a small ball and a large one in the same line far enough apart for them to appear of equal size, the same untrained eye cannot judge of the distance between them, except by experience.

4. Suppose you sketch a boy running; the general direction of the whole figure, that of each limb or part, and the proportionate length and size of each, as being what your eye sees first, are the *essentials* of what you have to represent. They are like the wire skeleton around which the modeller gradually builds up a figure. This inner-frame work is called in French the soul (*l'âme*). Notice that whatever may be superadded, the facts it gives remain the most important, for they are fundamental, not matters of choice, or of fancy, or of finish. It is to be observed in all good figure drawings, especially by the old masters, that the outer forms and contours are felt to be built up on this supposed frame-work or skeleton.[1]

Nature always works thus, from the centre outwards, never beginning with the leaves and going on to make the trunk of the tree, nor proceeding from the bark to the core. We should work according to natural laws and sequence and we must before all learn to observe these things.

Whether sketching a tree, a human figure, or a single flower, always look first for the main direction of the whole, then for secondary directions, which generally cross the first. See in a flower and leaf, for example, how much that is essential, its life, its growth, its vigor, can be expressed, simply by recording its directions. Great attention should be paid to these determining lines; if they be stiff and angular or round and flaccid, no amount of good detail drawing will convey the required impression.

[1] Note that we are speaking here of *what to look for*, how to conceive and how to render simply what we see; no extraordinary modes of proceeding being suggested.

Axial lines may be straight or curved, they will rarely, if ever, be exactly vertical or horizontal. Absolute symmetry does not seem to exist in nature, and a perfectly vertical or horizontal line is seldom required except in representing architecture or the surface of still water, or as a boundary to the sketch.

5. The axial principle is every whit as important in dealing with figures in repose as with figures in action, for in every case of translating solid forms to a flat surface the essential characteristics of life, action, movement, are given by the axial directions. The same is true in different degrees with regard to everything that has life, animal or vegetable.

Facial resemblance again depends very largely and, if we exclude color, almost entirely on the direction of lines. These give the axes of some parts, as of eyes and mouth, the accurate inclination of others, as the upward or downward slope of nostrils, of cheek-bones, or of muscle furrows.

A familiar face may be powerfully recalled by a few rightly placed lines, without any attempt at modelling; simply built up on straight lines and carefully observed angles. Caricatures are founded on an exaggeration of this treatment, that is, on its application carried out in defiance of proportion.

Albert Dürer, in his *Elements of Geometry*, gives amusing illustrations of this applied to the whole figure, showing how the artist can portray the same man as being very stout or very lean without destroying his individuality, which remains recognizable throughout.

II. The Oblique or Diagonal Principle.

6. Next to the fact of the importance of direction as an element of expression, is the fact of its almost universal cross-wise tendency as indicating movement and vitality; so constant is this that the oblique or diagonal line may well be termed the *line of life*, whereas absolute horizontals and verticals, which in architecture express stability, only tell of rigidity and death in their connection with the human figure.

Notice for example a person sitting at rest in an easy chair; no motion has to be expressed here, yet the oblique direction is con-

spicuous and this almost in proportion to the degree of restful ease suggested.

7. This same cross-wise or oblique tendency, which may be called the diagonal principle, is to be observed in the correspondence of parts in all organic and irregular forms and in the movements of animals,[1] etc. It is well exemplified with regard to motionless figures bearing great weight, in the familiar antique statue of Atlas supporting the world and in that of Hercules resting on his club.

It seems to be the very ground-principle of all great decorative compositions by the best masters, both in sculpture and in painting. On the other hand you cannot sketch a flower or compose the simplest still-life group without applying it. It exists and must be expressed in all landscape drawing as it always has been by the great painters, underlying all they do, whatever the differences of execution and style in rendering it. Sometimes it is expressed with great complexity of line as in Titian's drawings of classical landscape compositions and in Theodore Rousseau's lanes and hedges, sometimes with much simplicity as in Poussin's drawings. Among the recent masters, such as Corot, Dupré, Daubigny and others, it is often expressed by interwoven masses of light and shade or of silvery grey and white.

Chardin, in his wonderful still-life paintings in the Louvre, shows the importance of this diagonal treatment in connection with colors and values.

Everywhere the axial and diagonal principles reign supreme, carrying out visibly and tangibly the first teachings of the human eye, proving themselves to be the first elements in the expression of life and movement.

8. The idea of proportion, that is, of relative importance, has, as we have seen, the same elementary origin as that of direction, of which it is the necessary complement. What direction is for the expression of life, proportion is for the expression of form. As a matter of visual perception all drawing is founded on perspective, but as a matter of actual execution it is founded on proportion.

[1] The scientific fact of the diagonal movement of animals is well proved in Professor Muybridge's photographic studies, which, however, no one would think of suggesting as models for works of art.

To fully realize this is to understand how much less important it is that your drawing be of actual life size than that its parts be accurately in proportion throughout. This, which is so evidently true with regard to size, is equally so with regard to colors and values.

9. Let us now turn to those things that must be observed from the first, but still are, in a great degree, left to the discretion of the draughtsman, and may therefore be considered matters of choice.

As already explained, the axes and proportions of our model are essentials, not only because they rest upon the eye's first perceptions, but also because they exist in immediate connection with every form, and must be studied and accurately copied as they are seen, by whoever proposes to give its true representation.

But the whole aspect of the subject — model, figure, flower, or landscape — including even its visible axes and its apparent proportions, depends upon the choice of a *point of view.* Again, the apparent dimension and importance of an object depends upon the choice of a *point of distance.*

The importance of choosing well in these matters cannot be exaggerated, but they belong to perspective proper and will be spoken of in due course.

VII. THE PHILOGRAPH.

1. Nothing can so help the reader to a clear understanding of what has been already said concerning the manner of our sight, and of what has to be said about perspective theory, as the actual manipulation of a philograph. Explanations from now on are made on the supposition that access may be had to one.

2. This instrument consists essentially of a glass plane or window, fixed in a vertical position on a tripod stand, which allows of its easy removal, and, when necessary, of its inclination. A metal diagraphragm or eye-piece, of which the small aperture answers in size to the pupil of the human eye, is attached to a sliding bar. By means of this bar its distance from the glass plane, and, consequently, the size of the tracing made on it, can be regulated at will. The sliding bar and the upright metal eye-piece also ensure that the transpar-

ent plane shall always be at right angles to the draughtsman's line of sight, which is indispensable. The plane will be inclined only in rare cases when objects to be drawn are so near and so much below or above the eye that they do not come within the "normal visual angle."

3. The outlines and proportions of the object or view looked at are traced on the glass with a soft lithographic crayon, much as a print is overlined on the glass of a transparent slate. There is, however, this vital difference, that in the present case the student working from nature must see and choose for himself the lines and proportions he intends to record, whilst in the case of the flat copy this is already done for him.

VIII. PERSPECTIVE.

I.

1. Of perspective proper, the first thing to be remarked is how comparatively late in time it began to be generally studied and applied.

In the remains of ancient Greek, Roman, and Egyptian painting, discovered in different parts of Europe, but little sign of perspective knowledge is to be found, although we have the testimony of Vitruvius that the theory of perspective had been to some extent grappled with as early as the time of Æschylus.[1]

In many wall-decorations at Pompeii, representing architectural subjects, porticos and interiors, remarkable for their grace and their

[1] Vitruvius tells us that design "consists of ichnography, orthography, and scenography." — The first gives the ground plan, the second the elevation, the third exhibits "the front and a receding side properly shadowed, the lines being drawn to their proper vanishing points" (*Vitruvius*, translated by Joseph Gwilt, Book I, p. 10). Again we read (Book VII, p. 154): "Agatharcus, at the time when Æschylus taught at Athens the rules of tragic poetry, was the first who contrived scenery, upon which subject he left a treatise. This led Democitus and Anaxagoras, who wrote thereon, to explain how the points of sight and distance ought to guide the lines as in nature, to a centre; so that by means of pictorial deception, the real appearances of buildings appear on the scene, which, painted on a flat vertical surface, seem nevertheless to advance and recede."

beauty of coloring, and showing a certain suggestion of perspective truth, receding lines, and planes that should perforce converge, are for the most part drawn parallel, while figures, heads, hands, and feet are treated with a flatness that implies at least great uncertainty as to foreshortening, and a decided willingness to avoid its difficulties. Not until centuries later — when the dark ages of early Christian symbolism, Roman and Byzantine, had been passed through — can any real advance in this direction be established. Not until after the appearance of Cimabue's epoch-making, then termed "Naturalistic," Madonna, did painters draw figures which really appear to stand upon their feet; they do not seem to have even attempted to do so.

2. The name of Paolo Uccelli (about A.D. 1390 to 1472) became celebrated in connection with his studies of perspective, chiefly architectural; but, among many well-known and much admired pictures of his time and of a later date, the strangest ignorance of foreshortening may be seen, side by side with much that is beautiful and truly artistic.

So much for Europeans; the typical Oriental and, above all, the admirable Japanese artist does not yet realize the value of perspective.

How should they whilst following along their present lines? Marvellous accuracy of eye and hand, a fertile imagination, indomitable patience, remarkable taste in color and line combinations, a love of nature seen through this inborn decorative perception, and unrivalled delicacy of execution — all these they constantly give proof of possessing; but perspective, the science of appearances, is quite apart from these things; it is based on the laws of sight which must be understood, or at least applied, in order to obtain the true rendering of forms as they appear.

3. Before going further let us pass in review what elementary notions we have so far acquired concerning perspective.

Perspective comprises forms and spaces as perceived by the human eye. Perspective forms, perspective proportions, perspective angles, are forms, proportions, and angles as they appear to the eye. The organized study of these things constitutes the science of appearances.

This science of appearances, in so far as geometrical forms are concerned, has been very fully developed,[1] but the study of irregular and organic forms has not been, and, practically, cannot be, treated in the same way. Nevertheless, it constitutes the most difficult, and for many, the most necessary branch of the subject; therefore it is important that it should be simply formulated, and that some amount of certainty and precision be introduced into the mode of studying it.

The only kind of certainty possible here is obtained by optical means, enabling us to realize what we actually see, and to test our unaided efforts at graphic representation by comparison with what we know to be correct. The use of such means, in order that it may not become merely empirical, that is, dependent on experience without knowledge or art, must be made in connection with sound theory.

This takes us back again to Leonardo da Vinci. Perspective, as he made use of the term, and as it is here employed, is the art of right seeing. It deals with every kind of form, and implies both a knowledge of how and what we see, and also of how we should look at things in order to represent them to the best advantage. To this end we have studied the eye, its structure and its mode of working, also certain definite optical illusions to which it is subject, recognizing the connection between these illusions and pictorial work. With regard to seeing to best advantage we have still to study the special importance of the distance point, and similar matters.

4. In all pictorial drawing we deal with apparent, not real form. In perspective proper we have to deal with alterations in apparent form. These depend chiefly on questions of distance and position, on the point of view, the point of distance, the opening of the visual angle, all of which must be studied in detail.

[1] A rather natural reaction against linear, or geometrical, perspective seems to have taken place, and teachers are not infrequently heard to speak as though the study were entirely unnecessary. This is undoubtedly an exaggeration. The student cannot do without some practical knowledge of the principles of perspective; the important point is that he should learn theory only in connection with practice, and only so much and in such a way that he can thoroughly assimilate what he learns and carry it out.

We have learned the importance, theoretically, of direction and proportion as essentials in the graphic representation of organic form; we shall find them to be no less important at every stage of our practical work, as much so in simple model-drawing as in studying the forms and movements of the human figure.

We have also seen that the use of the philograph introduces into the study of organic form some equivalent for the certainty and accuracy that exist in the study of regular or geometrical form.

The laws of sight and the elementary facts and principles of perspective are the same whatever the forms dealt with, but they are easiest demonstrated and understood in connection with regular forms. These, therefore, are taken as examples at starting; and since they are made up of simple lines, planes, and curves, which really constitute all that is most important in linear perspective, we shall refer to these elements alone and to their apparent alterations, treating them not as abstract mathematical facts, but as demonstrable appearances.

5. PERSPECTIVE APPEARANCES. — *The Point of View.* — Perspective appearances are what chiefly concern the painter, the amateur, the sketcher, the drawing-teacher, and the student; let him learn to see them aright and the more abstract perspective truths, if he have occasion to master them, will be far easier to him.

The different appearances of a house, for example, as you gradually walk around it, depend upon your point of view, which is not immediately a question of perspective; but its different appearances as you go close to it or as you move away (without altering your view of it) depend upon your point of distance, which forms the very groundwork of perspective. This is aptly illustrated by the following anecdote:

A young Frenchman, named Valenciennes, who afterwards became a celebrated professor of perspective, called upon the well-known painter of sea-ports, Joseph Vernet, whose authority on this particular subject was unquestioned, and showing him some 200 perfectly executed perspective diagrams, asked his opinion and advice concerning further studies. Vernet looked them through attentively and said: "I see that you have worked most assiduously, but I also see that you do not know the first word of perspective." "What is the

first word, Professor?" inquired the student. "The point of distance," was the reply, and Vernet proceeded immediately to prove his theory by carefully sketching, exactly as he saw it, a small table placed quite close in front of him, so that he was of course looking down upon it. He then moved to the farthest end of the very long studio and again sketched the table exactly as it appeared. A third sketch was made, the table being seen this time from a medium distance.

These three typical sketches were then compared and pronounced upon. The very near one, giving what may be called a wide-angle perspective view of the subject was shown to have much in common with the artisan's working drawing or even with the architect's plan. The one done from a long distance was almost like a geometrical elevation, only the one representing the table as seen from a medium or *normal* distance gave a natural perspective appearance to the subject, properly suggesting its shape and its position. Valenciennes, who himself tells the story, learned his lesson and took his departure, feeling that he had gained more from that one simple demonstration than from many hours of assiduous but less well-directed labor.

6. Of these three points of distance, the normal alone concerns us for ordinary sketching purposes. With the wide-angular, so often seen greatly exaggerated in photographs, we shall sometimes have to deal in studying architectural interiors, etc. The geometrical, decorative (or far distant) has its uses, chiefly in certain large decorative subjects (hence the name) and in architectural work.

These are important facts; the student of perspective should lose no time in mastering them and putting them in practice. If his studio be not large enough to admit of experimenting with a table, he will take a large book or a flat box, and observing and sketching it from three different distances but from the same point of view, he will find that it completely illustrates the three kinds of perspective appearances.

If he have access to a philograph he should practice tracing, or at least mentally realizing, the outlines and proportions of his model on the glass plane, then compare his tracing with a sketch done from nature, and so make quite sure of understanding the required condi-

tions. The height of the model from the floor must be the same throughout.

7. What then is, or should be, the normal distance of the artist from his subject? How shall the student know where to place himself in order to sketch his figure or his still-life group to the best advantage? How much of the wide-reaching landscape before him shall he attempt to take into his sketch? Every sketcher has at times found himself confronted by these and similar questions, alike difficult to answer satisfactorily.

The normal distance of the artist from his subject, chosen by the masters as being the most favorable, is, broadly speaking, equal to two and a half or three times the greatest dimension of that subject, referring of course to a figure or a large still-life group. This is practically the same as to say that, whatever the size of the model or group of models, or the nature of the landscape subject, the draughtsman should place himself just so far from it that he may be able to take it all in easily at a single glance, without moving the head, hardly even the eye, — for the student will find that in choosing the above-named distance, he is precisely taking his natural visual angle as a measurement.[1] This is simply and easily demonstrated by the philograph, more conclusively so than by any amount of geometrical diagrams.[2]

Another reason for which the student needs to become familiar with the *visual angle* is that it constitutes a chief point of difference between human sight and photography. The visual angle is determined by the aperture of the pupil and its distance from the retina; this, as stated, gives normally an angle of from 25° to 30° for the

[1] Leonardo says three times the height. This would bring the subject within the visual angle and to spare, for the opening of the normal visual angle is 25° to 30° (Béclard), and the opening required in this case would be only 20°.

[2] For this fix the diaphragm or eye-piece of the philograph at different distances from the transparent plane, each time putting the eye close up to the small aperture, and try on the glass with finger or with pencil how much of what is before you you can see distinctly at a single glance, without in the least forcing the sight. You will first of all be surprised to find how small the object looked at appears and how small an area your sight covers; then by comparing the width of that area with the distance between the eye-piece and the glass plane you will see that one is equal, roughly, to three times the other.

amount seen at a glance by a well-constituted eye. Compare this with the visual angle of the modern camera lens, which takes in 70°, 80°, 90°, or more at a glance (see photography). The opening of the visual angle gives the extent of the area of distinct vision (see Chap. V). These are terms the student will find useful when clearly understood.[1]

8. The tracing made on the glass plane has been spoken of as being the *projection* of the object looked at, traced upon a transparent section of the visual cone. The transparent plane itself (the plane of the philograph) is mentioned as exactly representing what is known as the *picture plane*, and drawing consists, materially, in recording the forms and proportions of the objects we are looking at as they appear when translated on to the picture plane. In order fully to comprehend these terms and to realize what they stand for we must go back to the chapter on the eye and its workings.

The larger portion of the "sheaf of rays" (see Fig. 2) gives a conical or funnel-shaped form, of which the point is at the eye while the open end widens out indefinitely, as best represented by the rays of a search-light. A sheet of glass placed upright across this cone of rays gives a transparent section of the cone, which section will become gradually smaller according as the glass is moved nearer to the point or apex of the cone (in a word, to the eye). The projection of the rays upon the glass, in our case the image brought by those rays, will thus evidently vary in size, but, as long as the section is at right angles to the axis of the cone it will not vary in proportion. That is to say the proportion its parts bear to one another will not vary. But, if the section be not at right angles, the proportions will change, the rays will be of very unequal length and inclination and the projections thus obtained will evidently be faulty.[2]

[1] The normal perspective distance does, of course, admit of considerable variation, without going so far as to trench upon the others above named. Thus you may, within certain limits, lengthen or shorten the distance, you may widen or narrow the visual angle without greatly altering, although sometimes improving, your effect. This is chiefly a matter of experience and of observation.

[2] This is easily demonstrated thus: hold the plane of the philograph so as to make an oblique section of the cone rays and, whilst looking through the aperture as usual, measure with the hand, or rapidly trace, the object; its altered proportions will at once tell the tale.

The cut *A*, *B*, *C*, represents the visual cone (cone of rays), *X*, *C*, its axis, *a b* and *c d* are sections of the cone, at right angles to its axis, *y z* is an oblique section (Fig. 23). As to proportional size or extent, referring to Fig. 19 the student will see how the whole image and every one of its parts alters in proportion as the section made across the cone of rays is nearer the eye or further from it, and realize how it is that he may make a "thumbnail sketch" of an object, or draw it larger than life with equal truth, *provided its relative proportions be right.* That is, provided its parts bear the same relation to each other and to the whole.

9. In order to see an object perfectly well your visual rays must be of practically equal length when you look at it, and they generally are so, thanks to the constant movement of the eye (of the axis of the cone of rays).

We are all more or less consciously aware of this fact and our perception of it is clearly proved by many slight every-day acts. Thus, whenever we hold a book or a photograph in a sloping position before our eyes, or rest it on an inclined desk, in order to read more easily, we do so for the sake of bringing it more nearly at right angles to our line of sight, and thereby equalizing our visual rays. For the same reason pictures hung high on the wall are, or always should be allowed to slope forward and the degree of inclination should be made to vary according to their height. Pictures hung on a level with the eye should be flat against the wall. Exhibition cases of miniatures or very small paintings placed on tables or fancy easels, are generally slightly inclined backwards, just as when held in the hand, so that their whole surface may be exposed to the observer's visual cone of rays (Fig. 22).

A striking example of Michael Angelo's recognition of this fact is seen in the "Last Judgment," in the Sistine Chapel, Rome. Here the whole upper part of the picture is treated as though sloping forward to meet the gaze of the spectator standing on the chapel floor (Fig. 18). Charles Blanc seems not to have thought of this when he criticised Michael Angelo for having made the distant, upper figures larger than the near ones.

10. Images projected on different sections of the cone of rays though not identical in size, are similar, for they form the bases of

similar triangles, of which the apex is at the eye, and "equal angles produce similar triangles" (Figs. 19–23). Complete proof of all these things is obtained by setting up your philograph before the object, and tracing, *pointing* or measuring, with fingers or with compasses, the lines and proportions in question. This should be done several times, the model being at different distances from the eye. Without moving eye or model, the glass should then be placed at different distances between the two and tracings again made. It will thus be shown that the table legs bear the same proportion to its whole height or width in the small and in the large philographic tracing alike, just as when you have a large and a small photograph giving exactly the same view of the same subject.

11. The so-called picture plane, on which we have to "translate" and depict the solid forms before us, is then an imaginary, transparent plane, giving a section of the visual cone and stretching out indefinitely in every direction, and is tangibly represented for us on a small scale by the glass plane of the philograph.

When our subject is at a normal distance, our picture will only occupy the small portion of this imaginary plane embraced by our visual angle (see Fig. 19), but very often its extent is entirely conventional, especially in large wall decorations. In all such cases it is important to bear in mind what has been said about the visual angle, for according to the highest precedent, very extensive subjects must be treated either as though seen from a great distance, or as consisting of several parts to be looked at successively.

This is well exemplified in many works of that greatest of decorators, Paul Veronese as in his "Wedding Feast of Cana," in "Esther before Ahasuerus," a detailed description of which would go beyond our present subject.

12. Having once thoroughly grasped the idea of the imaginary picture plane on which our sketch is supposed to be made, we must next get a practical understanding of the so-called *horizontal line*, or *eye level*. The latter, more recent term, being more explanatory, is adopted here in preference to the old-time classical horizontal line.

The Horizon. — Suppose yourself standing on an immensely wide-reaching plane, the sky forming a hollow dome above your head, the ground apparently running up in the far distance to meet it; the line

formed by the coming together of ground and sky is your horizon, and it always appears to be exactly at the height of your eye. If you were to look at the same view from the summit of a hill or the top of a high tower, the plane of the ground would appear to run up further and would still meet the sky at the level of your eye.

No matter whether you look from mountain top, along smooth water, or down an even stretch of road, your horizon will always be determined by the height of your eye from the ground beneath you, and all planes lying on the ground (or parallel to the ground) that are below your eye will appear to run upwards, and all those that are above your eye will appear to run downwards to meet the ground at the horizon.

This is not only an important fact, it is the very key to all linear perspective (the perspective of straight lines and planes and of regular curves). The beginner must master and thoroughly assimilate this conception of the horizon from the outset, for he will do nothing worth mentioning without it.

13. But we are not always on an endless plane, and often when sketching can only see a few yards, or even feet, in front of us. No visible meeting of sky and earth will help us here. For this reason the *horizontal line*, better called the *eye-level*, is made use of. This is an imaginary line, passing right across the picture plane, cutting your subject in two at the level of your eye — represented by a line drawn across your sketch at the height chosen by you as being most advantageous.

Nothing can be simpler than this, yet there is nothing about which people make more mistakes or that, in many cases, they take longer to learn.

14. Vanishing Planes. — *The "eye-level" is the vanishing line of all horizontal planes*, that is, planes lying on the ground or parallel to it, at whatever height. These, after to all appearance gradually narrowing as they approach the height of the eye, will become as a single line or vanish when they are exactly even with it. You can prove this experimentally by holding flat before you a large book or a drawing board; raise it slowly and notice how it seems to get gradually narrower, till, when even with the eye, it has no apparent width at all. As you continue raising it, the under surface becomes visible

and gradually widens, just as the upper surface formerly narrowed, in proportion as its distance from the vanishing line increases, or as it gets further away from the eye level.

Again, if you sit on a low stool in a long hall, the flat ceiling appears to run down very low and the floor to extend a very short way up, but if you sit in a high gallery in the same hall, the floor will run up very high, and the ceiling will stop running down almost immediately, to correspond with the height of your eye.

15. Not only horizontal planes narrow and vanish to their proper vanishing line, but every plane that is not exactly *parallel* to the picture plane (does not form a vertical section of the visual cone) vanishes in the same way. — All planes then that are not parallel to the picture plane are receding or vanishing planes. — All receding planes have a vanishing line, toward which they run and in which they vanish, just as horizontal planes run toward the eye-level.

The *line of sight* is the central visual ray, the axis of the visual cone (or cone of rays) the line going straight out from the eye at right angles to the picture plane.

The vertical plane containing this line of sight is the vanishing plane of all vertical planes at right angles to the picture plane, and a vertical line drawn through the meeting of the line of sight and the eye-level gives the vanishing line of all such vertical planes. To prove this, place a drawing board end-ways on, upright, exactly before you, look at it with one eye closed, as usual in such experiments, and its whole face will appear to grow gradually broader until it gets beyond your field of vision. Move back to where you started and it will again narrow, disappearing as soon as it coincides with the line of vision.

16. The centre of vision is the meeting point of the line of sight and the eye-level or horizontal line. It is the vanishing point for all horizontal lines that run at right angles to the picture plane.

Every line and every plane that is not parallel to the glass plane of the philograph (to the picture plane) has its vanishing line or point, towards which it runs. In studying linear perspective by the usual processes, you learn to determine the position of each such line or point by measuring off with the compasses a certain required angle from the spot representing the spectator's eye. This way of

finding your vanishing point, which is all that can be desired in working out perspective diagrams, is of no practical help in drawing from nature. The thing needed in practical work is not to fix the vanishing point of a line, but so to represent that line as to give a true idea of its perspective position and length, when translated on to the vertical picture plane.

17. Here again we meet with direction and proportion as the most important elements of perspective appearances, and as the graphic facts that can be tested and proved by the transparent plane and visual angle of the philograph. The chief difference between their application here and in organic or living form is that, whereas in the latter case we look first for the *direction of axes* and the real or foreshortened proportions of parts to the whole, in the drawing of straight-lined forms we generally have to look for the *direction of outlines*, the relative importance different objects bear to one another and to the whole group, and the perspective importance of their different parts (as, for example, of the sides of a cube).

II. Organic Perspective. Contours.

18. Organic perspective consists in detail of the study of axes and of contours, of the apparent alterations in direction and in length of the axes, and of the apparent alterations as to form and nature in contours.

19. Contours (or outlines) depend very largely on these axes, and are of course secondary to them in the expression of life and movement. The modeller must think of his supporting wire skeleton first, and only afterwards of the clay that is to clothe and cover it. The forms grow and alter as he adds more clay, and shapes, strengthens and defines each part, and the contours alter correspondingly.

In nature, as in this example, the axis is the real, actual fact underlying the solid form, the contour is the apparent limitation of that form which only exists in connection with your position when you are looking at it. For example, take the side view of an arm, look at it against a dark background, its outlines will be very distinct and seem as definite and tangible as those of any straight-

edged solid; but, alter your position, take a front view, and the first contours no longer exist for you.

This intangible, ever-changing, nature of the outlines of the human figure, and of all irregular forms, is difficult to realize, hence, a very common idea of contours likens them to hard, wiry borderings going all around a figure uninterruptedly like the leading in stained-glass windows.[1]

That kind of contour, however necessary and suitable in the above case, is unnecessary and inadmissible in drawing from life. It is extremely important that the student be early taught the true nature and possibilities of contours.

He will thus learn that, although undeniably a conventional mean of expressing solid and rounded forms, the so-called outline or contour need have none of the rigid, unintelligent characteristics so frequently given it; provided only it be treated entirely in connection with the underlying facts of those forms (facts of structure, of movement, of direction, of proportion).

20. Contours of the figure consist largely of flat and of slightly-curved convex portions; they express essentially the apparent limit of each part, surrounding and enveloping outer forms, then running inward, penetrating the whole and indicating the structure of that part, giving its relation to all the rest.[2]

That being the case, studying and drawing the contours of a form mean studying that form, indicating and expressing its characteristics as far as is possible by the conventional language of line. These matters once thoroughly understood, any inclination towards the wiry bordering above-named will cease to exist.

Contours, as treated by a master-hand, express not only the form

[1] It may be objected that in some of the old Italian paintings very definite and continuous contours are to be seen. This in no way gainsays the text, for the bordering contours of the Florentine and other Italian schools are never wiry or inexpressive, but quite the contrary. Again, in some cases of wall-decoration contours *may* have much the same value and require much the same treatment as in the stained glass windows, but this is quite apart from the misuse of outline by students above referred to.

[2] As a mere question of words it is evident from the above that not the single contour or outline of a figure should be spoken of, but its *contours*, those of its many parts taken together.

but the nature of the part dealt with, whether hard and bony or soft, muscular or otherwise. This is wonderfully exemplified in Michael Angelo's drawings, in some of Andrea del Sarto's, especially of hands and feet, and also in Ingres's celebrated studies from the nude.

21. Contours of organic forms depend then not only on the shape and size of the actual form to be expressed, but on the altering directions of its bony axes, when foreshortened, and on the axes of its muscular masses when in action; in short, on the nature of what lies beneath the surface, and all this in relation to the point of view which must first of all be observed.

With regard to axial alterations, study the lines of a knee-joint, of a foot or a hand, notice the characteristic shape of each finger and toe, and see how the outline answers to the axis of each part. It is the same with all irregular forms, with locks of hair, blades of grass, leaves and flowers, and wherever life of any sort exists.

III. Foreshortening.

22. The term foreshortening (in French *raccourci*) is the one generally applied to the perspective of all so-called "irregular" and organic forms. To any special view of figure or of limb which does not admit of our seeing it in its full development, and, again, to the perspective alteration and apparent narrowing of any single part or plane. When the drawing of any figure, any organic form, appears clumsy, it is generally because it is too wide or thick for its length. Now, foreshortening often seems to increase the apparent width of form, and that in a very marked degree; therefore we must study its characteristics.

The perspective deformation of any form or part (its foreshortening) only exists in connection with your point of view and distance from it, and changes as they change. It does not of necessity imply the folding or bending of the part. Thus, the full length of an outstretched arm directed towards the spectator may be for him entirely covered and hidden by the clenched fist placed exactly opposite his eyes; but if his position, or that of the arm, be even slightly altered, he will obtain a characteristic foreshortened view of that

extended arm, which will still appear small compared with the size of the fist.

23. If we compare drawing with music, it may be said that foreshortening hastens the time, or measure (*précipite les temps*), that is, the lines become more inclined, their opposition to each other accentuated.

It causes the planes of a form to pass into, to penetrate or to envelope one another. It also serves to show and to accentuate their construction, even when it completely alters their appearance.

24. It changes the apparent relative proportions of the parts of a figure, often reversing them.

More knowledge is required to draw a foreshortened view of any form, than to draw the same form seen otherwise. The one is simple, the other is complex. More accuracy is also needed; an increase of one-quarter inch in length or width may here represent an alteration of a yard or more real size.

Correct drawing does not then evidently consist in rendering the actual proportions of forms, since the facts of foreshortening constantly alter and modify those proportions.

25. Every organic form must, of its nature, give a foreshortening or a succession of foreshortenings.

Hardly any "movement in space" can possibly be represented without foreshortening.

Where there is only flexion (bending or folding) foreshortening is simple; where there is torsion it is complex.

26. Every representation of a living figure must have some degree of "movement" or action, quite apart from motion. In this sense, where there is life, there is movement. For example, notice the antique statues of Atlas bearing the globe on his shoulders, and of Hercules leaning on his club. If these had no movement they would be mere pilasters. Here the movement (or action) is chiefly caused by weight or pressure, and altered proportions are the result of pressing together different parts till they seem to penetrate one another.

All the facts and properties of foreshortening that have been treated of in this section, whether relating to linear or to organic perspective, are easily demonstrated by the philograph.

IX. PHOTOGRAPHY.

1. The enormous services rendered to the whole world by photography, in every branch of science and of industry, speak for themselves. We need only take into consideration here the direct relation photography bears to pictorial art and consequently to Drawing.

Properly understood the whole aim and scope of photography, even apart from the question of color, differ from those of the painter's art, and this as the immediate outcome of the material differences existing between the nature and working of the lens and the nature and working of the human eye.

Art in the fullest acceptance of the word, must always consist in choosing out and perpetuating what is essential to the expression of a given subject, or idea, eliminating what is of secondary importance, and causing a sort of survival of the fittest. In doing this the artist, albeit unconsciously, follows the lead of his natural sight and the dictates of his own judgment, feeling and experience. This eliminating principle is tersely expressed in a saying familiar among French artists "L'Art vit de sacrifices."

2. Choice of subject, selection of detail, simplification, and hence intensification, of effect are then most important elements in the artist's work. For these he requires above all a knowledge of underlying and surrounding principles and facts, enabling him to give the true essence of his subject in such a way that his work, although dealing with appearances and optical illusions, is anything but surface work. That is to say his art, and even his simplest drawing, must produce an impression, must be an interpretation of the truth of nature, of what he himself has seen and felt in nature, and not a mere record of material facts observed. So then Art is an interpretation, an explanation of much that is intangible but has been, nevertheless, definitely perceived by the artist in nature. Photography, on the other hand, explains nothing, interprets nothing and gives at best only an unconscious copy of nature, the expression of her most material demonstrations.

3. Photography furthermore sacrifices nothing, but gives equal importance to insignificant details and to vital facts, so much so that

it is no exaggeration to say that the very things most characteristic of photography are those most opposed to the principles of Art.

Countless examples illustrate this difference; thus, where a master's sketch of a sleeping animal (see Eugène Delacroix' studies) will give some idea of the bony structure and the relaxed muscles, photography is very apt to show only the hairy surface. Sometimes it will even give an individual importance to every hair; on the other hand (depending on the amount and kind of light admitted) it will sometimes represent wide spaces of light or of shadow entirely devoid of detail. More importance is often given by photography to the weather stains on an antique statue than to its delicately modelled muscles and planes. Again, crowded surface detail frequently prevents due acuteness being given to central or specially constructive lines; the pattern on a drapery often interferes with and hides the far more important lines of its folds.

The differences between the eye and the photographic lens may well be compared to those between things of science and things of art. Referring to Chap. VI we note that the eye sees in the main what it chooses to see or knows how to look for. The lens sees all that is before it, and records all it sees. The artist, in order to realize the greatest concentration of effect, frequently looks at his subject with half-closed eyes — the photographic lens, having a much wider open eye, never closes it nor, intentionally, allows any detail to escape observation.

4. In face of all this it is to be remembered that these very points of difference between Art and Photography are what causes the exceeding value of the latter (to the artist no less than to others) as a means of recording facts, of circulating information and, further, of popularizing existing works of art.

These distinctions are best explained by the following example: Suppose a portrait has been painted from life by a first-rate artist, and suppose two photographs of the same subject have been taken. One from the painting, the other from the living sitter. It is absolutely certain that the artist will have eliminated many details of minor importance in order to give greater value to all that expresses the peculiar characteristics of the model; the photograph taken from the painting may accurately and satisfactorily reproduce the artist's

work (all except the color). In the photograph done from nature the same model is represented, pose, drapery, light and shade, all are to be exactly as in the painted portrait. — Place the two photographs side by side and compare them; the differences will be considerable and will very well illustrate what has just been said. The one done from life, however like it may be, will show all the small surface detail that the artist carefully left out, the other will reproduce all he was able to give of personality and expression.

5. From the artist's and the drawing teacher's point of view, there are dangers connected with photography against which it is necessary to be guarded. Chief among these is the danger of becoming so accustomed to its errors, its faulty perspective, its exaggerated foreshortenings, its over-crowded detail, as to give it precedence over our own sight. This is in no way surprising for "habit is second nature" and if we do not pay sufficient attention to observe these things, we can easily lose the exact notion of what our own eye sees. Every day and at every turn, in advertisements, in illustrations, too often even in pictures that purport to be something different, we have photographic reproductions (often very faulty ones) constantly before our eyes. It is therefore very important to know something of the differences between the lens and the eye.

6. Material differences are owing chiefly to the much more convex form of the photographic lens and to its even (or *homogeneous*) nature, also to the fact that the rays of light, after passing through it, abut on to the flat plate instead of on to the concave retina. They are thus of very uneven length and varied inclinations, which largely accounts for the distorted perspective so frequently seen in photographs.

This extreme convexity of the lens also gives it a much wider visual angle than that of the eye, that is, the lens takes in at a glance much more than the eye can do, and, even when focussed on a distant point, it is able to record *over the whole field of vision at once* details which for the eye, under the same circumstances, would not visibly exist.

The opening of the normal visual angle (the eye's angle of distinct vision) ranges as we have seen from 25 to 30 deg., that of the wide angular lens from 70 to 90 deg. or more. Add to this as causes of

difference the constant action of the iris, the pupil, the eyelids and lashes, the accommodating crystalline, and the immediate connection of all with the brain by means of the optic nerve.

7. The better to judge of these things, study the photograph of any wide hall or long gallery. Notice with what distinctness, or even intensity, patterns on carpet, curtain, wall paper, are shown, although quite close to the camera. Try to realize how much the eye would see in like case; that is, supposing it to be all the while fixed on the same point at the end of the hall on which the camera lens is focussed.

It becomes at once evident that the eye cannot compete with the lens in seeing all these things at the same time; but, if each be looked at in turn, all may be seen with perfect accuracy.

Notice now the unnatural perspective appearance of any chair or table that happens to be placed near the camera. It is quite different to the perception of the same forms by the human eye and brain. This difference is very important. We realized in studying the eye that it can only look at one plane, or even at one point, at a time. The sight being focussed there, the eye only *sees* that one point or object with clearness, but it perceives (sees vaguely and is conscious of) a great deal more.

8. So much for the eye and natural laws. The photographic lens on the other hand can be, and constantly is, so focussed as to represent with equal clearness and intensity several planes that are at great distances apart, and the striking perspective distortion which is the result shows once more how carefully we must beware of mistaking the photographic for the natural sight.

Photography is misleading, not only with regard to perspective proportions but, further, owing to the effect of color on the sensitized plate, which partly accounts for its want of aërial perspective. This brings out as black and white values what, for the eye, are only ill-defined suggestions of color, giving intensity to certain warm tones (as reds and yellows) and lessening just as much the value of cold tones such as tend to blue.[1]

In nature the half-tone of a rounded surface is frequently of a

[1] To this fact is due the deciphering of many ancient manuscripts and *palimpsests*, otherwise entirely illegible.

delicate bluish shade; this is especially noticeable in the intermediate planes of a face lighted from the front, those half-tone planes that come between the parts in full light and the receding, shaded parts. If that half-tone be replaced by white, an undue appearance of width is given to the model, even without really widening it. This may often be observed in photographic portraits done from life. It also applies to blue distances in landscape.

9. In view of securing the least possible distortion from the lens, especially where an enlargement is to be made, it is best to take an extremely small photograph, and for this reason: the convex surface of the lens may be considered as consisting of countless little facets. Rays of light passing through all these must be of very unequal lengths and are subject to considerable distortion, but if only those that penetrate one single facet come into play they will be practically of equal length, and no great distortion will result.

Things advance towards perfection according to their kind. Progress in the case of the artificial lens is therefore in the direction opposed to nature; the more recent and improved the camera lens, the less is it like the eye or its sight like the sight of the eye.[1]

10. The best proof of the need of knowing these things in order to avoid them, lies in the fact that, among modern exhibition pictures bearing well-known signatures, not a few might be named having all the characteristics of wide-angle photographs: in which the near portions of the subject are exaggeratedly large, the distant ones as much too small; where the children in front are full life size, the parents seen across the room are no bigger than the baby's doll in the foreground. In others, lines of restaurant tables are shown in such violent perspective that only the far distant ones are at all as they would naturally appear.

All this points afresh to the supremacy of the eye and to the need of studying the conditions of the natural sight as being the most reliable guide in oft-raised questions concerning the proper place of photography in relation to art.

[1] In the above remarks the general characteristics and tendencies of photography are alluded to. Improvements or combinations likening it to the natural sight are constantly being made, such as those connected with panoramic views, or with the use of achromatic plates; but that does not alter the main facts.

11. People have been known to predict, in view of the enormous progress made of late years in the practice of photography, that it will eventually over-shadow or swallow up the painter's art, that the constantly improved photographic lens will, in a sense, supersede nature's still more wonderful lens, the human eye. Let them compare the two, not only as to structure but as to working.

Let them take note of the unconscious or intuitive direction of the eye towards whatever momentarily claims attention, its rapid-scanning sweep over the whole field of vision, interchangeable quick as thought with the careful, intense study of some particular point, or the absolute repose of darkness. Against this let them place the single, rigid glance of the lens and they will feel that, in spite of apparent danger, any fear for the genuine artist's supremacy is surely groundless. Photography is, and in the nature of things must always remain, an auxiliary, powerful, and, if its failings be duly recognized, useful, but it can never become in any real sense the rival of Art

X. MATERIAL AIDS TO SIGHT; THEIR PLACE IN THE STUDY OF DRAWING.

1. Before considering the place and use of material aids in drawing, an important distinction must be established.

The value of mechanical means and processes in many kinds of artistic reproduction cannot be ignored, but the use in the study of drawing, of anything that purports to give results without labor must be most strenuously opposed. There is no royal road to knowledge here.

Granted so much, the difference between the thing that does your work for you, and the one that, by teaching you to see and to understand better, enables you to do it yourself, is as the difference between night and day.

People readily agree as to this fact, but they do not perceive that, for example, a correction made by the master on the pupil's drawing is, for that pupil, a sort of mechanical fact, one that he has neither conceived nor expressed of himself. To say to a pupil "It is as I tell you," does not necessarily enable him to understand or to realize

the point in question. If he be dutiful he accepts and follows blindly, then if the correction be right, what he does will be right also; if otherwise, he will follow suit just the same.[1]

2. The guidance and showing of a good teacher will, in many cases, stimulate the student's observation, but the master's actual correction cannot by any possibility have the same educative value for the pupil as the positive record of his own sight, and this is what, — in matters of fact, not of taste — the serious student must seek.

Again, it often happens that two masters in the same institution whose teaching is interchangeable see differently and express opposite opinions; here the use of some one definite and acknowledged means of correction is desirable. It is to be supposed that the competent unprejudiced teacher will favor whatever tends to forward the advancement of his pupils, including the rational, well directed use of material aids to sight.

3. Aids available and admissible in drawing from nature are of two sorts: those that help in the actual production of a good freehand drawing, and those that serve as a means of training the eye and hand. These latter are used by the student in two distinct ways: 1st, for optical demonstration; 2d, as tests or correctors of his own freehand work.

Among those that help in doing the drawing, almost universally accepted are the plumb-line, the measuring pencil or rule, the card or metal sight-finder (*cherche-motif*) and the rule or strip of paper divided in equal parts, to guide the eye, when an equal division of the subject is required. To these some others may be added for special occasions.

4. Observe that in every separate case the end proposed is to help in translating perspective appearances on to the picture plane, which it is the draughtsman's chief task to do. For this the second series of aids are of value. They guide or force the student to see forms aright with his own eyes, and to know what he sees from the

[1] The pupil who thus owes his convictions, as to what he sees or does not see, simply to the moral influence of a chosen teacher is surely a rather apt example of "suggestion," that strange power, to which of late, and in every country, so large a place has been given in modern science.

first, before he has contracted any habits of half-seeing or of misseeing and of misrepresenting them.

This need has been fully recognized by many teachers, and it has led, in some cases, to the unwise use of various devices for drawing in connection with large or small squares that, being totally artificial, are misleading and harmful.

The value of the transparent plane, used in connection with a disc and eye-aperture effectually isolating the glass from all but the object to be studied, and aiding the student in determining his visual angle, etc., has been spoken of at length in Chap. II. It will be found that all the practical devices made hitherto, both for the optical demonstration of perspective and for tracing perspective forms from nature, are contained essentially in the philographic series.

5. Let us now inquire into the uses of the philographic tracing. Its use for the demonstration of visual principles has been already dealt with (see Chap. VIII). Its use for practical purposes of correction is evident on account of its accuracy, but still more because it forces the pupil to perceive for himself the truth of the correction and in such a manner that he can gradually improve his own work up to it. Suppose, for example, the direction of an eyebrow or the proportionate size of an eye be in question; the line traced over nature on the transparent plane is the record of the student's own sight, depending on his own effort at seeing, on his own knowledge of the form to be expressed, of the line required, and is his own handiwork. His immediate part in the operation prevents all uncertainty and consequent unwillingness to alter what he has done. In a word he sees for himself instead of following another person's sight.

6. So much for the pupil; what of the teacher? It has been said: I have no use for pupils who do not believe what I say. — This feeling is very natural on the part of one who has acquired the science of his art, but how is the student to discriminate between the one who has really acquired that science, and the one who only thinks he has acquired it? It is safe to say that there are very many in the latter case. Again, it has been said: My pupils would think I could not draw if I used any kind of mechanism in teaching them.

These remarks only imply a misapprehension of the subject. In point of fact the teacher's rôle is not one whit lessened in importance by making use of such test instruments as are suggested here. It is somewhat changed, but changed in the direction of giving it greater, because more intellectual, value. Thus, the accurate inclination, the relative length of a line any one, with practice, can learn to determine; but the nature of the line required, its connection with underlying form, the various reasons that may call for its accentuation, in fact the science of the whole matter rests with the teacher to explain and to inculcate.

So understood, his part is incomparably more important than that of a correcting machine, which here is assigned to the philograph. More than this, the teacher who is thoroughly trained and familiar with his subject can by no possibility lose prestige by this means. On the contrary he gains by it considerably, for he can immediately prove the need of the correction he indicates. So far it has been a question of the teacher who not only knows thoroughly, but also knows how to demonstrate and to explain to others. Such an one is rare. There are many, well equipped with knowledge, who lack facility of demonstration; to them the philographic instruments will prove valuable auxiliaries.

7. Teachers and students will find this adaptation of Leonardo's transparent plane an immediate help in obtaining the desired end of training and subsequent self-dependence. While it does not create, does not by any means do the student's work for him, it enables even the least gifted to see for himself, as nothing else can, the *perspective* facts that form the basis of *Drawing*.

XI. STAGES OF WORK.

1. The first stage of work consists in training the eye and the brain to realize and the hand to record perspective appearances of common objects and especially of *regular* forms. This is done by constantly repeated effort at copying them by free-hand from nature, each time proving to the eye how far the free-hand sketch is correct by comparing it with the tracing of the same form made on the transparent plane.

Every exercise, however simple, is preceded by some amount of analysis, done largely by questioning, and by explanation of what is to be drawn. This should be followed by a memory sketch, however rudimentary, of what has just been done. Exercises are thus varied and made interesting, and good training in intelligent observation is secured without any formal theory whatever, unless perhaps the general idea of the eye level. For this the simplest means of expressing suffice, merely a few light lines and light masses of shade; execution being of secondary importance.

2. The work in stage II consists of similar exercises, but more complete and accurate rendering is required here. The importance of Direction and Proportion are strongly insisted upon and elementary notions of perspective theory are introduced; such as the choice of a point of distance, the visual angle, picture plane, etc., according to the pupil's capacity. These should, in every case, be demonstrated by help of the transparent plane and movable eye-piece.

Analysis, description, and memory drawing on the part of the pupil are of course made more of than in the first stage of work.

3. In stage III the student enters upon the elementary study of irregular and organic forms, fruits, flowers, parts of the figure from the cast, etc., in connection with the axial principle, direction and proportion, and the laws of sight. Here shading is still only used as expressive of form, and difficult foreshortenings are avoided. Test drawings or tracings are made, for self-training and criticism, and the subject is analyzed, described and sketched from memory as heretofore.

4. Having reached stage IV we are no longer dealing with elementary work. The student now enters in full upon all the complexities of drawing, whether of figure, landscape or otherwise, and must shirk no difficulties, mental or executive. If he has worked systematically along the lines laid down he may be supposed to have mastered the first principles of perspective form, and to be able to fully realize all that has been said of its connection with the expression of life and movement. He has also gone through a considerable course of eye and brain gymnastics and should be able, gradually, almost unconsciously, to incorporate into his work all that he has learned or has still to learn of perspective theory, which will greatly help him

in his more complete study of form, light and shade, expression, composition or arrangement.

5. Henceforward his work is no longer merely that of the drawing student, but of the Art student in the proper sense of the term, and lies outside the scope of this volume.

The study of Art is without bounds. The genuine artist studies and learns to the end of his career. Art is also divided into different *Schools*, which it is not our present purpose to discuss or to criticize. It is for the young artist at this point to follow his own inspiration and choice.

XII. INTRODUCTION TO PRACTICE CHAPTERS.

1. It is not here proposed to give a complete course of drawing, not a number of chapters standing for the same number of cut and dried lessons, but rather some helpful suggestions for turning to account what is contained in the preceding theory chapters.

COLLECTIVE TEACHING. — Although one pupil only is mentioned throughout, it is evident that the teachings suggested apply equally to a large class. This presupposes the presence of a teacher bent on inculcating general principles, on arousing and cultivating intelligent observation, on requiring careful and understanding record of what has been observed, and memory work in proof that something definite has been mastered and retained. In all this great simplicity of execution, no show drawing.

Independently of the individual correction given to each pupil, the teacher gives from time to time a collective lesson in which points of general theory such as the axial principle, optical illusions, perspective are dealt with progressively.

2. QUESTIONING. — Much of all this may be got at by appropriately questioning the pupils and, as all modern teachers agree, the opportunity of so doing should never be neglected.

OBSERVATION. — The beginner must be accustomed to look at simple forms with a view to drawing them, and encouraged to try his hand freely at sketching objects of every-day use. No extreme accuracy is at first to be required of him; the chief thing is that he be led on to observe apparent form. Even a child, his interest once aroused, can

thus be taught a great many important facts in easy and natural connection with his own observation, endeavors, and experiments. For example, sketching a garden bench leads to the study of horizontal planes. The subject may then be pursued indoors with the careful study of books, drawing boards, etc., at different levels as suggested below.

PERSPECTIVE THEORY. — This, coming as a desired explanation, will not seem dull or uninteresting, and a sound foundation will thus be laid for later work.

LINEAR PERSPECTIVE. — Perspective alterations of regular forms can be studied, accounted for, and even recorded by mathematical rules and processes, but with such we have nothing to do here. Optical demonstration and repeated free-hand endeavor are the only means suggested.

3. MEMORY DRAWING. — To be able to draw from memory is above all desirable, but this, be it remembered, is not the same as drawing from imagination. In the literal sense of the word, all drawing is memory drawing, for, even with the model before him, the draughtsman can only put down at once as much as he remembers. He records as much as he is able to retain of the image formed in his eye when looking at a given object.

Memory drawing depends, then, on that image being very distinctly defined, and on the draughtsman's ability to retain it, and then record it at will. Distinctness of the image depends chiefly on its simplicity and on its isolation from all around. The power of seeing simply is sometimes natural, but it can be very profitably cultivated by learning what to look for, by practice, by purposely eliminating detail in our mode of looking at things, as we have to do when we draw them.

The power of recalling an image depends greatly on familiarity with it. For this repetition is the great thing. Repeated seeing and repeated drawing from memory are the all-powerful means of success.

The exercises in memory drawing here recommended for beginners consist in reproducing from memory after an interval what has been already drawn with careful study from nature. Attempts at drawing from memory without such effort of previous critical study easily degenerate into a bad kind of drawing from imagination and cultivate the harmful result of what in French studios is stigmatized as "*dessin de chic.*"

4. MEANS OF EXPRESSION. — So long as the young pupil is still learning to realize simple perspective forms, single objects as models, simple line indications, and the simplest materials are best. Very soon the front or advancing portions of these lines may be accentuated, thus suggesting perspective values.

This matter of accentuating lines has sometimes been objected to on the score of its being conventional. An outline drawing (or any representation of solid forms without light and shade) is so essentially conventional that no one should be misled by such a practice intelligently carried out. The whole thing is a sort of shorthand expression of forms and facts. This in no way contradicts the statement that drawing is emphatically *not* calligraphy. It does not depend for its value on serpentine curves and flourishes, on fine lines or on highly finished execution. It is the graphic expression of just as much perspective truth about the required forms as the student is able to see and to tell. The value depends therefore on the *right seeing* and on the knowledge it tells of, and on the clearness of the telling.

SHADING LINES. — Very light lines showing the directions of planes and suggesting the individual characteristics of each form (apart from facts of light and shade) are next to be made use of and their importance at once indicated as showing, for example, the difference between the flat surface of a table, the upright sides and the sloping lid of a box standing on it. Very strange effects are often observable in book illustrations for want of attention to these things: thus there are sometimes seen *vertical* indications of a floor so made as to suggest that the people in the room were sitting on the top of a high wall, with water below them, and other similar misrepresentations.

MASS SHADOWS. — Mass shadows as a simple means of expression are early needed, especially in dealing with irregular forms. Their use implies looking at the model with a view to realize which of its parts receive rays of light, and which are so *turned from the light* as to receive none directly. They should be laid in in simple, pale, gray masses suggesting, by their effect, the relief and construction of the model. These are only put in where necessary, all the intermediate half-tones being for the time left out.

LIGHT AND SHADE will come in later as a separate branch when a good ground knowledge of form has already been secured. Having

once obtained a mental grasp of separate perspective forms the student must study models as he will ultimately have to represent them, that is, in connection with their surroundings, showing their relative importance as to size and position, as to light and shade and values. This implies definite study and practice in the elements of each of these branches as well as in composition (or *choice in arrangement*).

5. The artist, though he devote himself particularly to portraits, landscape, or still life, is above all a painter, and rarely deals exclusively with one branch alone. Either by way of study, or for practical reasons, he will need to approach nature from different sides and to train his hand to render her in all sorts of ways. The same is true in a lesser degree of the student, and he also needs to familiarize himself with different kinds of work, different subjects, different materials, and different renderings of nature.

Pictorial drawing may be broadly included under the three heads of *Still life*, *Landscape*, and *Figure*. This of course gives no specific place to animal painting, to flowers, to architectural interiors, etc. Most will be said here about *still life*, because, from the student's point of view, it includes to a great extent the elements of all three.

Each of these great divisions will be subdivided into several grades or stages according to difficulty. In every case one or more detailed examples will be given to represent one stage of work. The number of lessons must depend upon the pupil's aptitude and on the teacher's judgment.

6. The exercises are intended to demonstrate practically how the preceding theory may be applied in teaching; the form generally employed, that of addressing the pupil directly, is chosen in the interest of students working without a teacher and in order that each point in turn may be as easily understood as possible.

Serious differences of opinion with regard to the theory introduced cannot exist, as it rests upon the classification of fundamental principles of teaching and of study accepted and adopted by the best masters. There can only be differences with regard to certain minor details of application.

7. In regard to the use of the philograph as an adjunct of teaching, it must be constantly borne in mind that it is not advocated as a

means of learning without labor, but as a means of proving perspective principles and facts and of helping to overcome certain difficulties by making each point clearly evident to the eye.

Its application as a test or corrector involves chiefly two kinds of operation. First for *practical demonstration.* Thus, the student looks through the eye aperture and the glass plane, and is made to see the perspective appearance of lines and forms to be drawn, after which the instrument is put away and a free-hand sketch is made. Secondly, for the production of a *careful tracing* to be laid side by side and compared with a free-hand sketch, the mistakes judged of and correction *made from nature.* In each case demonstration or tracing may be made either before or after the free-hand sketch, according to convenience. Both these modes of use are proved to be absolutely practical and helpful when intelligently applied.[1]

A third mode consists in looking at the free-hand drawing *through the transparent tracing*, so that the errors of every form, line, and proportion are shown with accuracy.

For this, without altering the position of plane or of eye-piece, the pupil will place his philograph facing a wall (or any other perfectly vertical surface), to which he will then attach his free-hand drawing, exactly opposite the glass plane of the apparatus, and at approximately the same distance from it as was the original model. His drawing will thus occupy the same relative position (and be at the same distance from his philograph and from his eye) as the model at starting, and he will look at it through the eye-aperture and the glass plane (on which is the tracing) just as he looked at the model.

He will then, by slightly moving the apparatus, make the tracing on the glass and the drawing on the wall to correspond accurately in size, obtaining practically the same effect as though a tracing made over the free-hand drawing were held close against the original model; the distance between the tracing and the drawing makes up perspectively for the real difference in size.

[1] The teacher will always bear in mind that in every accurate perspective representation of a form it is treated as seen by a single eye, whilst a free-hand representation is the product of the sight of both eyes. The difference, though very small, exists and must be taken into account.

In the exercises, for brevity's sake, only one tracing and one sketch are spoken of. The tracing made on the glass may be retraced on paper, and kept for reference. As an easy means of ensuring that it shall not be used as a foundation for the complete drawing, it is well to insist on the free-hand sketch being made much larger than the tracing.

XIII. STILL LIFE.

I. Regular Forms.

1. Still life offers a little kingdom of itself. Not only have the greatest painters studied it, but many of them have left still-life pictures which count among their important works. The term is generally applied to paintings of fruit, flowers, game, and to groups of objects relating to any special subject, as music and sculpture. In the present classification it relates chiefly to the drawing of common objects with which the student enters upon the study of perspective form.

Even in this limited sense, still life deals with regular and irregular forms. We shall have to do with, first, sketching single objects, and, second, groups; with simple regular forms, simple irregular, difficult irregular forms; also with composition (or arrangement), with light and shade, with values, and with execution. As typical examples of these three divisions of forms we will take: (*a*) a book or a drawing-board, (*b*) a pear or a daisy, (*c*) a rose or drapery.

Regular or geometrical forms being the easiest to learn, it is best to begin by them, and as even the most complicated of these are composed of simple planes and curves, it is well to master first the perspective appearances of these elements, and then their widespread application. The greatest difficulties met with by the young sketcher also depend largely on these very simple elements, as, for example, the perspective alteration in horizontal and vertical planes.

2. To sketch simple straight-lined objects from nature. Horizontal planes.[1]

[1] A horizontal plane is a plane lying parallel with the ground at any height or distance from it whatever, as a book on a table, or the flat panel of a ceiling.

Remember that the first thing to be learned is the difference between the real and the apparent form of your models. Take a good-sized book, a music folio, or a sheet of cardboard, and, before you put pencil to paper, study carefully its form and characteristics, thus: hold the book up in front of you so that all its edges are about equidistant from your eyes; notice its shape, its length compared with its width, etc.

Now lay it flat on the table, three or four feet away from your eyes, with its nearest line *parallel* to them, and look at it again carefully. Its *apparent form*, as seen from your present point of view, is very considerably altered; how great and how important is that alteration you will better understand after some amount of practice. Very possibly, at first, and unaided, you may not fully perceive the change.

3. Without altering your point of view, set up your philograph and adjust it so that you can see the book easily, looking through the small eye-aperture, then trace the outline of the book on the glass with four quick, simple strokes. The lines so traced show, better than anything else can do, the perspective alterations that have taken place. Look at them and make yourself realize that they *record what you actually see.*[1]

Then at once put away your instrument and your tracing, and, with four quickly sketched lines, sketch the same view of the book, free-hand and from nature, forcing yourself to see what is before you, and to draw what you see, not simply what you remember to have traced.

Compare your free-hand sketch, which should be of good size (say five or six inches one way), with the smaller tracing; place them side by side and carefully note the differences as to direction or inclination of line and proportionate width. The tracing, in spite of its small size, will enable you to see your mistakes, for its proportion will be correct and so will be the direction

[1] Your very first exercise, made just as freely as above suggested, will have shown you that the long end of your book is apt, in any perspective position, to appear shorter than the short end. It is well to have a means, apart from the tracing, of guiding yourself in your free-hand sketch; for this you will use the measuring pencil and the plumb-line (see Appendix II).

of its lines, and these are the things most necessary in drawing regular forms.[1]

Lastly, put away all that you have done and make a memory sketch of the book as you have learned to see it.[2]

4. You have thus made three representations of that horizontal plane: a tracing giving the record of what your eye actually sees, a free-hand sketch recording what you consciously see after practical demonstration, and a memory sketch.

Each of these implies making four simple strokes (not four painfully corrected straight lines), and the actual doing of all together requires less than a minute's work; but the thought, the mental effort required, represents much more time and much more result than appears at first sight. For if you have thoroughly realized the nature and value of what you have done, you need not again be at a loss in drawing any kind of horizontal plane, whatever may be its surroundings.

In this one typical exercise you have made a first step towards a practical knowledge of perspective. You have been shown the difference between real and perspective form, between what you know to be the actual fact and the perspective fact as seen by you. You should repeat this exercise many times, and with various flat forms, until it becomes fairly easy to sketch any horizontal plane correctly at sight; then pass on to another exercise.

5. THE HORIZONTAL LINE OR EYE-LEVEL. — Take again the same large folio or sheet of cardboard, remembering that it represents all kinds of horizontal planes; and as you have learned the differences that exist between the real and the apparent form of such a plane, now learn how differently it appears according to its position above or below the spectator's eye; that is, above or below the *horizontal line.*

[1] Those who are not persuaded that the tracing will be of much use to them should before all else make a rough sketch from the model by free-hand, and quite unguided, giving their first untutored impression of its appearances.

[2] At this point the teacher should explain the theory of what has been seen and done, but the student who is working alone should go right ahead, leaving theory until later; his task is to learn to see perspective forms, to get a mental grasp of them, and he will do so if he persevere.

Hold it level before you in both hands with one edge parallel to your eyes and as far down as your arms allow, then raise it gradually up to the height of your eyes and higher still, and as far out as you can reach. Notice how it appears to get narrower as it nears the level of your eye, till its whole width lessens to a single line; then as you go on raising it, the under surface comes into view and gradually widens as you lift it higher, further away from the eye-level.[1]

Notice also that the lines of its edges to right and left appear to run upwards or downwards according to its position above or below the eye level. This eye-level (see perspective) is the perspective horizon, the very key-note of linear perspective. All horizontal planes and lines seem to run towards it and are said to vanish in it, exactly as in the present case.

6. The eye-level exists and alters in accordance with the spectator's own position, a fact you must always bear in mind. Many mistakes commonly made are due to the sketcher forgetting that his horizon is not the same when he sits on the floor as when he stands up or sits on a high seat. The result is the same whether the eye or the object looked at move.[2] Thus: when you sketch a pile of books the upper one, exactly above the others, will appear narrower than any of them and much narrower than the lowest; so it is with a box or a cylinder, with floors and ceilings seen in turn as you go up and down in an elevator.[3] You will need to do a great many exercises in order to become thoroughly familiar with these things. For this, start as before by the simplest examples, as follows:

Place your folio on the floor about three yards from where you are sitting; sit low and adjust your philograph so that you can trace it

[1] Any line, whatever its direction, lying on or against a horizontal plane, is a horizontal line.

[2] The same is proved by holding a very long pencil or a flat rule with one end towards you; when immediately opposite your eye, only the round end of the pencil is visible or the thickness of the ruler.

[3] Besides the fact of the lines running upwards and downwards towards the eye-level, and the narrowing and widening of the horizontal plane, you will notice that horizontal lines run from you (from the picture plane) at different angles or inclinations. If, with a long rule, you were to carry far enough the direction of each line you would find that some run to right, some to left, and that they slope differently. These directions must be carefully observed in drawing.

easily. Make a second tracing from the same position of the same model placed on a table, and a third, for which you will support it on the backs of two high chairs or have it held above your eyes. Make free-hand sketches in corresponding positions and compare as before, then put all away and do it from memory exactly as formerly explained.[1]

7. THE DISTANCE POINT. — Having studied the perspective alterations of horizontal planes in their relation to the eye-level, you will now study them in connection with their distance from you, with the point of distance. This carries out completely the theory taught in the anecdote of Vernet and Valenciennes (see Chap. VIII). The same models and exercises will serve, in each case analyzing as before, tracing, sketching, noting mistakes, correcting from nature, and repeating from memory.

8. These and many of the following exercises can be done satisfactorily with simple lines; still, where shade planes are very distinctly marked and especially where there are cast-shadows, there is no objection to putting them in. This is best done by means of broad gray lines laid in closely, with pencil or with charcoal, so as to form a monotone mass shadow.

9. VERTICAL PLANES have next to be studied in the same way. Take the same folio, or a drawing-board, turn it on one end and notice its apparent alterations; see how, when placed exactly in front of the eye, edge-ways on, it becomes like a single line (only its thickness showing), and how it gradually widens and narrows when moved to right and left, just as it appeared to do, lying flat, when it was raised or lowered above or below the eye-level.

A vertical line drawn through the centre of vision plays the same part for vertical planes as does the eye-level for horizontal planes. It is the vanishing line of all those that run at right angles to the picture plane.

Now start at once to make studies from your vertical drawing board. Turn it in different directions (as when you slowly move a

[1] If the distance were made too short the model would not come within your visual angle, and in that case you would have to *slightly incline* the plane so as to ensure its remaining at right angles to your line of sight. Here the small aperture diaphragm is a perfect guide.

door on its hinges) and note the altered direction of each of the horizontal lines bordering it.

Realize once and for all that it represents every kind of vertical plane, as well a window, a palisade, an iron railing, as the walls of a room, the side of a house. So does the glass plane of your philograph, but this latter also represents the most important of all, the picture plane.

Place two books upright before you, parallel to each other but a little apart, to right and to left of your eye. These give two vertical planes running in different directions towards the vertical vanishing line. Study and sketch them.[1]

The upright borders of your vertical planes remain upright, do not appear to run together, but those further from the picture plane necessarily appear shorter because contained between two horizontal planes converging toward the eye-level.

Just the same and as simple exercises must be done with vertical as with horizontal planes; then the two must be studied together, as in the planes of an open box. Here the inclined surface of the lid can also be represented. This, which represents the slope of any gabled roof or similar subject, may be studied by the help of the glass plane and of the plumb line.

10. REGULAR CURVES. — In order to become familiar with the circle in perspective you should study a dinner plate in the same way as the other planes. Tracings made of a plate in a horizontal position at different heights, vertically placed or even sloping, will show what you could not so fully realize otherwise: that the plate appears round in one position alone: when held up straight in front of you. All this is easily learned after having systematically studied simple planes.

In drawing circular or curved forms it is the greatest help to look out first for the axes of the curve, its perspective diameters. You know positively that every line running through the centre of a

[1] The apparent width of a horizontal plane depends on its height or depth above or below the eye-level. The apparent direction of a horizontal line depends on the angle it makes with the picture plane; and its slope, gradual or rapid, depends on the height of the plane containing it. The apparent width of vertical planes follows the same rule with regard to the visual line.

circle from edge to edge will be of the same length whatever its direction, but that circle is no sooner seen in perspective than it has a long and a short diameter or axis. Observe and sketch them and your work will be much easier, as they are the natural construction lines of every circle or curve. This applies in every case of sketching: example, a round-arched door-way, a circular fountain basin, vases, table tops. Again these same curves suggest the skeleton outline of certain flowers, as of the daisy, the chrysanthemum.[1]

Practice drawing a large cylinder or a jam-pot, standing upright, lying on its side, or inclined against some other object. This gives opportunities to study circles in all kinds of positions. Notice in the cylinder the apparent difference of width between the circular base (which is far below your eye) and the exactly similar top which is near your eye-level (whether above or below). You can stand it on a sheet of paper and mark all around its base, then move it to one side, sketch and trace, and compare the top and the bottom circles.

The great thing is to do as many exercises, and as simple, as possible. You will soon go ahead without timidity, and learn a great deal in a short time. A softish lead pencil and fairly smooth paper suffice as materials.

XIV. STILL LIFE.

II. Irregular Forms.

1. You will next have to study forms of which the contours are *not* composed of straight lines, nor of right angles, nor of sections of circles. They are called irregular or ungeometrical, although some geometrical elements may often be observed underlying their irregular exterior. As examples of simple irregulars take single fruits or *simple* flowers.

In each case the first thing you have to think of and look out for (having already decided how you will place your drawing on your paper, and how large you will make it) is the chief line of direction or axis of that model, its length and inclination, — as the long axis of

[1] Regular curves, circles or parts of circles, may also be thought of as enclosed in a square or other rectangle, but nothing is so really helpful as to make sure of their perspective axes.

a pear, or the axis of stalk and calyx in a flower. After this you will find the secondary direction or axis (Chap. VI, No. 2), which almost always crosses the first. In the case of the pear this lesser axis runs through the fruit at its widest part. When you have made sure of this, you will have the apparent or proportionate breadth of that pear, its width in relation to its length. In the case of the daisy this secondary axis will show at once how the flower grows, whether it turns upwards or downwards, or to one side; whether it is a mere bud or a full flower. A third line giving the short diameter of the circular flower will suffice to show its perspective proportions and position.

These axial directions and the curved contours are to be carefully studied, then traced and sketched from nature, and again from memory, as in the case of straight-lined forms. The advantage of using the transparent plane is even greater here than in the former case, for, although you might have drawn the straight lines correctly by rule, no rule will teach you as the glass plane does to see aright the exact direction and curve of the flower-stalk, or the irregular outline of the pear.

2. Only absolute essentials must be traced on the glass, and it is best to keep your work on the paper, as far as possible, equally simple. In sketching the pear you will have to indicate, besides the general outline, the meeting of two or three large planes that are respectively in light, in shadow, or in half-tone.[1] For the daisy you must with very few lines or touches suggest accurately the direction

[1] The term plane — which in drawing and painting is applied to the component parts of irregular and organic forms as seen in light, shade, or half-tone — must not be confused with the same term used in an exact geometrical sense (*see Perspective*). Actual planes belong to geometry and architecture. In the painter's sense a plane is rather a comparatively flat or even space only *suggestive* of a real plane. Exaggerated theories, purporting to divide all organic form into a variety of sharply-defined planes, were put forward some years ago in France. This caused the term to be regarded with horror by some teachers (see Boisbaudran). Taken in the modified sense now generally given it, the term planes could hardly be replaced, and should never be misleading. The treatment of organic forms by planes implies breadth or simplicity of effect, and is by no means opposed to extreme delicacy of form, as shown in some of the best work of the great masters. The student should clearly grasp the meaning of this and kindred terms in use among artists, for while a true knowledge will greatly help, a half-knowledge will as greatly confuse him.

of its petals, and the curve of its centre. In your first exercises you can do all that is needed merely with lines and touches; then, when you have become familiar with the forms, you will need to indicate simple light and shade masses, both as a means of suggesting solidity and relief and of expressing the construction and nature of irregular forms. For this it is useful to have two pencils ready at hand, one with an ordinary point, the other with a wide, flat, chisel point; with this you can make the broad, soft, gray surface-lines (see Chap. XII, No. 4), which, laid very close together, produce a good, simple monotone mass shadow.

3. The amount of grace, of vitality, and of individuality expressed by the axis of a flower-stalk, or by the stalk and mid-rib of large leaves, and the difficulty of perfectly rendering them is surprising. The teacher should call attention to these things, and also show how easily the character and position of a flower can be altered by changing the direction of the axial lines, or of its circle diameters. The student when unguided is too apt to pass these things by, thinking more of carefully imitated details.[1]

The circular suggestion does not help in all flowers. Thus the sweet pea must be studied like the pear, by its lines of direction and its distinctive curves; the golden-rod by its general axis and that of each spray; its outside form will be obtained by simple, almost straight lines, rather than by curves; but the morning-glory and all the lily forms are built upon the circle and its funnel-shaped continuation, through which the main axis of the stalk must be carefully prolonged.[2] Flowers and leaves offer endless matter for study as to form, direction, proportion. They do, in fact, constitute a separate branch of work, though for want of space they cannot be so treated of here.[3]

[1] No one has so thoroughly realized this as the Japanese decorators; hence, in part, the exceeding charm of their art, in spite of their neglect of perspective.

[2] This of course applies to drawings of single flowers or plants, not to drawing flowers in landscape.

[3] Among flowers taken separately the rose is perhaps the most difficult to draw satisfactorily, and for several reasons: The same vitality, and something of the same grace, must be expressed without the graceful curving characteristics and without the long tapering connection between stem and blossom that belong to many of the less sturdy flowers. You must also be careful, in indicating its numerous close-growing petals, to avoid the suggestion of over-crowding. For

4. As soon as it has become fairly easy to you by frequent practice to sketch all sorts of regular and irregular elementary forms, you will pass on to forms that are more difficult, in that they are more complicated. Of these examples are found in profusion among articles of furniture, plants, drapery, or you can obtain models by placing together several single objects to form a still-life group.[1]

The difficulties of these and countless other forms and combinations you can simplify and overcome by determined application of what you have learned in regard to direction of plane and of line, relative proportion of parts, etc. The real difficulty lies not so much in sketching any single object, but in representing it in its relation to other objects, giving its proper position on the ground plane of your picture.

5. DRAPERY affords matter for long and careful study, whether taken alone or in connection with the figure. In the latter case it is an auxiliary of organic form, and does not belong here.

Studying drapery in still-life drawing implies studying its values, its texture, and its folds, which last alone immediately concern us now. Here, again, are several divisions; the material may be thrown down in such a way that its folds are left to chance, there being no special determining cause for them. It may be used as a covering for some object, or it may be "draped" for purposes of effect. In either case you will need to arrange as well as to study the folds.

Thus even when they are informally massed together there should be some suggestion of the *principle of radiation*, which demands that they flow or radiate in some degree from a given point; this is of great importance in still-life composition.

When used as a covering, drapery may be arranged as simply as possible to show the form beneath; example, a table and its cover. When it is draped from special points of support these must be care-

this, after observing its chief axial directions, and their proportionate length, you must lightly block in your flower, observe its light and shade masses, and suggest in them by line or by touch whatever is most characteristic of the flower. This requires minute attention to the direction of planes, the form and proportion of masses, and very delicate execution (see Light and Shade, Chap. XVI).

[1] Among familiar household objects there is the large rattan rocking-chair, of which none of the uprights are verticals, nor any of the planes horizontals.

fully chosen, and allowed to appear as centres of radiation; and in this, as in every case, great attention will be given to subordination of detail, which is always a stumbling-block for the student. The folds should generally be few and simple, but above all, characteristic of the kind of material used.

6. It is remarkable to what an extent in drapery both constructive elements and special characteristics are given by lines more or less straight and generally suggestive of triangles. Folds, whether chance-made or purposely arranged (except when hanging from a single point) almost invariably assume such shapes. Sometimes the triangular indication is characteristically interrupted at its apex or has one side very much prolonged, sometimes it is almost complete. Nothing helps so much to steer clear of overcrowded detail and of roundness and *woolliness* in execution as careful observation of this underlying angular tendency.

Observed and carried out with sufficient accuracy, the fold goes very far to indicate the special nature of the material. Before beginning your sketch you should seek out the constructive lines and analyze the shape and kind of fold peculiar to the material of your drapery. Thus the sharp crosswise tendency in silk and in satin produces wide triangular planes with minute breakings, while in heavy woollen stuffs duller lines and simpler planes are to be observed.

As practical exercises you should select and sketch materials of different sorts, arranging them in the three different ways indicated. Your lines should be kept exceedingly simple and no details shown until your free-hand sketch corresponds with your tracing. Memory sketches as usual.

Very interesting examples of triangular somewhat conventional drapery folds are found in Albert Dürer's engravings; others of a more varied and graceful nature are seen in Leonardo da Vinci's studies (Louvre).

XV. STILL LIFE.

III. Groups.

1. Composition or Pictorial Arrangement. — The term *composition* as used in art has many varieties and shades of meaning, and the subject calls for attention at an early stage of the student's

work. In landscape it is chiefly a question of selection and of choice. In still-life study and in the decoration of given spaces it refers also to actual placing or arrangement; in figure subjects, to all this and a great deal besides. Only its merest elements find a place here, for composition belongs essentially to the province of Art proper, and we are dealing with the underlying principles of Art alone. Therefore while a few practical suggestions are offered, no attempt is made to lay down decisive laws.

When the student begins to study still-life groups, his work consists as before in translating solid forms on to a plane surface, but instead of being chiefly a matter of simple lines and proportions as before, it becomes almost entirely a question of effects, — a matter of lights and darks, of masses and of values. He must see to it that these, however simply treated, produce a pleasing or at least a satisfactory impression on the well-trained eye. In this certain things must be avoided, certain others sought for, and that chiefly with regard to the light and shade effects in the group, to the darks and lights of the drawing.[1]

[1] When real forms are represented, it is done chiefly by accurately reproducing their darks and lights, with all the delicate intervening gradations, thus translating their relief and natural appearances on to the plane surface of the drawing. When a flat surface, as a textile or pottery, is to be decorated in a purely creative way, the work becomes almost entirely a matter of areas and spaces in chosen combination. Then relief and reality of appearance have little or no importance for the student. The essential differences of aim thus indicated form the basis of the commonly accepted division of graphic art into two branches, called respectively Pictorial and Decorative. In the opinion of many thinkers and critics of great worth exaggerated and harmful importance has been given to these distinctions. Lengthy discussion of the matter would be out of place here, but the student's attention is called to the need of attaching some degree of right meaning to the terms.

In a general sense it may be said that when a subject is dealt with *pictorially*, — or as a picture, — it must be represented as seen from one determined point of view, and the picture itself when painted should be looked at in the same way, that is, from such distance that it may come within the chosen perspective angle. The decoration of spaces or of forms — whether of an object small enough to be held in the hand or of a large wall space — requires that it may be seen from a variety of points of view with equally satisfactory effect, and for the most part distance and relief are slightly suggested rather than actually represented.

Perhaps the quality most distinctively characteristic of the picture proper is that representation of depth and space which makes the spectator feel as though

2. First place satisfactorily the different members of your group, your models, then study the effect of the whole as to light and shade and *values*.[1] In placing them you will have to deal with *direction* and with *proportion*, both as to lines and masses and as to light and shade effects.

That is to say, your group once arranged, some few chief lines and directions will be suggested by its general contour, and by the outlines of its separate parts or masses, and a distinct impression, pleasing or otherwise, of its relative proportions will at once be given.

These things must be learned by practice, and you will do well at a very early stage of your work to experiment in arranging groups suitable for sketching, in doing which it is important that you remember and apply the few points following:

(*a*) Your group must not look overcrowded; therefore you must avoid many models and must have no superfluous or insignificant ones. (*b*) It must not be so regular as to be stiff. (*c*) Nor must it be spiky or straggling.[2]

3. Therefore your models should not be placed all in a row, or all equidistant from the picture plane. They must not, owing to their position, be all equally visible. Large objects must not be placed outside smaller ones so as to wall them in.

he himself were behind the frame and could freely move around in the scene portrayed. Such representation of nature is very different from its servile imitation. Here the French by help of their expression "*trompe-l'œil*" establish a whole code of Art faith which in English must be discussed at some length to be made plain.

This term *trompe-l'œil* (deceives the eye) is applied properly to painting in which the imitation of relief has been carried to such an extraordinary extent that the spectator is positively deceived by it, that the painted object appears rather to be the actual object standing out from the canvas and so near that it might easily be touched by the hand. Art represents the same object seen in space duly softened and modified by atmosphere and surroundings. Note the contrast! Fact and theory are well expressed in the artists' favorite maxim: "Le trompe-l'œil n'est pas l'Art." (The painted counterpart of nature is not art.) The same term is also applied to the imitation of carved or stucco decoration seen at a distance, as for example that of the vault of Milan cathedral.

[1] See Chap. XVII.

[2] Michael Angelo is said to have declared figuratively that a sculptured group should be so solidly composed, its parts so well knit together, that it might fall from a mountain top without any of its extremities being broken off by the shock.

4. A very large and a very small model must not be placed side by side in such a way as to contrast disagreeably. Neither may several objects of the same size be placed close together with irksome sameness, suggesting a game of nine-pins. Nor should they stand right in front of each other, for in all these cases the lines produced would be stiff and unpleasing, and so would be the parts, masses, and proportions of your group.

5. You will find on the other hand that if the same objects be placed at different distances from the front so that, by their diagonal direction, they lead the eye inwards from the picture plane, if large and small members be so grouped together in simple, well-proportioned masses that they complete and support each other, instead of contrasting clumsily, the eye will be satisfied and the homeliest objects will become interesting as forming parts of one harmonious whole.

6. CONCENTRATION. — Most important of all, you must avoid so disposing your objects as to form two distinct centres of interest. Whatever the nature of your models, you must bear in mind that they are to form a single and complete group, through concentration of interest.

This is obtained not only by arranging the models, as to form, size, direction of lines, but, even more strikingly, by concentration of pictorial effect, which involves study and choice of light, shade, and color. You will soon learn so to compose your group that what you consider most interesting as to form or color shall be most fully lighted, making all the rest of subordinate importance. When you come to this study of effect you will begin to realize the importance of eliminating detail.[1]

[1] There are cases in which concentration of effect has to be replaced by a more general diffusion of interest. This happens in still life as in every other kind of subject when treated *decoratively*. Two of Chardin's canvases in the Louvre, representing respectively the emblems of music and of sculpture, are excellent examples of this, both as to arrangement and execution. They are long and low in shape and were painted to surmount two doorways in the Hotel Lambert, Paris. The perspective suggests a table nearly at the level of the spectator's eye. Light is generally diffused, though coming mainly from one side. The interest extends fairly equally over the subject, acuteness of detail or of effect being avoided throughout. The whole constitutes a decorative rather than a pictorial composition.

7. It may not be amiss to remark here with some insistence that it is with pictorial effect, pictorial interest, that we have to deal throughout. People sometimes, even in still-life painting, make the mistake of putting first some literary or sentimental interest which has, properly speaking, neither part nor lot in such connection.

Notice again the importance in the present case of the *oblique* or diagonal line or axis. It frequently figures as the constructive line of great decorative compositions, both of painting and of sculpture, whether of past or present times.

8. So much for the theory of still-life composition. Special exercises which are extremely useful consist in placing models, arranging them as to light and shade, analyzing and discussing the effects obtained. This concerns the inner composition of the group. Besides this we have to study what may be called its outer composition, its relation as a whole to the background and foreground. This concerns the form and size of the picture. For this, valuable help is obtained by using the *proportional frame* of the philograph (see Appendix III).[1]

9. ELEMENTARY EXECUTION. — Now, leaving theory aside, let us return to the starting point, to the first stage of practical work, and commence the sketch of our group of models. — Suppose you begin simply with three or four books laid unevenly upon one another, another book rests sloping against the pile, and a vase or similar object completes the group. You will arrange these so as to please your own eye, which implies doing it in the spirit of what has just been said of composition. This done, choose your point of view, for the same group might be copied from various positions. Next decide upon the size and form you wish to give your study. For this you may look at it through the proportional frame, testing its appearances as seen through a narrow upright, a flat, or a square opening. Having decided this point to your satisfaction, you may, with four charcoal lines, lightly frame in a corresponding shape on

[1] The glass plane is used whenever it is a question of copying what is already placed or "composed," the proportional frame specially for choosing what part of an indefinite whole will best "compose" as a picture, or what is the outside form best suited to a given group or subject.

your paper and proceed to block in your subject, treating it very simply, as you are accustomed to treat single still-life forms.

10. BLOCKING IN THE GROUP. — First find the extreme outside points which give roughly the shape of the whole mass on paper, then the direction of two or three principal lines, chiefly lines of contact between uprights and the ground plane of your picture, beginning with the edges of the lowest book, upon which all the others are supported. These directions, when understood, tell the exact position of each object sketched, and the length of the lines gives the perspective extent inwards.[1]

You will, first, mark the *eye-level* (see Perspective) which governs the width and inclination of all horizontal planes and lines, and then proceed to find the proportionate height, width, and inclination of all the separate parts of your group. In doing this you may use the measuring pencil and the plumb line (see Appendix II). Having clearly defined the size and position of each object, you will further study to express its individual form and characteristics. For this first carefully draw its contours, then, by help of its mass-shadows and of the light surface-lines already described (Chap. XII, § 4) indicate its roundness or flatness, and the inclination of its planes. You should do a great many exercises in simple group-sketching of this sort before attempting to carry the work further, because for complete execution you will need a good knowledge of the principles of light and shade.

Memory sketches, already so strongly recommended, are equally important in connection with composition.

11. WORKING MATERIALS. — The use of charcoal (*fusain*) and the rather rough white paper already recommended may be sometimes varied by the introduction of dark tinted paper and white chalk. For this the group is sketched as above; its light masses are then

[1] The true principle or blocking in, or commencing a drawing, whether of a single object or of a whole group, is admirably expressed by the French phrase *chercher la mise en place*, which implies looking for the proper place of each component part of your subject, giving it accurately its relative importance. Nothing can better describe the simple and positive nature of the work required, so far opposed to the vague ideas frequently connected with every kind of sketching.

laid in broadly, the high lights and most intense darks being added progressively. The charcoal should always be handled so lightly that it can easily be dusted off with a handkerchief or leather, or with *amadou*. Shades and cast shadows are best laid in in broad lines made by holding the charcoal between the thumb and three or four fingers, almost parallel to the paper, which rapidly wears down its end to a broad flat surface. These lines are then lightly "massed" together with a large paper stump, or still better, with a rag rolled round the finger. The uncovered finger itself is in many cases the best of tools, especially for subduing a detail or softening an outline. Bread should not be used until the work is well on towards completion; it will then help in taking out crisp lights, or removing spots and unevenness. It can be worked into a very fine point, and will render excellent service in its proper place, but if used too much, and when it is too fresh, it is apt to grease and spoil the paper.[1]

XVI. STILL LIFE.

NOTE. — In studying still-life groups it is especially recommended that the plan of doing the work by the sequence of Analysis, Execution, and Memory, as before laid down, be closely followed.

1. LIGHT AND SHADE. — Just when the study of light and shade should be entered upon is a matter for the teacher to decide. It is suggested that it be begun at an early stage, but here several distinctions need to be observed. As soon as the pupil has become familiar with elementary perspective appearances, he must use simple mass shadows to express form. But half-tones and every complication are better left until the subject of light and shade can be studied as a whole.

There are various ways of studying light and shade. Formerly it was common to draw and shade a single object, say a vase, carrying

[1] Charcoal drawings are best fixed by the usual means of spraying *fixatif* upon them with a spray or atomiser. Care must be taken, in so doing, to stand far enough away to insure the spray being very fine. *Fixatif* is easily made by dissolving white shellac in alcohol, proportion 1 shellac to 10 alcohol. A solution of isinglass may also be used.

it on to a high degree of finish irrespective of all surroundings. This is still done to some extent but is against the best practice and should be avoided. It is much like painting a single eye or a mouth entirely isolated from the rest of the face. Students who learn this way have the greatest difficulty in realizing afterwards the proper nature and relations of light and shade. Here as elsewhere the importance of the broad, natural mode of proceeding cannot be overestimated.

2. THEORY. — Here is recommended the same kind of exercises as those suggested in studying composition. For this, before making any sketch, you will practice arranging groups of objects, in view of obtaining different and pleasing light and shade effects. You will see that the light comes from one direction only, preferably from your own left side,[1] and when once the different objects are placed to your satisfaction, you will look at the group and study it, not as consisting of a number of models but as forming a single whole. Look at it from a distance and with half-closed eyes, and try to realize in every way you can the powerful, simplifying nature of light and shade, which plays fast and loose with every consideration of form, size, line, color, and, in the pictorial sense, completely subordinates detail and even important fact to general effect.[2]

In studying light and shade theoretically the white models, commonly used in schools, are of great service, for they exclude all complications of color values. Group them properly and then study them with reference to the rays of light. Just as in looking at a book you see it better when it is inclined so as to be at right angles to your visual rays, so here that object or that plane is best lighted which receives most rays of light falling at right angles to its surface. In other words the relative intensity of light depends upon the angle at which the rays fall on the lighted surface.

3. In thus studying your group it is helpful to establish a scale of relative intensity. This is easily done by holding in your hand a white card, which you place parallel to each lighted surface in turn, observ-

[1] So that in drawing, the cast-shadow of your hand may not at all inconvenience you.

[2] The Claude Lorrain mirror is helpful here; so are smoked glasses (see Appendix).

ing the variations from high, full light (where the rays fall perpendicularly) to half-tones (where the rays fall obliquely), and on to complete shade or absence of light, in those parts so turned that they receive no rays of any sort directly from the light-giving source. To do this will greatly simplify your after-work in sketching. It is important to be familiar with the accurate meaning of terms commonly used in connection with this subject.

Shade implies absence of light. *Shadow* is absence of light caused by some object intercepting the rays. A *cast-shadow* is the definitely outlined shadow of an object thrown upon some other object or plane. Intensity of shade and of shadow depends mainly on surroundings, on the amount of reflected light proceeding from them.

You can easily prove the large part played by reflected light. With your same white card you can lessen by many degrees the deepest shade mass in your group, merely by so holding the card as to cast a strong reflected light. Reflected light does not necessarily imply the presence of a bright or shining surface.

4. Artificial Light. — The same object or group of objects seen by lamplight will show marked differences that should be studied experimentally. By daylight, owing to the size and distance of the sun, the rays are practically parallel to each other. Their inclination or obliquity will, it is true, be different at noon and at sundown, but there is no sign of that divergence of rays so strongly marked in every case of artificial light proceeding from a definite centre. The difference most immediately observable here is in the direction of cast shadows. Evidently these are not matters to be disposed of in one or two lessons, but require great attention and oft-repeated efforts.

5. Light and Shade Exercises. — Having gained a general understanding of the theory of light and shade effects, you will proceed to put it in practice thus: Sketch a number of very simply lighted groups, doing it with the determination to put down only the general light and shade effect of your group as a whole, when seen from a long distance or looked at with half-closed eyes, in order, as far as possible, to lose detail in the broad masses of effect.

In arranging your group you will concentrate the effect on what you consider most interesting. This central point of interest may

be, oftenest will be, in the middle of your picture, but it may also be to one side, in which case the general oblique direction of the mass of light must be such as to counterbalance that intensity and prevent any "lop-sided" effect.

These sketch exercises may be executed in one of two ways. First, the general lines, directions, and proportions of your subject being determined, the contours of each object are to be carefully drawn, independently of light and shade; and only when the group is thoroughly *constructed* the effect will be laid in broadly over the whole. Second, the size and shape of the group as a whole being determined, its relative light and dark values may be laid in as surface masses rather than as representing definite forms. This is very good for the purpose of assimilating what you have learned of theory, but should not be carried far as to execution. In every case a memory sketch should follow.[1]

XVII. STILL LIFE.

I. Values. II. Complete Execution.

1. Artists of widely varying schools agree that painting is primarily a question of values, and the moment we begin to deal with pictorial renderings the same may be said, in a lesser degree, of *black* and *white* work. The term *values* is applied to the combined effects of light and shade and of color,[2] which in nature are so closely connected that it is practically impossible to separate them unless by studying from white or monochrome models. The word, a literal translation of the French *valeurs*, is now generally used by English-speaking artists. The nearest equivalent of the original would

[1] This mode of proceeding is most useful in making out-of-door studies, when the required atmospheric effects are not forthcoming. The form and nature of each part is studied and represented by means of the light surface lines afterwards to be partly, though not entirely, merged in the mass effect. This allows of great freedom in completing your work.

[2] The term values may also be used in a partial sense. Thus you may have, for purposes of explanation, to speak of color values or of light and shade values. On the other hand the term black and white values may imply the expression in black and white of the complete light, shade, and color effects in question.

perhaps be "relative dark and light effect." The familiar Italian *chiaroscuro* also means literally light and dark, but in its accepted use is particularly applied to the *relief* obtained by light and shade.

2. The study of values, in the complete sense, is more difficult than that of light and shade pure and simple. In the first place, it is more *subtle*, because the color of any given object lessens its individual light and shade value. It is much more complex, for its component elements (light and shade and color) frequently have opposite tendencies. Take for example a brown earthenware pitcher, a white plate, a loaf of bread, a glass, and a knife, and arrange them to form a "still-life" group, the pitcher placed to the left of the group, the light coming from the same side. Suppose that pitcher were white, it would offer the largest, most strongly lighted *mass* of the whole subject; but, being of a dark color, although it receives the same amount of light, it does not produce the same effect, and you must take this into consideration when grouping your models. In this case the strong *color value* of the pitcher most distinctly interferes with the effect naturally produced by the rays of light, and at first sight appears to reverse it.

This points to the practical advantage of simple light and shade exercises, for they serve as a means of dividing and thus lessening the difficulties. In the present case it may be an easy matter to see the relative values of the pitcher and its surroundings, but it is not always so, neither is any such definite guide to be had here as the white card used in judging of light and shade; it is a question of careful observation and practice. You can help yourself in judging of values (for translating them into black and white) by glancing suddenly at the subject or by observing it attentively from a distance and with eyes half-closed, in view of realizing what impression it makes on your sight as a matter solely of *contrasted* light and dark masses.

Although the drawing-student must perforce acquire some understanding of values, it does not come within the range of his work to carry out such studies, even in black and white, to the most advanced point which implies special difficulties that belong to the artist, or at least, to the advanced art student. You will do well in your early studies to think most of light and shade, and to arrange your still-

life groups in view of great simplicity of values; you can thus avoid many a combination that would add to the difficulty of your task without necessarily teaching you more than simple effects would teach.[1]

3. Among further familiar examples in which light and shade are interfered with by color, we find that deep-toned foliage seen against the sky, however broad and strong the light on it, will still appear as a dark mass against a light ground, even though the relief of its individual parts be most pronounced. This light and shade relief is the drawing-student's own particular province. In it he may obtain exceedingly interesting and picturesque effects; as proved by the series of Nicolas Poussin's drawings, landscape and figure compositions (see Louvre collection). In these a whole scene is forcibly portrayed by deep or by pale shade-masses rendered in flat sepia washes, at times with a degree of relief suggestive of sculpture, and yet, by a light stroke of the brush, so delicately massed together, so well sustained in its effect as a whole, that you seem to see before you the complete picture rather than a summary sketch.

Again, a dark-complexioned person, placed in full light, if draped in white or seen against a white background, appears very dark, in spite of light and shade facts. These are matters of color contrast. The painter must not allow himself to be misled by them, nor, in his own sphere, must the young drawing-student.

Referring again to Nicolas Poussin's drawings, it is evident that the same subjects expressed entirely by their values — which is the more modern tendency — would appear quite different, though not necessarily better or worse. It is also evident that some subjects lend themselves to one kind of expression, some to the other. The intelligent student, knowing of these things, will observe and determine beforehand what he intends chiefly to represent, and how he will express it.

[1] Many of the present-day painters take pleasure in studying white upon white, red upon red, etc. For example, a light-robed figure seen against an equally light background. Some even make constant practice of so doing; but this is less a question of art than one of overcoming great technical difficulties, of executing a "*tour de force*," with which we have nothing to do here, and that should be left to artists of great knowledge and experience.

4. Returning to our still-life group, let us notice in detail some points of practical importance. Suppose the surface of your brown pitcher be decorated with delicate pierced or relief work, and that you desire to call the spectator's attention to it, to concentrate on it the pictorial effect of your group: what means will you adopt? If it were pure white, and you sought to throw it up *as a whole*, you would naturally choose a dark background; as it is dark, you as naturally think first of a white one. Try the effect; your pitcher will simply contrast as a dark mass against that light ground, and all its detail be lost; but put behind it a ground as dark or darker than itself, and the beauty and relief of its ornament will show to full advantage. This is a case in which delicate values are killed by contrast.

Exercises in values must be done in every branch of drawing. Like all the foregoing, they require observation, repetition, self-criticism, and memory work.

5. THE COMPLETE EXECUTION of groups is best not attempted until the student is fairly sure of elementary form, and has obtained an intelligent understanding of values, and some practice in doing light and shade work of a broad sort. In order to carry his work through to the end he must be specially careful of it at each elementary stage.

Thus, your group having been satisfactorily arranged, you must decide upon the shape and size of your sketch. Lightly frame it in on your paper; then block in your subject; study in detail the true form and proportionate value of each part or member, and the light and shade masses of the whole. When all this has been successfully carried through there will still remain to be done that bringing together and simplifying by which is obtained the oneness, the "breadth" of effect characteristic of all good work and so strongly insisted upon by artists. For this you will have to sacrifice, or at least to subdue, every detail that interferes with the mass values of the whole, whether in light or in shade.

A full understanding of how necessary this is only comes with experience and practice. The student's appreciation of the true principles of his work is best shown by his readiness to sacrifice labored detail to breadth, and to practice relentless elimination of

the unnecessary. Outside the careful observation of good Art works, half-closed eyes and distance are what will best help you here; but with all your efforts, the teacher's guidance will still remain of the greatest importance.[1]

6. As a matter of execution, this completing process, which consists rather in eliminating details than in adding high surface finish, requires many successive efforts. Here both the charcoal point and the softening finger are required, alternately bringing a form into stronger relief by a firm outline and giving crispness to a detail, or causing them to blend into their surroundings.

Every degree of proficiency thus obtained in accordance with sound theory will prove valuable later in figure and landscape drawing; but mere surface dexterity of the breading and stippling order is worse than useless, for it is misleading.

It is evident that all these matters of composition, light and shade, values, execution, may be, and in the long run are, studied simultaneously. Experience proves, however, the great practical advantage of so dividing them at the outset that the whole attention may be concentrated on one point at a time.

XVIII. LANDSCAPE.

I.

1. The first exercises in landscape drawing may almost be considered as still-life studies, the greatest difference consisting in the fact of their being done out of doors and consequently differently lighted. They must, of course, be very simple, but their simplicity will depend chiefly on the way you look at your subject and on the way you execute it.

Thus you may commence with a *foreground subject:* a bush, a post, or a garden bench, and their respective immediate surroundings; or, more difficult, a boat at its moorings. The horizontal line or

[1] Interesting examples are frequent in very celebrated paintings by Titian, by Leonardo and others, of the subduing, almost the effacing, of carefully wrought details for the sake of the general effect. This is seen in the "Belle du Titien," (Louvre), where the fine white pleating round the neck was first painted with a precision of detail characteristic of the early school, and then partially obliterated.

eye-level is to be indicated by a single line, and no complications of distance suggested.

Or you may choose a stretch of roadway with an upright wall or building, requiring the practical application of what you learned concerning typical horizontal and vertical planes, in which lines vanish to the centre of vision, or are parallel to the picture plane.

Again, you may select a broad, open expanse of field or of seashore, with the natural horizon and but few details of any kind; this, or any other of the countless subjects in which the ground is represented by a fairly even, horizontal plane.

In each case the facts dealt with in your model-drawing and still-life exercises will greatly help to straighten out all the perspective difficulties. The teacher should ascertain how far the pupil realizes the relationship, not always at first apparent, between the regular, typical forms that have been studied and the very irregular shapes and contours met with in nature.

2. In examples dealing with open spaces you will have but little to do at first with light and shade; the very careful placing (*mise en place*) of each part is the most important thing. It is helpful to think of your subject as consisting mainly of the two great planes of ground and sky meeting at the horizon; houses, rocks, boats, hedges, furrows, are then as details on the ground or ascending plane; clouds, and practically all that is high above the horizon, are as details of the descending plane, and diminish gradually (perspectively) as they recede from the eye and approach the horizon. Example, the lines of any long avenue of trees.

All that was said formerly of the point of distance in connection with the visual angle, and the area of distinct vision, etc., should, of course, be brought in here. The different appearances of the same object, as a house or a group of trees, according to its distance from the eye; the widening of the field of vision obtained by lengthening the visual ray, and other similar points which may have been hitherto chiefly matters of theory, now become indispensable for practice.[1]

[1] A convenient way for the beginner to obtain his visual range is to stretch out his arm at full length before him, with fingers wide-spread; then, with one eye closed, turn the hand slowly about. The amount of distance covered by the spread fingers will equal, roughly, the base of the natural visual angle.

3. In the first examples, consisting of near or foreground subjects, the shape of the sketch has to be decided upon and the subject blocked in exactly as was done in the still-life groups. Then the form and inclination of each part should be indicated with broad charcoal lines as in such groups. Planes of light and shade and cast shadows should be *massed* as in still life, if you are working in sunlight, otherwise their relative values should be studied and determined as already described.[1]

Simple landscape exercises may well be done interchangeably with still-life groups. You should not attempt to exhaust indoor subjects before working out of doors.

4. In sketching trees there is room for great variety of rendering. Nowhere, outside of organic form, is the axial principle more evidently and constantly important than in representing the trunk and limbs of trees; nowhere is it oftener neglected, with the frequent result of more nearly representing an imperfect stovepipe than a living tree. The alternating and oblique growth of branches and foliage is a botanical as well as a pictorial fact. The enveloping contours, the varieties of plane and surface, all are worthy of careful study as the ground-work of that breadth and simplicity of effect which, at a later stage of your work, it will be your chief aim to attain.

Foliage is to be studied as a question of mass and so represented, both when it is seen in simple values against the sky and when it is thrown into high or slight relief by brilliant light and shade. This treatment will render the individual characteristics of the tree far better than any so-called "tree touches."

[1] In each case the philograph is to be used as hitherto: that is the glass plane for tracing, comparing, and testing form, proportion, and direction of line; the proportional frame for determining the extent of your subject and the outside form and size best adapted to it. For out-door work philographic tracings are best made on gelatine or on celluloid plates. They can then be retraced at leisure, if required, or simply effaced after the lesson. By this means a single instrument might suffice for a whole class, enabling each one to make a test tracing of the subject from his own point of view, without having to use tracing paper or lose time cleaning the glass.

XIX. LANDSCAPE.

II.

1. After passing the rudimentary stage of work, the specific difficulties of landscape consist chiefly in the rendering of such elements as space, atmosphere, and light. These, however, belong to the domain of Art proper and do not enter into our present programme.

2. LANDSCAPE COMPOSITION. — What in still life was a question of arrangement, is here rather a matter of choice and selection. Certain present-day painters, however, flatly denounce the idea of composition in landscape work. They practically say: No choice is required, copy nature as you see her, just shut your eyes, turn yourself around, open your eyes again and paint what happens to be before you. In a way this is a recoil from the "classic" landscapes with their ruined castles and sculpturesque trees, their sheep, their shepherdesses, their swains, so fantastic in the eyes of our time; but this feeling, carried too far, flies in the face of common sense.

Countless portions of nature, seen among their proper surroundings, produce charming effects, often due almost entirely to contrast of color, value, or form, but, isolated from those surroundings, and reproduced upon canvas, they are found to be neither interesting nor suggestive of truth.

Truth in Art is not so much a matter of accurate fact as the *rendering of what will produce an impression of fact* on the mind of the spectator. Here comes in the necessity of choice and the selection of a subject that forms an harmonious whole of which it is possible to render a satisfactory impression. Surely this cannot be inconsistent with any true conception of impressionism or of realism. The greatest modern landscape painters, among them Constable, Corot, Dupré, Daubigny, always paid extreme attention to the choice and arrangement of their subjects, and this kind of composition is among the qualities that chiefly serve to immortalize their works. The youngest student should be taught the importance of this matter and encouraged to choose at least his point of view, his distance, the form and size of his sketch, and the space he means to include in it. Such teaching is not likely to come unasked, for the very first ques-

tion that suggests itself in view of a landscape sketch is always: Where shall our subject begin, where end, and what shape shall we give it?

3. A series of exercises in landscape composition and drawing can be turned to great account. The following, recommended as specially adapted at this point of the work, consists: (1) in studying on a small scale what might be called the anatomy of a landscape, of foregrounds combined with water, vegetation, tree growth, etc.; (2) in treating the same subject ("motive") on a scale large enough to admit of careful detail study; (3) in dealing with scenes or views so extensive that they need to be treated panoramically.

4. Here the proportional frame is of much use in selecting the subject by determining its form and its extent, and helps in sketching it in correctly and rapidly by dividing it into several proportionate triangles. You will use it thus: Place the frame upright on its tripod stand before you, having first selected the opening you prefer and fixed the sliding shutter to maintain it. Look through that opening and sketch (in your sketch book by free-hand) just what you see, simply blocking in with very few lines the skeleton of your subject. No detail is required, but the directions of the lines and the proportions of the masses given by them must be accurately observed and recorded.

Several such sketches can be done at a sitting from as many different points of view. This enables you "to walk around your subject," so to speak, to straighten out its perspective foreshortenings, to realize its structure, and its altered appearances dependent upon the points of view and of distance.

5. Individual parts of the subject must also be studied and represented to some extent in detail. For this you will choose among the different views of your "motive" the one that you prefer and make a large charcoal drawing, four or five times the size of the first sketch. In this, each plane, each irregularity of the foreground, each tree or bush will be given its due importance as to size and as to form and inclination.

6. The third kind of exercise in landscape drawing belonging to this stage is the one in which you deal with a very extensive view, such as distant mountains or a wide-stretched plain. These can only

be treated panoramically, that is as a succession of parts, or a series of views seen in succession as they are in nature. Here the same kind of facts have to be dealt with on a much larger scale. The great difficulty lies in judging of relative distance, height, and extent. As a test means you will use the glass plane and the large aperture diaphragm as elsewhere explained.[1]

7. The ultimate picture will depend largely for its artistic value on the choice and rendering of atmospheric effect. The gifted artist might with equal facility depict moonlight or mid-day, sunset or dawn, without changing the component, constructive parts of his subject. It is precisely the artist's life-giving rôle to choose and to render the striking, the pictorial, sometimes the poetic aspect of a subject, but in order to do so with required freedom he must have fully mastered the underlying facts and forms which it is the beginner's special duty to study.

XX. ORGANIC FORM.

1. The study of organic form is essentially the study of the human figure, the climax towards which all the rest tends. The difficulties that have to be grappled with here are greater than those of any other kind of drawing, just in proportion to the infinitely greater complexities that have to be dealt with. Not only will you have to do with the most accurate rendering of form, and the most complex construction; but the aspect of that form is perpetually altering, owing to the constant variation of action, movement, pose, to which your model is subject.

[1] The kind of subject containing, perhaps, the greatest difficulty as to actual line perspective, excluding, of course, complicated architecture, is such as groups of houses, seen from below or from above, and especially a street or steps leading sharply downward from the spectator's eye. Such motives are oftentimes very picturesque, but on account of their difficulty are rarely grappled with and should certainly be avoided until much elementary work has been done. The chief difficulty in all such cases consists in realizing the apparent direction of lines and planes. Here planes that really slope downwards must, like any horizontal plane, be represented as running up towards the eye-level; for their width can only be expressed by a certain vertical space on the paper. The philographic tracing enables you at once to realize these facts, but the required impression will only be produced by help of contrast with some high upstanding foreground mass.

Besides these must be considered individual characteristics of facial likeness and expression, and the pictorial factors of light and shade, color, values, and composition.

2. THE AXIAL PRINCIPLE.—Life, action, movement, are expressed essentially by the direction and inter-relation of axial lines, and by the accurate rendering of perspective form together with adequate representation of light and shade. Here you must think not only of the boy running, the man carrying a burden or making any strong bodily effort (as in pulling or pushing), but further of the person standing at ease or sitting in a comfortable chair. In each case the essential characteristics of the figure for the time being—its action, movement, or state of repose—can be expressed by the directions of a very few lines, in great part even by the two, giving respectively the *axis* and *counter-axis*, named in Chapter VI.

These lines form angles that are as a rule more or less acute in proportion to the greater or less energy of the action.[1] Wherever there is life there is "movement," which does not, however, necessarily imply action. Movement exists (graphically) even in repose. To study the apparent direction of the axial lines of any figure is to study the anatomy of its movement. This is infinitely more important in drawing living figures than any mere record of anatomical facts, and should be made the first rather than the last step in studying from nature.

Charles Blanc, the great art critic (formerly Ministre des Beaux Arts), points out in his "*Grammaire du Dessin*" the help that may be gained by using small, flat, cardboard figures jointed with pins like the old-fashioned "Dutch doll," as a means of realizing how forcibly vigorous action and various attitudes can be suggested by straight lines.[2]

[1] When a large number of figures are dealt with, this becomes even more apparent, as in a battle scene, a foot-ball scrimmage, a horse-race. It is to be observed that in all good works of art, whatever the amount or quality of detail shown, intensity of motion or of energy is expressed exactly in proportion as every other consideration, such as form, color, modelling, is made secondary to the variety of axes suggested.

[2] The science of the movement of bodies acting upon one another is called dynamics. Dynamics come into play in the figure where different parts act upon each other as levers. It is this action which mainly strikes the eye and must first

3. Perspective and anatomy govern apparent individual form. The value of a proper knowledge of anatomy cannot be called in question, but it must never be forgotten that for the art student it is to be learned in connection with life, and not with death as is too generally the case. Still further should it be studied in connection with perspective appearances. Nowhere are perspective alterations more absolute than in organic foreshortenings. A merely conventional knowledge of anatomy is as apt to be misleading here as "form study" was shown to be in our first efforts at realizing apparent form. You may know every bone, muscle, articulation, and suture of the human figure and yet not be able to convey by your drawing an impression of repose or of action; such knowledge in fact sometimes interferes with the student's power of simple observation; therefore what is called the anatomy of movement deserves the first place. This depends before all on intelligent observation and study of the figure as a whole, *from the point of view of artistic expression.* There are thus practically for the drawing student two kinds of anatomy; one dealing with the material sub-structure of his model, the other with its action and its perspective appearance, the one immediately affecting the outer forms and contours of its parts, independently of action, the other its whole *pictorial existence.*[1]

4. LIGHT AND SHADE here, as in still life, must be treated by the beginner as secondary to general constructive proportion. But when once his eye is well trained he will frequently sketch figures or groups by their light and shade masses entirely.

be thought of in the graphic rendering of movement, and that may be studied by help of the line sketches and the card figures referred to in the text. The study of the same parts when at rest is a branch of the science of *statics*, and the temporary alterations of form under such circumstances are due generally to weight or downward pressure (*tassement, pondération*); as example see the statue of Atlas bearing the globe.

[1] This is no more meant as an attack on the study of anatomy proper than was a former paragraph on that of "form study." Here as there you must represent forms as they are seen, to do which to best advantage implies both having a thorough knowledge of them and being able to choose how to represent them. If, when you do begin to study anatomy, you start by thinking of muscles simply as groups or masses acting on certain bony levers and producing certain alterations in form, instead of learning one by one names and attachments which have no living meaning for you, your first notions of the *anatomy of movement* will have done you good service indeed.

As to execution, the different stages, or processes, of your work follow each other here much as elsewhere. Having studied the directions of your figure, you must find its general proportions and construction. After this observe the form of each part, its planes, its bony articulations, its smooth or wrinkled surfaces. Then indicate these as simply as possible by means of contours, of shade planes, and of carefully studied surfaces. Do this with a view to expressing first the life and nature of the model, which must continue to be your sole aim during many careful studies, before beginning to think of pictorial effect or of any degree of finish.

5. PROPORTION. — A similar danger to that of studying medical anatomy attends the study of theoretic proportions, and especially any attempt to divide the figure geometrically. Divisions in nature are not geometrical, but always consist of a greater and a lesser part (*une majorité et une minorité*), answering in a sense to the chief and secondary axes of movement. These natural divisions are what must be looked out for and taken into account, but even they are subservient, graphically, to momentary conditions of pose or action, and, above all, to perspective alterations.

It may be convenient, for the actual placing of your figure on your sheet of paper, to divide it in halves, or to think of its height as representing so many *heads*. But in studying it you must notice accurately what is its foreshortened appearance, rather than search for its actual proportions, which are often hidden. The apparent mass of the folded arm, or that of the bent torso, in proportion to the whole, the seeming narrowness of the far side of a figure seen in profile, these are what you have to note and to record.

For contours, envelopment, and foreshortening, see Perspective.

Construction consists chiefly in the fitting or boxing together (*emboîtement*) of parts to form an articulate whole. Notice here the fullness, the frequent convexity, and the occasional flatness of the natural contours. Rarely if ever in nature is any exterior form concave.[1]

[1] Eugène Delacroix used to say, in support of the general convexity of organic form, that you can represent the human figure in full life and action entirely by means of circles or parts of circles. Many interesting sketches made by him give proof of this statement.

6. For composition (arrangement of single figures) and organic drapery, see *portrait*.[1]

7. PRACTICAL EXERCISES. — In view of helping yourself to lay hold practically on this anatomy of movement, it is well to make frequent free-hand sketches, in which you will apply yourself to study out and to sketch the *axial lines alone* of a living model, or those of any good cast of a figure in action. Your sketch will thus represent the wire-skeleton or "soul" of the clay modeller, and should be tested by the philographic tracing. The axial directions of the whole will be followed by those of each part, and this may be carried out down to the separate joints of fingers and toes, for even these have their value of expression.[2]

In making a tracing of the whole figure no detail is to be attempted, and only such lines or points marked as will suffice to place and indicate what is constructively most important; for example, the height, width, and direction of the head and shoulders; the direction of the torso. Make similar indications of the width and position of the hips, the knees, the ankles, according to what is clearly visible from your point of view and to your knowledge of construction.[3]

8. The "normal perspective distance" is even more important for properly representing the human figure than in any other case. Where it cannot, for material reasons, be obtained, the student must know that he is working under imperfect conditions, and as far as possible adopt means of counteracting them. Otherwise his drawing is likely to be in flagrant opposition to the laws of sight, as frequently happens in over-crowded schools and studios. In such places

[1] Training the eye to see form correctly must go hand in hand with training the mind to select what should be seen. This is more difficult in organic form than elsewhere, as more depends upon accuracy. In still life and in landscape you may thoroughly well represent the nature and characteristics of your subject without perfect accuracy of proportions, but with the figure it is not so. Hence the special need of accurate test means, and the value of the transparent plane for realizing the perspective appearances of organic forms, and for testing your free-hand renderings of them.

[2] This, which to some may suggest a return to the young child's first endeavors, is proposed less as a method of drawing than as a means of mentally realizing the essentials of a movement (see *Drawing from the Cast*).

[3] Axes need not always be visibly sketched, but they should be observed first of all in analyzing form.

the model's head is often represented as seen from below, the feet as looked down upon from a great height, and only a small portion of the figure as seen from a natural, true point of view; all of which it is extremely important to avoid.[1]

When these inconveniences cannot possibly be prevented, the student must find means to see his model from a distance, especially while making his general sketch (his *ensemble*), so as to insure its being free from the contradictions just mentioned. This done, when he returns to his original place to complete his drawing, rather than work out the detail with the distorted perspective angle, it is suggested that he have recourse, under the master's guidance, to certain make-shift means, namely, vertical displacement of his point of view. By raising or lowering himself, according to the part he is copying, he can thus always be opposite his work. Note that by detail is meant here the modelling of the principal bones and muscles, not mere surface detail.

9. ORGANIC DRAPERY. — Taken in connection with the figure, drapery not only includes both the large and loose, or close and clinging arrangements of folds, familiar in Greek statuary, but every other kind of clothing. In the first case, and especially when the material is thin, it must completely follow the form beneath in such a way that, whilst hiding detail of form, it rather accentuates the principal action or movement. So true is this that many artists habitually make studies of the nude model first, adding afterwards what is especially characteristic of the material required (see *Still Life, Drapery*). This must be borne in mind in the treatment of every kind of costume, which should, whenever occasion offers, express rather than hide the characteristic form and action beneath. Observation and thoughtful choice of what is important are required here, and, equally, rejection of what is unnecessary. Insistence must be made on such folds and creases as suggest the form, and such as are use-

[1] In order fully to realize the extent of these distortions you only need make the following experiment with your philograph: first, using the small aperture, make a tracing from such distance that you can see the whole figure at a glance, that is, within the normal visual angle; then, having renewed your glass or gelatine plate, you will immediately make another tracing from your forced, near position, using necessarily the wide-angle aperture. On comparing the two you will completely realize the differences.

less must be severely suppressed. Exercises consist in accurately drawing figures, or parts of the figures, with the drapery or clothing belonging thereto, and testing your sketch by the usual philographic tracing.[1]

XXI. THE HEAD. PORTRAIT.

1. Here two distinct things have to be dealt with. An artist may paint heads admirably and yet not be able to paint a good portrait, in the sense of a really accurate likeness of his model. On the other hand, a drawing may forcibly recall the model and yet be of but small account as a work of Art. We have as usual to consider here only that part of the subject which belongs to the science of drawing and can be learned by every student.

Drawing from the head may be said to comprise three divisions which must be studied progressively. These are Construction, Characterization, and accurate Facial Likeness.

2. CONSTRUCTION. — The first stage of the work deals with facts of form common to every head, and, broadly, with the individual proportions and position of the model. Whether the head is ultimately to be a portrait or merely a study (called in French *tête d'expression*) it must at the first stage be treated with the same absolute simplicity and subordination of parts to the whole. But it is natural that what first strikes the eye and calls the attention should seem chiefly, if not solely, important; thus it happens that the beginner invariably thinks most of the eyes, nose, and mouth (with their great power of expression and of individuality) and exaggerates

[1] As to the size of drawings, many great teachers are of opinion that the whole of figure-drawing may be learned on the ordinary-sized sheet of paper, and recommend this in preference to very large studies, because only in such case is it possible both to see your work at a single glance and to command every part of it at the same time. The good sense of this is evident, drawing being so entirely a matter of proportion. The old masters almost invariably made their sketches and projects for composition quite small, whatever the ultimate size of execution. This system had the advantage of leading the draughtsman to minimize detail, an important point in judging of the effect to be produced in large fresco decorations. Example, Raphael's studies for the Farnesina. This does not, of course, apply to studies of portions of the figure where detail and breadth of execution have to be combined.

their size and value. The temptation to do so is indeed so great that even good artists are often misled by it. Hence the need of studying construction apart from the rest and as the foundation of all (see below, the *Cast*).

3. CHARACTERIZATION. — The expression of personality is the most intangible, the most artistic part of the work, and consequently, that about which least can be said by way of instruction. As a matter of execution it answers to the artist's first painting or *ébauche*. In black and white work characterization is rendered chiefly by broad mass modelling, and individuality is expressed above all by directions. A certain simplicity or breadth of effect belongs to this stage which it is very difficult to retain when you come to add the careful, accurate rendering of detail in form and contour that constitutes the third division.[1]

4. ACCURATE LIKENESS of feature and contour is placed last because it should be sought for only after the aim of the first two divisions has been attained. You must not think about the small detail of your head until you have made sure that it exists as a well built up whole. Looked at from a distance or in a dim light it must not fail to recall your model individually just as forcibly as you can possibly make it. It is evident that accurate detail of form must not be ignored, but here, as usual, the main point is to realize the interdependence of parts and especially the all-importance of perspective fact. Perspective alterations we have seen to be surprisingly great in dealing with the whole figure; they are of necessity much greater here, owing to the enormous differences of expression caused by sentiment, passion, or fatigue.

Forms and types of features may be analyzed and learned by

[1] We found that in the whole figure life, movement, depend largely upon the directions of a few lines and their inter-relation. The same is true of the head, though with differences of detail. Here truth, beauty, actuality of form and pose, the setting on the shoulders, the inclination sideways, forwards, or backwards, must precede the study of face and feature. These all are expressed in the first place by the same elements of direction and proportion which we had to look out for in drawing from the *academy*, as well as in still life, in landscape, flowers, etc. The act of recording these belongs to Construction, but the study and the choice of what will most characteristically represent the model belong rather to Expression, to the second of the divisions suggested in the text.

heart individually, as suggested by Leonardo, but the modern tendency is to study them synthetically, in connection with one another and with the whole face. Thus, before questioning whether a nose be long, short, pointed, or hooked, you observe whether the character of the whole profile be straight, convex, or concave. With regard to the importance of direction here, notice how much more of individual likeness is given by the sharp angularity of an eyebrow or lid, or of the corner of a mouth — or on the other hand by their general roundness and the absence of accent — than by the perfect modelling and finish of each part. You can have no better illustration of this fact than by comparing a photographer's rough proof with his finished portrait.[1]

5. The use of description and analysis carried out to the furthest point, and the good of memory drawing cannot be overestimated in portrait study. A portrait is not and must not be merely a record of the form and color of the sitter; again it should not, generally, represent any one temporary expression, any passing mood of sadness or of mirth, but rather so much of the usual, constant characteristics of the original that it may recall him to all who are acquainted with his face and personality under whatever circumstances. For this you cannot rely upon any accuracy in copying separate forms; the life-like impression will proceed from another source. Of this, in as far as it implies natural, artistic gift, nothing further need be said here, but, in as far as it can be learned, the intelligent and assiduous drawing student will find that he possesses excellent keys to theory and practice in the above simple suggestions and in the accompanying exercises.

6. EXERCISES in construction, as well as in detail-drawing from the head, are spoken of at some length in *drawing from the cast.* With regard to expression, both as to pose of the whole figure or of

[1] A remarkable likeness may be produced — especially when the original has strong *individuality of character* or shows any special expression, such as pain, distress, or merriment — simply by means of straight lines giving accurately the direction of the features, and of any creases or wrinkles showing the play of muscles, as in laughing. This method is much adopted in caricatures, where it may be carried out to the full, even sometimes at the expense of truth of construction and proportion. It is needless to say that the student, while he may derive much good from it, must carefully avoid all such exaggerations.

the head alone, and as to individual characterization, a series of exercises, very interesting and very useful in portrait work, may be carried out with the help of the transparent plane as by no other means. Difficulties in portrait sketching (the whole figure) consist first in posing the sitter to best advantage, both as to the position of the figure and as to the size and shape of background; secondly, in sketching, rapidly and accurately enough to obtain the characteristic lines and proportions on which the truth of the whole depends; that is, by which that model in that pose is essentially expressed.

For this you will practice (1) looking at your model through the proportional frame from different perspective distances, and with the shutter fixed so as to give different openings representing the picture frame (see Appendix III). (2) With the glass plane practise sketching your same model several times in slightly different positions, first on the glass with very few lines and points, then by free-hand, and compare. Similar exercises are to be done from the head alone, and especially by placing your model in various conditions of light and shade and sketching the features entirely by the salient points, directions, and accentuations most visible through the glass. These effects are often very unexpected, and the practise of sketching them is an excellent study in values.

XXII. THE CAST.

1. The chief principles of drawing from life and their material expression may all be studied in an elementary way from the usual plaster cast models, which are either moulded from nature or reproduced from admired works of sculpture. Intelligent study from the cast as leading up to the figure (life model) has distinctive advantages for the beginner:

It is motionless; not only you have no difficulty in securing and maintaining the pose while drawing, but you can come back to it for repetition and reference as often as required.

It is monochrome, which simplifies difficulties as to light and shade.

It is, if a sculpture copy, generally simpler and "broader" than the living model, for the artist has already eliminated surface details and accentuated chosen characteristics.

You can "walk round" your motionless plaster model, realizing its different appearances, as a whole or by parts, its foreshortenings as seen from above, from below, in a way that is most helpful in studying form, and impossible in working from the life. The life model's pose is subject to constant, even though hardly perceptible, alterations. With the best of will, fatigue causes the muscles to relax and the body to sink together (*se tasser*) and spoil the "movement." Change of expression, a little more or less animation, will produce still more marked variations, if you are working from the head alone.

2. The cast should serve as a stepping-stone to the life, and the good to be gained from studying it depends largely on the spirit in which the study is conducted. No objection is raised here to the student's working from nature at once, although for the above reasons the cast is recommended. The amount of time to be devoted to it depends on the student's aptitude and industry and must be decided by the teacher. Work from the cast comprises three divisions, (1) the whole figure, (2) the fragment, (3) the head. Each is good for one special purpose and all should be studied alternately; the figure for its movement, axial directions, proportions, construction; the fragment (done full life size) for execution on a large scale and for detailed study of construction and foreshortening, planes and contours; the head for special structure, facial lines and features, and also for execution.

3. EXERCISES. — The following series of exercises are recommended for studying in turn: The anatomy of movement; proportion and construction; light and shade; perspective alterations and foreshortening.

These may be done, apart from more complete figure work, as rapid, successive sketch studies. Or again, the kind of progression suggested may be carried out, making the usual full-sized and completely studied figure-drawings. In every exercise and at each stage of work, the plumb line and the measuring pencil will help in doing the free-hand drawing; the philographic tracing and the memory sketch will aid in testing your work and strengthening your memory of form.

4. THE WHOLE FIGURE. — Place your philograph at a convenient distance from the model; study and then accurately trace on the glass its axial lines, the direction and proportionate length of each, as in the head, neck, thorax, thigh, leg, and foot, — for example, the exact inclination of the upper-arm, from shoulder to elbow, that of the fore-arm, from elbow to wrist, and that of the hand according to its actual appearance, — then the oblique direction (counter-axes) of each articulation. Having done this, put away your instrument and make a free-hand sketch, as simple as the tracing but of larger size, compare the two, study the differences from nature, and sketch from memory.

In your first sketches the movement of a figure is expressed by its axes. You have now to build up that figure by clothing those axes with the muscular masses belonging to them. This you will do very simply, paying attention chiefly to the relative width of different parts and to their *fitting together*, or *articulation* (*emboîtement*).

In many cases you can do this upon the original axial sketch, or you may use a fresh paper, on which you have indicated the former axes by lightly retracing them by transparency.

The play of light and shade, as expressing your figure by its planes and masses, is next to be studied, which may be done still on the same sketches. Here, to get more practice you can turn or move your cast model so as to alter its light and shade effects and thus make several fresh studies from the same point of view.

5. So far it has been chiefly a question of what can best be rendered by simple, almost by straight lines. Now come sketches that require, on the contrary, the greatest variety of curves and angles. In order fully to realize the perspective alterations and foreshortenings of your figure, you will next trace and sketch it in all sorts of positions and from different distances. This, which implies much more of artistic freedom than the foregoing, is better done from the living model than from the cast; still very much may be learned by making numerous sketches from a figure small enough to be laid flat or inclined so as to be seen from every possible point of view. Express all you can by the large contours visible, as the axes of your figure will not show enough to help you greatly. The strange alterations of proportion and form will need accurate observation and

prove a constant source of surprise. Broad light and shade planes may, as before, be added to the contours, forming again a separate series of exercises.

Practice of this sort, whether from the cast or from life, will not have the fault of sameness, and will call forth constantly renewed interest.

6. DRAWINGS FROM THE FRAGMENTARY CAST are to be executed full life-size, in outline and in light and shade alternately, and in connection with the theory contained in Chap. VIII (see contours and foreshortening).

Blocking in. — Suppose you have, as model, a shoulder, a hand, and an arm bent at the elbow. First choose a simple view with simple light and shade effect. Study axial directions; then block in contours and planes, indicating pale shade masses and laying them in so as to agree with the chief directions of the planes themselves; omit all half-tones and be very careful of the articulations. For example, see that the wrist is right as to place and direction, look for the main axial direction of the hand (running generally from the outer wrist bone — radial head of ulna — across to the knuckle of index finger), then the direction of the knuckles, and action of the thumb.

Foreshortening and Construction. — The cast will be turned and inclined, observed, traced, and sketched from varied positions, as was the small figure. Being copied on a much larger scale it affords occasion for more detailed study of planes, articulations, and the other elements. Execution should be as simple as before, first lines alone, then pale monotone shade planes suggesting solidity.

7. LIGHT AND SHADE AND COMPLETE EXECUTION. — Place your model so as to have a simple view and simple effect, with light from one direction only; construct carefully, then observe and analyze relative values. Draw in the mass shadows firmly (shade and cast-shadows together), then the half-tone planes, keeping their form distinct, not letting it trench upon the lights, which must be broad as possible.[1]

[1] You will look frequently from a distance both at your model and also at your drawing, in order to judge properly of the effect required and of that obtained. The broad, light, surface lines recommended elsewhere (see Still Life) will answer here, over which the large paper stump may sometimes be used to crush and unite the charcoal into a simple tone.

When flat shade and half-tone planes are all laid in broadly, you will next observe and carefully indicate any accentuations required. Shaded parts in high relief and coming towards you are generally slightly darker than those in more distant planes or in the midst of much reflected light. This can be judged of and studied as in still life.

There must be no small work, no high finishing, no stippling, — not, at least, until many studies, showing simply broad, well-defined planes of light and shade and half-tone have been satisfactorily carried out. The difficulty will lie in maintaining the required breadth, in keeping the half-tones pale enough, and in not exaggerating either the accents or the reflected lights. Remember that truth of proportion must be observed as much in regard to light and shade values as to form, size and extent.

8. THE HEAD. — The importance of proceeding systematically from the general to the particular is as great here as in working from the whole figure; therefore no commencing with separate features — studies of eyes, noses, and mouths — is to be allowed.[1] You must first construct the head, then add the features, giving them no more than their strictly proportionate importance.[2] In studying a head from the cast look first for its general directions, in connection with the whole figure. These are given by the axis of the neck, seen or unseen, and by one or more counter-axes suggesting its general position and inclination, as by a line running through from ear to ear, or, in profile view, the line of its greatest length, from chin to furthest point of the skull. Your head must be placed as a mass on your paper, its outside proportions fully established, before you begin to search for any more individual characteristics. This done, you

[1] Benvenuto Cellini, the great Florentine gold and silver worker and sculptor, criticizing the methods of his time, speaks strongly against the custom of letting pupils begin by drawing eyes, noses, etc., instead of learning first to construct the head, of which they are to form a small part. He recommends the beginner to study first a simple bone, as a tibia, then add others and so by degrees build up a figure. Vandyke recommended the system of drawing an egg to represent the oval of the face and on it sketching the features.

[2] No doubt, in common with all other beginners, you will have to overcome the tendency to make your drawing, as a whole, larger in relation to the original than you meant it to be, and that of exaggerating the size of the features.

will proceed to indicate the several large planes and parts of the skull and of the face which come together at the ear.

Having already determined the general direction of the face you must next find the relative proportions of its parts, as forehead, nose, chin, and position of the mouth. Now place, with line or mark, all that tells of its bony sub-structure,[1] according to what is visible from your given point of view (as the line of the jaw, the temple, the bridge of the nose, summits of the cheek-bones, arch of eyebrow, etc.). All this is included in the first construction of a head, and exactly this and no more will you put down in your philographic tracing and in your corresponding large-sized sketch, after which it will be comparatively easy to place and draw the features in detail.

A head thus constructed can be carried right along to the finish, but you will get much more good by following the same system recommended for the figure: doing first a series of simply constructed heads, then another series with fuller details of form, and with light and shade values.[2]

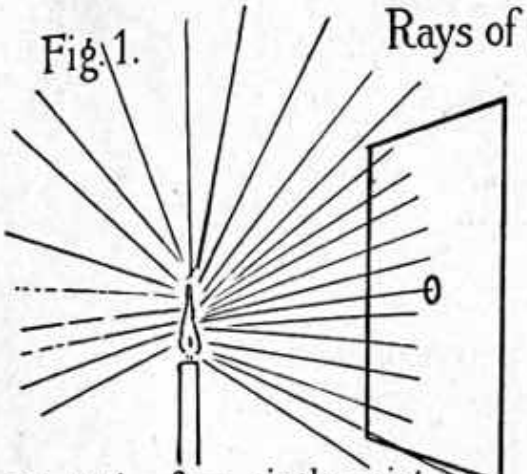
Detailed studies of features are really valuable, coming after these construction exercises, and also careful studies of individual characteristics as shown by line direction alone. Exercises consist here in making full-sized philographic tracings and similar free-hand and memory sketches from large casts and from life. Others equally useful consist in sketching a head seen in different foreshortened positions as explained for the figure and fragment. All these constitute a sort of gymnastics and can be done interchangeably with every other kind of work.

[1] No special knowledge of anatomy is required in order to do this. With a skull to demonstrate by, and even without one, the teacher can sufficiently well explain the construction and the plastic importance of these parts, and of the large planes of the face, for every student to realize clearly what he has to look for, much more clearly in fact than any ordinary knowledge of book anatomy will enable him to do.

[2] You will for some time only think of the features with regard to the space required and to the accurate position of each, but you will make very evident whether you were looking at your model from above or from below. You will also constantly compare the apparent relations of your model, as of width to height, and the inclination of its chief lines, axial and others.

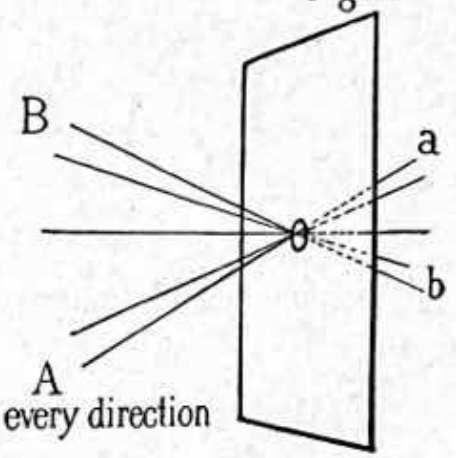
PLATE 1.

Fig. 1. Rays of light and card screen.



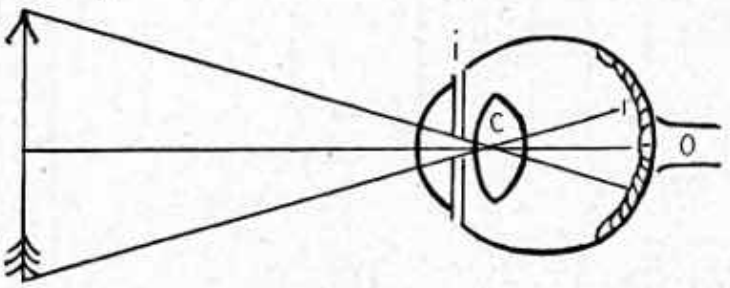
Radiation from single point,

Fig. 2.



from every direction

The eye and the Visual angle

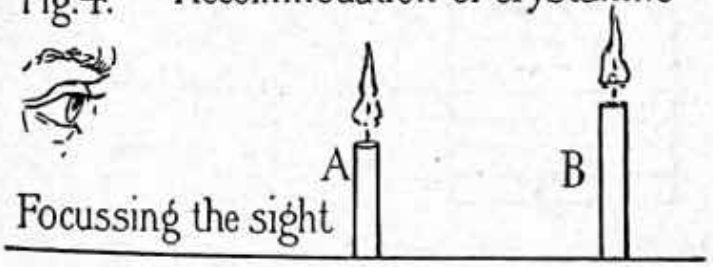


Crossing of rays in the eye.

c crystalline
i iris
r retina
o optic nerve.

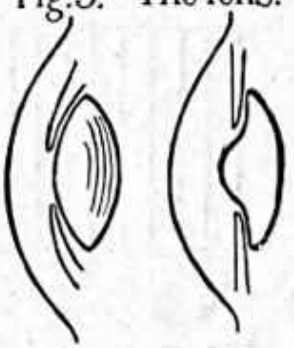
Fig. 3.

Fig. 4. Accommodation of crystalline

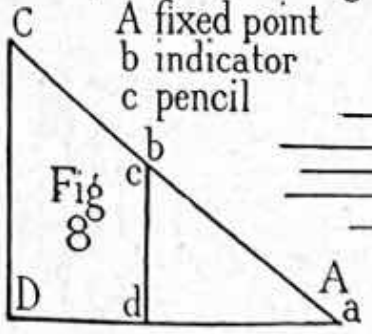


Focussing the sight

Fig. 5. The lens.



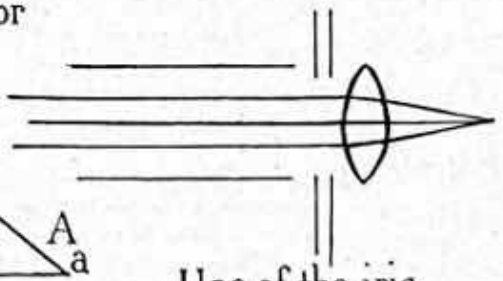
Principle of the Pantograph



C A fixed point
b indicator
c pencil

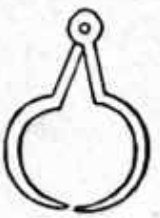
Fig 8

Fig. 7.



Use of the iris

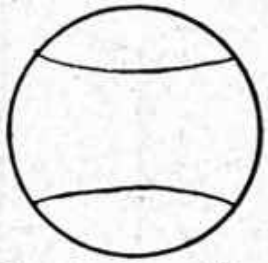
Fig. 6.



The Callipers.

Plate 2.

Fig.9. Optical illusions



Illusion produced by curved form

Contrast

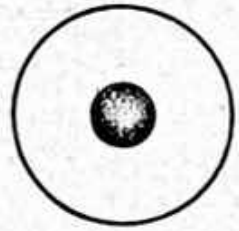
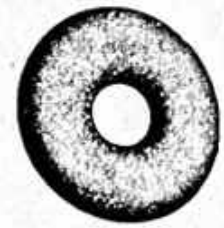


Fig.10.



Black and white areas

Fig.11. Subdivision of spaces

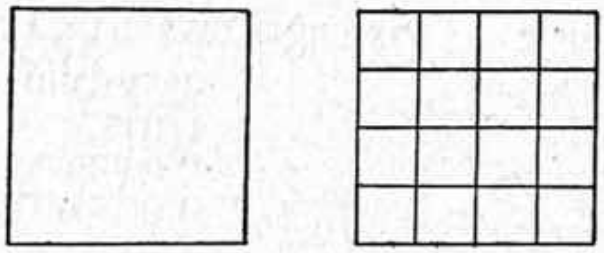


Fig.12.

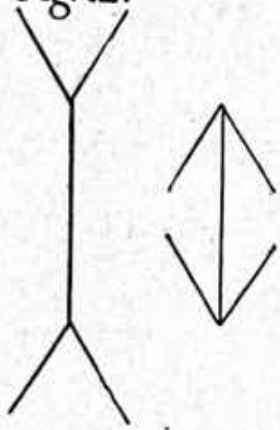
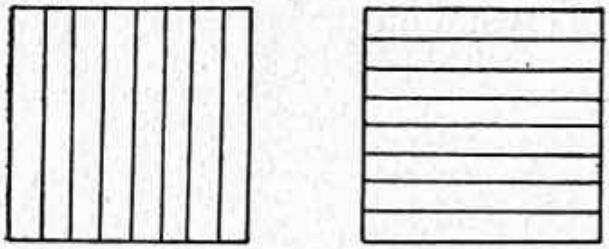


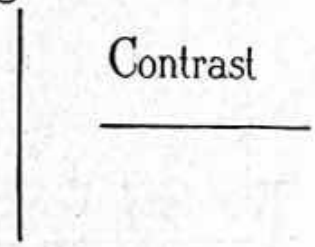
Fig.13

Fig.14. Contrasted directions.



Direction of line

Fig. 15.



Contrast

Fig.17. Contrast and juxtaposition

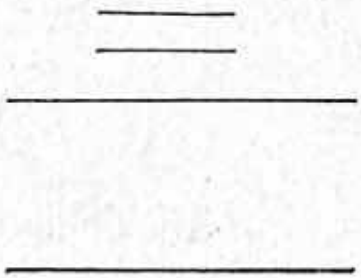


Fig.16. Continuity of line

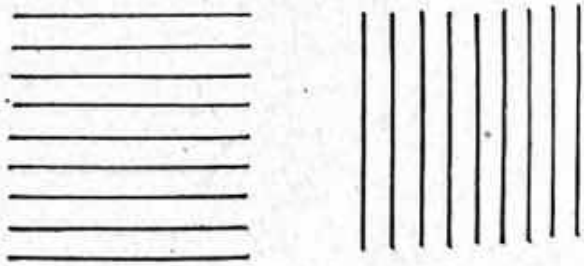


Plate 3.

Fig. 18.

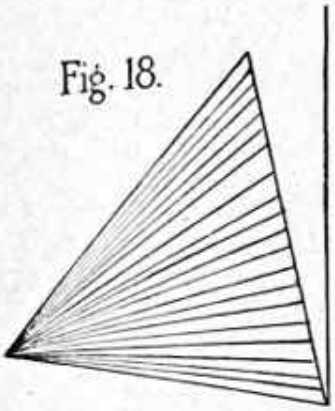
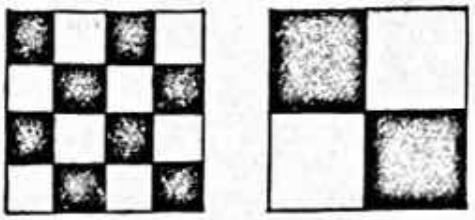
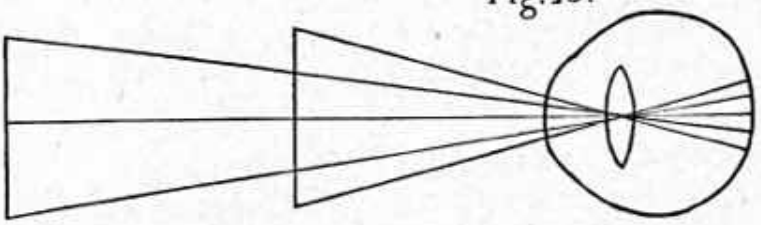


Fig. 20.



Contrast and extent

Fig. 19.



The visual angle and sheaf of rays

Fig. 21.

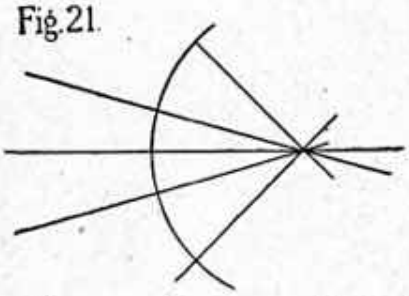
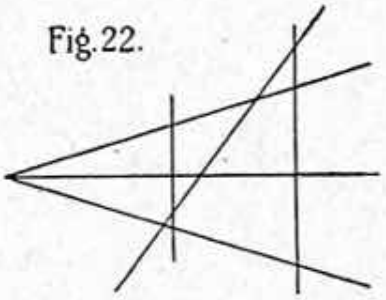
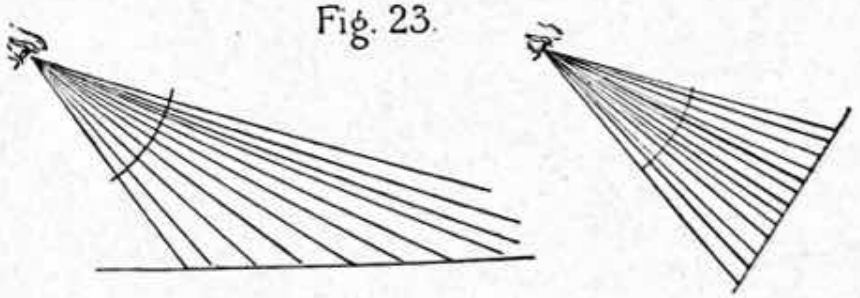


Fig. 22.



The visual cone with perpendicular and oblique sections

Fig. 23.



APPENDIX I.

THE large number of mechanical aids to drawing that have been invented, some of them by artists of undisputed renown, is a sufficient proof that a need has all along been felt for some certain and accurate means of recording what the eye actually sees; but no less remarkable than the number of inventions is the paucity of educational theory suggested in connection with their use, and the want of a proper understanding of their limitations.

The somewhat negative success so far obtained is certainly due to these shortcomings: on the educational side to the want of underlying principles systematically applied; on the practical side to the attempt to do with a mere machine the intelligent work of the human brain, eye, and hand, which is impossible. This is largely accounted for by the fact that these inventors were, for the most part, either celebrated artists merely experimenting for their own use or satisfaction, or scientists lacking practical experience in drawing, or practical draughtsmen lacking both science and Art principles. Only at a comparatively recent date have some few teachers undertaken to use such aids systematically and apply them to purposes of education. It will be seen with what result.

An historical review of some of the most important mechanical aids used in drawing, with names and dates of their inventors.

1452–1519. — First in importance for our present subject is LEONARDO DA VINCI'S suggestion of the use of the transparent plane in studying perspective. See his *Treatise on Painting* (already quoted in Chap. II).

1444–1514. — BRAMANTE (the celebrated architect of St. Peter's, Rome) made use of a gauze-covered frame in order to obtain by transparency the perspective outlines of real forms.

1471–1528. — ALBERT DÜRER, in his *Elements of Geometry*, gives illustrations showing mechanical adaptations of the glass plane,

and different modes of using them. He also develops in the same work another theory for the simplification of organic perspective or foreshortening. This consists in treating the human figure as an architect does his drawing of a building, by making his *plans*, and front and side *elevations*, each corresponding geometrically with the other. For example, you start with the front view (or front elevation) of a figure; then, by prolonging, to right or to left, parallel lines giving the height of eyes, chin, shoulders, arm-pits, hips, knees, and feet, you obtain the lateral position of each of these points. Now, suppose that beneath the said front elevation you have its *plan*, giving the exact shape of the space it covers; by "producing" sideways, beneath those just obtained, the chief points of this *plan*, you have all that is required, theoretically, for obtaining the side elevation of your figure, — all that would be required in the case of a geometrical solid. This system, which works perfectly when you are dealing with flat or regular surfaces, as in architecture, cannot really avail in representing the human figure. The doors, windows, and mouldings of a house-front, however numerous, are contained in certain given geometrical planes; compare their regularity with the extreme irregularity of any organic figure, and it becomes evident that "the human form divine" cannot be dealt with according to such geometrical methods.

1495–1554. — HANS HOLBEIN is by many supposed to have sometimes made use of a transparent surface in obtaining the first sketch of his infinitely numerous portraits.

1533–1589. — JEAN COUSIN, the celebrated French artist (painter and sculptor), experimented considerably in the same architectural direction as did the illustrious Nuremberger, necessarily with no better result. For details see his *Vraie Science de la Pourtraicture.*

1615–1646. — JEAN FRANÇOIS NICÉRON, the learned friend of Descartes, in his *Thaumaturgus Opticus*, gives illustrations of an elaborate drawing apparatus, on the principle of the transparent plane. Here the tracing over the real form was done in the air, and the projection obtained was at once transmitted to a horizontal surface, and there recorded.

1631–1773. — SIR CHRISTOPHER WREN, the famous English architect, invented an instrument in which also the tracing was made in

mid-air, this time by a point connected with a pencil, marking the outline obtained on a vertical drawing-board to the right of the transparent plane.

1780. — Besides this, a number of simple mechanical devices made use of by the wood-engravers of the eighteenth century are recorded, and one by the SIEUR DE GETLINGER, Superintendent of Mines in France, about 1780, who claimed to have originated the idea of outlining by transparency.

1820. — FRANCIS RONALDS, an Englishman of some account, introduced an improvement on Nicéron's invention about 1820, and some ten years later a French naval officer named

1830. — GAVRARD invented the so-called *Diagraph*, long used for obtaining reduced outlines from the pictures in the Louvre.

All these instruments, however simple or complicated their construction, are the outcome of Leonardo's suggestion and founded on the common principle of drawing by transparency, of obtaining and recording the actual perspective projection of forms as seen by the human eye, and *without any* artificial intermediary.

1499. — Mechanical aids founded on other principles are, 1st, the *Pantograph*, now so widely used, especially for map-drawing, the invention of which is attributed to one DILLINGEN, a German, about A.D. 1499. Here proportional enlargements and reductions are obtained from outlines on the flat by means of similar but unequal triangles.

1520–1615. — 2d, the *Camera Obscura*, the invention of J. B. PORTA, the learned Italian scientist. In this the lens is so arranged as to throw the pictured projection of the forms or scene looked at on to a vertical or a horizontal plane. This was the forerunner of the *Daguerreotype* and of *Photography*, but, before either of them, of

1608–1680. — 3d, the *Magic Lantern*, a combination due to the German ecclesiastic KIRCHER. Here the same lens-given image is projected, very much enlarged by the strong light behind it.

1600–1682. — 4th, the *Black Mirror*, called after the great French landscape painter, Claude Lorrain. This concentrates and reflects in such a way as greatly to simplify *values*.[1]

[1] The usual smoked, tinted, or "sun" glasses can be used with much the same effect as the Claude Lorrain Mirror, as previously suggested. The simple mirror, whether of large

1766–1828. — 5th, the *Camera Lucida*, invented by the English scientist, DR. WOLLASTON, and much used by architects. Here the complete image of scene or object is reflected on the drawing-paper through a prism in full daylight.

All these, with the exception of the Pantograph and the Mirror, are also founded on transparency; but it is with the addition of some agency foreign to the natural sight.

1830–1845. — No definite educational use of any of these instruments is recorded; no complete system or theory is connected with them. The first person to think of such use and theory seems to have been a Parisian drawing-teacher, the SIEUR ROUILLET, in about 1830. His idea of using a glass or gauze-covered frame for teaching purposes was soon after adopted by his pupil, MME. CAVÉ, wife of the then *Ministre des Beaux Arts*. This lady obtained some renown in France by her method of teaching, by her books on "Drawing without a Master," etc. (which have since been translated and published in America), and by the influence of Eugène Delacroix, who wrote some articles on the subject.

The instrument here consisted of a gauze-covered frame, fixed or held upright against a straight-backed chair; instead of using the card eye-piece adopted by M. Rouillet, Madame Cavé recommends the draughtswoman to fix her head to an upright spline attached to her own chair, obtaining by this means the necessary fixity of the eye.

Since Mme. Cavé's time many instruments based on the principle of transparency have been made and used in teaching drawing, chiefly in France, where some of them are recommended by the Ministry of Public Instruction. These are known by various names, as *Perspectograph*, *Perspectomètre*, etc., etc. Others, purporting rather to be labor-saving or handy devices, are the *Orthorama* (Bourgeois), the *Optimeter* (Parris), and others. In some of these a tracing is made on glass or on gauze directly from nature; in others nature is looked at through squares of wire or of thread, and the drawing is made on sheets of paper squared correspondingly.

size for studio work, or small enough to be held in the hand, is of very great and constant use. The drawing seen in it is reversed, which makes faults much more apparent. Besides this, the original and the drawing being seen reflected side by side, and of reduced size, questions of value and of light and shade are easier to decide than without such help.

In the *Educational Museum*, at *South Kensington*, are several models named after a M. JOLIN and others, in which both the rays of light and the vanishing lines and planes of linear perspective are figured by threads passing from the eye to the object, and from the object to the *horizontal line.*

The instrument known as *Ablett's Glass Plane* is generally used in England in the Girls' High Schools for demonstrating the first elements of *linear perspective.* In America, still more recently, *Mr. Anson Cross' Transparent Slate* has received high commendation.

The fundamental idea is in every case the same, and familiar to most teachers, namely, the use of *demonstrating tangibly* what the rules of perspective teach theoretically, and what the student's eye, or rather his brain, has much difficulty in realizing without some such help.

APPENDIX II.

AIDS TO DRAWING.

1. *The measuring pencil.* — To obtain the proportionate extent of different objects, or of parts of the same object, as they appear from your point of view, hold your pencil very lightly between your thumb and three or four fingers, stretch out your arm to its full length, and, having closed one eye, measure with the pencil the apparent length of the object, turn your hand slowly round and compare that measurement with the next you require, for example, with the whole height of the same object. Your arm, which thus serves as a pivot, must not bend, and your pencil must be all the time parallel with the picture plane, otherwise the measurement is of no use whatever.

With some practice you can thus test approximately the extent of every kind of foreshortening, realizing exactly what space it occupies on the picture-plane as compared with any other chosen dimensions.

2. The *plumb-line*, held with outstretched arm in the same way, gives a perfect vertical, and serves to show exactly what points correspond with each other vertically, or, on the other hand, just how much any line, or succession of points, deviates from the vertical ; thus, in a standing figure, you will use it first to make sure of the vertical relation between the front of the neck and the supporting foot.

3. The *sight-finder* serves to determine the extent of your landscape or other sketch, before you commence it (see *proportional frame*).

4. The equally *divided rule*, held before your eye at such a distance that its two extremities correspond exactly with those of your subject, shows whereabouts similar divisions would come upon it (halves, quarters, etc.), and is sometimes helpful in placing your drawing on the paper correctly.

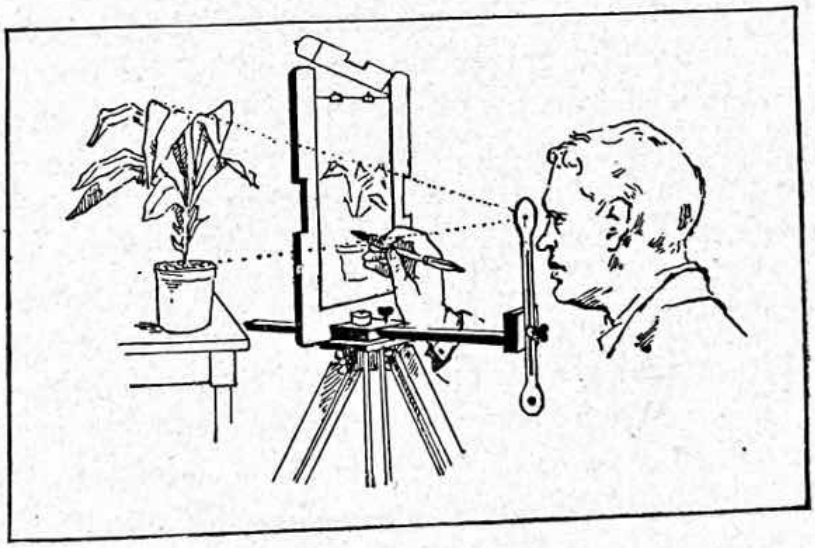
5. In using all these aids, one eye must always be kept closed or covered, for the obvious reason that, the picture plane coming between the eyes and the object looked at, where their separate visual rays meet, any single measurement taken upon it, or any single image traced, is necessarily the projection of what one eye sees ; otherwise a double or *stereoscopic* image would have to be made.

APPENDIX III.

AIDS TO SIGHT.

AMONG all the material aids to natural sight, the philograph unites in the highest degree convenience of use and range of application.

1. THE PORTABLE PHILOGRAPH consists of a glass plane fixed upright to a head, which in turn is screwed to a tripod stand or a table, so as to be turned or pivoted at will by the operator. A bar, sliding through the head, supports at one end a metal eye-piece (or diaphragm), and is secured in place as soon as the required distance between the eye and the glass plane has been established. The eye-piece, or diaphragm, has a disc at each end, pierced by a large and a small aperture respectively; the



large one may be used by beginners, but the small one ensures more accuracy, as it represents the natural opening of the pupil of the eye. The large aperture is equal in size to the whole eye. The eye must be placed close against the disc, when the chief outlines, proportions, axes, etc., of objects seen through the glass may be traced on the glass itself by means of a *lithographic crayon.*

2. The tracing, when properly done, is of course the accurate projection of the forms seen, that is, of their perspective appearance. It is necessary that the distance between eye and glass, and also the exact height and

position of the eye, be firmly fixed, and, above all, the eye must always be looking at right angles to the plane. The cut will show how these points are insured in the portable philograph.

3. The eye is isolated from everything else by the disc-shaped eye-piece, seeing only, through the small aperture, as much as it sees naturally at a single glance. This is very important.

The large aperture used in the same way admits of the eye seeing about as much as it habitually does, owing to its natural rotation, but without moving the head. It allows of a much wider visual angle, such as is needed in some subjects (architectural interiors, etc.).

4. Arrangement can be made beneath each aperture to hold a lens or spectacle-glass of any required number *for persons in the habit* of using one. The frame is notched at each end in order that it may be fitted to the block for upright or for horizontal subjects; one end is hinged, and opens for removing the glass, or for inserting over it a sheet of gelatine or of celluloid, on which tracings can be made in exactly the same manner as on the glass. Gelatine is either gummed to the glass at its corners or slipped into the grooved edges of the frame, when it may be further held in place by small clips on the edge of the glass.

5. Tracings are cleaned off from glass or celluloid by dampening with water; from gelatine with turpentine or alcohol (never water). A sketch can always be retraced from the glass by placing over it a sheet of tracing-paper, or of medium thin writing-paper, turning the glass so that the light comes through from behind (the paper is then seen against the light); remove or lower the eye-piece and retrace line for line.

6. To use the philograph set it up as shown in cut; place the subject to be sketched so that you can easily see it through the glass, then according to the subject trace over the outlines, or obtain the *apparent direction* of its chief lines. When there are no lines distinctly visible, mark the extent of *masses* and of *parts*. No matter if your tracing appear rough and unsightly; it will always give you some useful facts with more precision than you could obtain unaided. Make each line with a single stroke; work simply and lightly both on glass and on paper. The *size* of a tracing is governed by the nearness of the model to the instrument, and by the *distance of the eye from the glass plane* (see cut and Fig. 22).

7. The "*wide angle*" *eye-piece* (the large aperture) is to be used, under the teacher's guidance, as affording a practical means of training the eye and hand to deal with perspective over a wider field. Place it very near the glass plane; you can thus, by looking rapidly upward and downward through it, obtain the direction and position of a few principal lines and

points, enough to guide you very materially in your work, which has now to be done chiefly by free-hand.

This applies, for example, in sketching any architectural subject, interiors large and small, whether of a church or a small room, in every case in fact where space will not permit of your going so far away as to include your subject in the "normal perpective angle" of from 20° to 30°.

Evidently you cannot here make the same accurate tracing you could make with the small aperture and the long distance, but you obtain in this way the *resultant* of a number of glances, and the *perspective effect* of having seen your subject from a considerable distance.

The inequality of rays caused by looking through the glass at a slightly irregular angle is in this case so small as to produce no perceptible difference of appearance on the tracing.

8. A very extensive *panoramic* subject must not be sketched as though seen at a single glance from one point of view, but rather treated as a succession of views seen by gradually turning the head. Such subjects can be studied from nature by aid of the philograph as follows: Fix the glass at a certain chosen distance from the eye and make your tracing, then gradually pivot yourself and your instrument, making as many sketches as are required to take in the whole subject.

The visual angle being the same throughout, your panorama must give a true impression and record of the scene. In all this work only absolute *essentials* are to be recorded on the glass plane for use as a test of free-hand work.

9. A gauze-covered frame, through which are passed threads coming from the angles of the object studied, and representing the near portions of its *vanishing lines*, or representing the rays coming from it to the eye (small aperture of the diaphragm), may be used for still more literal demonstration. It must be fixed upright in the place of the glass plane when required. Model and frame must of course be kept ready for this special purpose. This gives the equivalent of a certain instrument or model exhibited in the Educational Museum at S. Kensington, and sometimes used in Europe for perspective demonstration; but this adaptation has the immense superiority of the movable eye-piece and variable angle of vision.

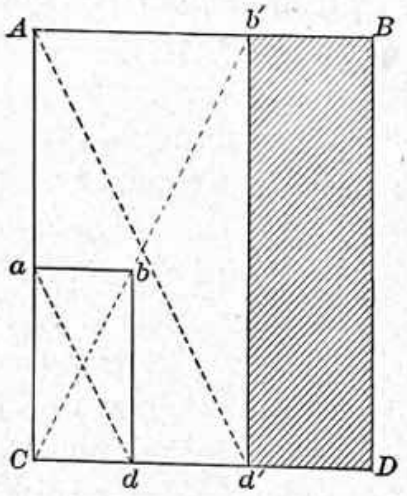
10. THE PROPORTIONAL FRAME serves the double end of helping in the study of proportion and also of considerably assisting in the production of a well-constructed landscape drawing from nature.

It is a square wooden frame of about 7 inches' opening, through which the student looks at the landscape or object he proposes to sketch, gradually altering the *form of the opening* by means of a *sliding shutter* until

that best suited to the subject is decided upon and retained (by fixing the shutter in the chosen position with string and loop).

Rubber threads give the diagonals of the opening, whatever its final form may be, and the full-sized sketch is made similar in shape to the opening by making its diagonals parallel to the rubber threads.

THE PROPORTIONAL FRAME.



A B C D, canvas.
a b C d, opening of shutter.
C b′, "produced" diagonal.
A b′ C d′, large "similar" space for sketch.

This is done most conveniently by placing the frame so that one corner of its opening exactly corresponds with the corner of the canvas (see cut). Measure the angle given by the rubber thread, or else with a string or a rule "produce" it upwards to the full height of the large surface. The diagonal thus obtained enables you to form immediately the larger "similar" rectangle; close this in, add the second diagonal and one or two cross lines if desired. The picture will thus be divided into triangles exactly similar to those of the extensible frame.

Sketch or block in your subject to correspond with what you see through the frame, taking as "sight," or starting-point, some object coinciding with the intersection of the rubber diagonals. Notice where these cut the real scene or subject, and make each point of your sketch agree with those seen (through the frame) in nature.

To obtain on your canvas an exactly similar form (larger or smaller, as may be required) lay the frame upon it, making the left hand angle *C* of the chosen opening correspond with or cover the angle of your canvas, produce the rubber diagonal line up to the full height and complete the rectangle.

11. The frame may be used either fixed to a tripod stand or held in the hand upright at a convenient distance in front of the eye thus: draw out the shutter to one side as far as it will go, then close it in by degrees, noticing carefully the while whether the square or the high narrow form

better suits the subject. Turn the frame so that the shutter draws upwards, giving to the opening the long and low form so frequent in marine subjects. Try again and again, and when you have quite decided on the best form for your sketch or picture, notice carefully just how much of the real scene is enclosed.

Look until each detail is fixed clearly in your mind. This deciding beforehand what you intend to represent is very helpful in the execution of your work.[1]

12. Observe, in connection with the use of this very simple instrument, (1) it carries out the axial principle, the diagonal of any given rectangle being its special characteristic, or so to speak its axis; (2) it has none of the disadvantages of the straight-barred gridiron system. It obliges the student to make constant comparison between its small triangular spaces (four or six in number) and the larger ones on the free-hand drawing, which is a continuous exercise in proportion.

13. THE AUXILIARY PHILOGRAPH (SELF-CRITICISM). The auxiliary or panto-philograph is a simple adaptation of the elastic pantograph for working *directly from nature*, that is, for making tracings from the model the identical size of the original or larger.[2]

14. Outlines thus produced, being generally much larger than tracings made on the glass, can be utilized for the cultivation of the critical faculty thus: the student has made, directly from the model, very rapidly, without fatigue to eye or hand and literally without seeing what he does, a skeleton sketch; this he immediately proceeds to correct and complete to the best of his ability, carefully studying the original. He can thus turn to account the ready power all possess of seeing the errors in other people's work. His first *mise en place* being thus made for him, it is as though he were called upon to refine and fully execute some one else's drawing, correct as to main facts of direction and proportion, but totally wanting in

[1] The geometrical axiom *equal angles produce similar triangles* is made evident here as well as in using the glass plane, in the working of the eye and of every artificial lens, where the entering rays meet, cross, and form with the plate or retina the smaller, similar triangle. In each case $A\ C\ b'$ is similar to $a\ C\ b$, however different the area of the two triangles. The elastic thread of the panto-philograph (auxiliary philograph) works on exactly the same principle combined, as in the other cases, with transparency (Figs. 8 and 23).

[2] In the typical wooden pantograph two unequal triangles are so connected as to work simultaneously. One of them is provided with a pencil, the other with an *indicator*. — Suppose the indicator to be on the small triangle and made by the operator to trace over any given flat form or design, the pencil affixed to the large triangle will reproduce exactly the same figure, but on a larger scale, or *vice versa*. The pantograph is very much used for enlarging or reducing drawings, maps, etc., on the flat. In the present adaptation the elastic thread with its movable indicator represents the *bases of the two unequal triangles*. See Fig.

accuracy of detail and in artistic feeling. Without expending strength or effort in laying first foundations, he can immediately bring to bear on such a sketch, having no fear of spoiling what is done, all his powers of criticism and refinement, with a freedom and clearness of vision impossible in the case of work he has himself just laboriously built up. This will prove a useful exercise in studying difficult foreshortenings from the cast, etc. See cut.

PRACTICAL USES OF THE PHILOGRAPH.

15. The contention of these pages thus far has been for the educational uses of the philograph, and nothing has been said of its advantages in many other directions. As a matter of fact the instrument has great value to every kind of draughtsman *working from the round.* The portrait-painter by its help can save much time in obtaining with precision characteristic facts of pose, proportion, expression, details of foreshortening, of drapery,

etc., whilst avoiding all the drawbacks of photography, such as disproportion and distorted perspective.

16. The illustrator will find it of great convenience for the rapid sketching of groups, interiors, and countless other objects.

To the public teacher or public lecturer whose work involves accurate diagrams and representations, it renders a unique and inestimable service. By its use, even though he have no knowledge of drawing, he can instantly present the characteristic lines and forms of any object or specimen he wishes to illustrate; which may be done in immediate connection with the magic lantern or the stereopticon for *lecturing purposes*.

17. Its value to the medical student, the patent agent, the wood-carver, the mechanic, the embroiderer, and to all others for whom rapid and accurate drawing is a necessity is equally obvious.

ABBREVIATIONS.

an. . . . anatomy.
ang. . . . angle, angular.
ap. . . . apparent.
app. . . . appendix.
arch. . . architect, -tural.

b. and w. . black and white.
bot. . . . botanical.

c. . . . . counter (axis).
charac. . characteristic.
col. . . . color.
con. . . . contour.

diag. . . diagonal.
dir. . . . direction.
dist. . . . distant, distance.
dr. . . . drawing.
drap. . . drapery.

educ. . . educational.
exp. . . . expression.

f. . . . form.
fig. . . . figure.
flow. . . flowers.
fore. . . foreshorten-ing.
Fr. . . . French.

geom. . . geometrical.
grap. . . graphic.

hor. . . . horizontal.
hu. . . . human.

ins. . . . instrument.
irr. . . . irregular.

l. and s. . light and shade.
lands. . . landscape.

mat. . . . material.
math. . . mathematical.
mech. . . mechanical.
mem. . . memory.
mod. . . model.
mov. . . movement.

n. . . . note.
nat. . . . nature.
nor. . . . normal.

ob. . . . oblique.
opt. . . . optical.
org. . . . organic.

pers. . . perspective.
phil. . . philograph.
phot. . . photograph, -er.
pic. . . . picture.
pl. . . . plane.
po. . . . point.
port. . . portrait.
prac. . . practical.
prin. . . principle.
prop. . . proportion, -al.

reg. . . . regular.
rep. . . . representation.

s. . . . . sight.
sci. . . . science.
shad. . . shade, shadow.
sket. . . . sketch, sketching.
subj. . . subject.
stud. . . student.
surf. . . surface.

trans. . . transparent.

val. . . . value.
van. . . . vanishing.
vert. . . . vertical.
vis. . . . visual.